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ТЕМАТИЧЕСКИЙ РЕФЕРАТИВНЫЙ СБОРНИК № 46-2

“Radar Complex Signal”
(«Сложные РЛ сигналы»)

Публикации в трудах конференций

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"Airport Detection in SAR Image Based on Perceptual Organization"

Being one of the key transportation targets, airport detection is of great importance in military and civil applications. In this paper we propose a new method based on perceptual organization for airport detection in large SAR image. Since the runways are the most obvious characteristic of the airport, we first design belief functions for the runway features, which include collinearity, proximity, width and texture similarity. Then we propose to use the DS-evidence theory for the fusion of all belief functions, which can serve as a criterion to decide whether the two region units can be grouped. The candidate airport can be found by grouped region growing and detected by airport knowledge. Experimental results showed the effectiveness of the proposed approach for airport detection in large complex SAR image. [C1]

"Adaptive RFI Suppression Algorithm Based on CEMD for SAR Data"

This paper proposes a novel adaptive filtering method based on complex empirical mode decomposition (CEMD) for narrowband radio frequency interference (RFI) suppression applied to SAR. This method decomposes the RFI contaminated signal into a finite and often small number of Intrinsic Mode Function (IMF). The sum of some selected IMF components is taken as reference input of adaptive filter based on the characteristics of CEMD. Experiment results show that CEMD provides an effective way to obtain reference input. The proposed method can effectively subtract RFI component from the RFI contaminated signal, which is the primary input of the adaptive interference canceller. The point-target simulation is used to show the working principle of the proposed algorithm. Experimental results based on SAR real data are also shown to verify the proposed algorithm. [C2]

"A Novel Polarimetric CFAR Target Detection Method"

A new polarimetric synthetic aperture radar (PolSAR) image CFAR target detector is proposed in this paper. By introducing the inverse Gamma distribution which is extensively used in modeling, the distribution of polarimetric matched filter (PMF) metric, denoted as P_G0, is derived on the product model; Furthermore, a fast and exact parameter estimation method of P_G0distribution is presented using the "second kind statistics" based on the Mellin transform; Finally the formula of the CFAR detection threshold is deduced, and the target detection using the proposed constant alarm rate (CFAR) detector is performed on the RADARSAT-2 PolSAR data. Experimental results demonstrate the great efficiency of the P_G distribution and the corresponding parameter estimation method in data fitting of areas with different degree of homogeneity. Moreover, the successive CFAR detector can successfully complete the automatic target detection with low false alarm rate and high detection rate in complex clutter environment where the homogeneity of terrain varies sharply. [C3]

"Radar signatures of complex buried objects in ground penetrating radar"

The evaluation of radar signatures of buried objects for three experimental ground penetrating radar setups will be addressed in this paper. The contribution will present corresponding results and experiences. The performance of the imaging capabilities of the designed radar system will be assessed by reconstruction of complex shaped test objects, which have been placed within the ground. The influence of system parameters of the ground penetrating radar have been varied systematically in order to analyze their effects on the image quality. Among the modified parameters are the step size in transverse plane, height of the antenna over ground, frequency range, frequency points, antennas and varying instrument settings. A signal processing technique based on synthetic aperture radar has been applied on the measured raw data. The focus radius around a specific target has been analyzed concerning the compromise between image quality and processing time. The experiments demonstrate that the designed ground penetrating radar systems are capable for detection of buried objects with high resolution. [C4]

"Complex permittivity of common minerals and one soil at low water contents"

The complex permittivity of quartz, feldspars, calcite, and non-crystalline gypsum at 4%-7% volumetric water

content shows low conductivity and low-frequency dispersion. At similar water contents, montmorillonite, gypsum crystallites, and a desert soil all show unusually strong and broad low-frequency dispersion, and strong attenuation rates above 100 MHz. The desert soil contained 80% quartz, 10% feldspars, and 10% gypsum, with the gypsum appearing as crystallites and crustations on the quartz particles. Despite insignificant salt or clay mineral content, the dispersion and attenuation rates of the soil exceed those of its constituents and are similar to that of montmorillonite, with a rate exceeding 100 dB m-1by 1 GHz. We attribute this to a Maxwell-Wagner type of relaxation, likely caused by polarization resulting from surface charge and from the charge separation caused by dielectric and conductivity contrasts between the gypsum and quartz. The conductivity contrasts were likely enhanced by ions dissolved from the gypsum and feldspars into free water within, and water adsorbed on the quartz surfaces. [C5]

"Radar pulse repetitive paterns detection"

Pulse Repetition Interval (PRI) is an important parameter in the recognition of pulsed radar signals because of its distinctiveness. Pulses time of arrivals (TOA are PRI sources. Depending on the radar function various PRI modulations are used. So PRI pattern requires the estimation of the numerous calculations to determine its values correctly. PRI complexity makes it as a distinctive parameter for electronic intelligence, under condition that the signal's parameters are estimated ambiguously and repeatedly for different series of measurements. Significant difficulty of analysis is an existence of distortions arising from the propagation properties and signals interference under measurement. In the literature much attention is paid to seeking ways to solve the problem. Proposed, are various algorithms showing good properties for certain types of modulation. They are ineffective for others PRI types. They can be successfully used in ELINT systems, while in the ESM devices, where full automation is required, their usefulness is limited. The paper presents some aspects of PRI analysis on the base of simulated and real signals. Also presented is a modification of the algorithm based on the use of autocorrelation function in the analysis of PRI. The proposed solution allows for more efficient analysis of long sequences of periodic changes in PRI (stagger, complex, dwell and switch) in terms of having a relatively short measurement sequences. [C6]

"Weak signal detection using compressive receiver"

Nowadays modern radar uses more and more complex waveforms. Some waveforms are developed intentionally to make their intercept almost impossible. The main distinctive features of modern radar signal are hidden in its time-frequency structure. In the near past the problem of radar signal feature extraction was considered in time or frequency domain separately, because radar waveforms were relatively simple. Today, however, the signals should be observed simultaneously in both domains. Time-frequency distribution concept offers a new approach in radar signals classification/identification. The paper presents some results of weak, pulsed and continuous radar signals detection by the use of compressive receiver. [C7]

"The detection performance of complex cosine CWT and entropy analysis for narrowband signals"

The problem of detection of narrowband sinusoidal signals buried in additive noise is addressed. Detection is formulated using continuous wavelet transform (CWT) with the custom designed complex cosine wavelet and estimating the presence and frequency of useful signals in the wavelet domain. An adaptive entropy based threshold detector is proposed to detect presence and time localization of useful signal in the transform domain. A simple and pragmatic method of threshold setting as the average of minimum and maximum entropy is proposed. Application example is focused on detection of useful signal in the harmonic radar system. Simulation results show that the proposed method also allows detection of signals with negative signal-to-noise ratio (SNR). Time-frequency characteristic of the CWT is compared with the short-time Fourier transform (STFT) for the specific mother wavelet. [C8]

"GPR characterization of rocks buried in the Martian subsoil"

This work presents theoretical and experimental analyses of GPR investigations for the detection of rocks buried in media simulating the Martian soil, in the framework of the "WISDOM" project of ExoMars mission. An experimental set-up has been built consisting in a box filled with a host material and scatterers, scannable with a GPR bistatic antenna. This set-up has also been implemented and studied through an electromagnetic CAD tool. Excellent agreement has been found between the measured and the simulated results on the scattering features, thus providing reliable information on the detectability of rocks in Martian complex subsurface scenarios. [C9]

"Estimation of soil electromagnetic parameters using frequency domain techniques"

In this paper two frequency domain methods for characterization of the dielectric properties of dry sand over a broad microwave frequency range will be presented. The investigated electromagnetic parameters of the soil

relevant for most GPR applications are dielectric permittivity and loss tangent. Although the majority of GPR applications concentrate on frequencies below 1 GHz, this work will investigate the constitutive parameters of soil with very low water content in three microwave bands (X, Ku and part of K) ranging from 7 to 20 GHz. In particular, this study will focus on the evaluation of the complex permittivity by means of a numerically robust evaluation rather than the well-known Nicolson-Ross-Weir (NRW) method. The proposed procedure yields the apparent real part of the permittivity and the loss tangent without the inaccuracy in the vicinity of λm/2 resonances known from the NRW method. The second approach utilizes a free space measurement, in which the soil is confined by a polystyrene probe holder in a mono-static GPR setup. The measurement result of the backscattered excitation will be compared with a commercial time-domain solver based on Finite-Integration-Technique (FIT). The material parameters of the electromagnetic model are adapted iteratively in the way that measurement and simulation results coincide. The measurement results of both frequency domain methods demonstrate the validity of the estimated dielectric parameters. [C10]

"Instability analysis of Villa Arianna site in Castellammare di Stabia (Naples)"

The paper is on the use of GPR to detect features of instability affecting the structures of Villa Arianna archaeological complex. GPR data were acquired with a 250 MHz antenna on a cave excavated from an in situ deposit and inside the Villa, which lies on the top of a tuffaceous terrace. The study shows a direct correlation between the time shifts and amplitude spectra variations of the ground direct wave with the detachment surface location. [C11]

"A study of GPR vertical crack responses in pavement using field data and numerical modelling"

The application of ground penetrating radar (GPR) as a non-destructive technique for characterization of pavement structure on road networks has gained considerable attention during recent years. High resolution ground coupled GPR has the potential to provide important additional information on pavement deterioration, defects and cracks, the last being the focus of this study. Crack geometry and the electrical properties of the pavement surrounding the crack can be quite variable, resulting in often complex and hard to interpret data. Therefore, FDTD numerical modelling has been employed to help understand a range of GPR vertical crack responses observed in a variety of pavements. [C12]

"From Pseudo-3D to full-resolution GPR imaging in archaeology: A complex Roman site in Lugo, Spain"

This case study demonstrates how extra effort on data acquisition can beneficiate advanced interpretation of 3D GPR data over a complex Roman site situated in a semi-urban area. Two 250 MHz surveys during May 2007 and July 2008 were accomplished after Roman wall remains had been found by chance during soil remove works at Agro da Ponte (Lugo, NW Spain). First campaign covered the whole area by using a pseudo-3D strategy which was only enough for defining the areas of interest and some archaeological features. According to those results, next campaign was focused on a smaller area and based on an ultra-dense grid strategy which eventually revealed full-resolution images of walls, apses and chambers of a Roman villa. [C13]

"GPR resolution in cultural heritage applications"

The non-destructive study of historical buildings, archaeological sites and other Cultural Heritage structures requires high resolution methodologies and a good knowledge of the potential of the different methods. Laboratory measurements provide valuable information about the ability to detect different targets and to determine structural problems, but these data must be compared to the results obtained in real and complex structures. In this work, we present experimental GPR measurements made in order to determine the spatial resolution under laboratory conditions. These results were compared to the data obtained in different GPR surveys applied to Cultural Heritage. The information obtained in drillings, in visual inspections and in old documentation about the historical buildings and archaeological sites is used to determine the resolution in each case. [C14]

"Multi-objective optimization of an isoflux antenna for LEO satellite down-handling link"

A multi-objective optimization approach has been applied to the synthesis problem of the geometrical structure of antenna with complex set of requirement specification. This methodology is a promising tool for new development and application for several kind of microwave structure. [C15]

"SAR and Landsat ETM+ image fusion using variational model"

Multispectral and synthetic aperture radar (SAR) image fusion is one of the most complex tasks to perform

integration of multi-source remotely sensed imagery. Fusion of SAR and optical remote sensing image, with highly complementary characteristics, may contribute to a better understanding of the objects with the imaged scene and finally benefit to application such as precision farming/ agricultural. In this paper, we adopt a variational model to fuse SAR imagery and multispectral imagery. Experimental results on Cosmo-Skymed SAR and Landsat-7 Enhanced Thematic Mapper Plus (ETM+) satellite images of an urban area, demonstrate accurate spectral preservation, which is indicated by high correlation between original multispectral and fused bands. [C16]

"Cooperation in distributed surveillance"

This paper discusses distributed surveillance problems, where a set of sensors, of different modalities, can sense collaboratively and continuously a certain volume of interest. Surveillance operations in complex environments, such as littoral regions, are introduced and their main features and challenges are presented. Effective cooperation among the sensors can synergistically improve the performance of these systems and can endow them with higher-level faculties, such as dynamic task allocation, communication relaying, and cooperative target search and tracking. Different forms of cooperation in distributed surveillance systems are mentioned. The paper focuses on intra-and inter-platform target cueing and handoff as augmentative forms of cooperation in distributed surveillance. [C17]

"Fault diagnosis expert system of artillery radar based on neural network"

The fault of new type artillery radar is highly complex and correlative. The neural network technology was incorporated into the radar fault diagnosis after the fault features of new type artillery radar and the shortage of the expert diagnosis system were analyzed. There are many difficulties in the process of the servicing for the artillery radar, such as technology level is low, fault diagnosis is difficult. To resolve the problem, a fault diagnosis expert system was realized based on RBF(Radial Basis Function) neural network. The collectivity structure of expert system, structure and function of software were discussed. Accordingly, several key techniques such as the fault diagnosis principle of RBF neural network, knowledge database, reasoning engine were also given in detail. The application results showed that the expert system proved its feasibility and practical, the servicing efficiency and fault diagnosis ability are improved. [C18]

"Complex radar signal source for radar receivers testing"

This paper presents a design of a Radar Signal Generator (RSG) for radar receivers testing and development (i.e. receiver dynamic measurement, pulse compression modules). RSG is a multifunction flexible radar signal source generating multichannel coherent signals with reference signal for radar station and the other auxiliary signals and noise signal. The presented design is based on digital synthesizers with high flexibility in radar signal intrapulse modulation schemes. The architecture of RSG allows complex signals generating with bandwidth up to 150MHz (the frequency range is limited with proper filters due to most used frequency ranges). Phase stability of the output signal is less 1є deviation RMS and phase noise performance of reference signals is -134dBc/Hz@1kHz for 10MHz. [C19]

"Moving multy-scatterer target parametric identification using radar image"

The wideband coherent pulse radar provides high resolution image of the target. A model of this image is composed of the complex envelope superposition of signals diffracted by the point scatterers. The values of complex envelope are distributed over the radar image coordinate plane in accordance with the point scatterer's positions and their reflection coefficients. The radar image model is combining of the range and Doppler profiles. The parameters of the target point scatterers are processed using one dimensional data extracted from the complex discrete Fourier transform of the radar image. The Matrix Pencil algorithm is used for the parametrical target identification. [C20]

"Principles of the electromagnetic modelling of som microwave components, based on the circular waveguides with azimuthally magnetized ferrite"

The principles of electrodynamic analysis of the characteristics of the ferrite control components (nonreciprocal digital phase shifters, cut-off switches and isolators) which use circular waveguides, entirely filled with azimuthally magnetized ferrite or containing a coaxial disc- or ring-shaped area of the medium alluded to and a dielectric one, surrounding it or taking up its hollow, resp., and work in the normal TE01mode, are enunciated: i) employment of complex confluent hypergeometric and eventually also of real cylindrical functions; ii) indispensability of inventing of numerical methods for evaluation of some special functions of the mathematical physics: the Euler gamma function, its logarithmic derivative and the confluent functions in the complex field, as well as of the cylindrical ones in the real domain; iii) elaboration of techniques for numerical solution of

complicated transcendental equations, involving complex confluent and possibly real cylindrical functions, too; iv) introduction of a new class of real numbers, called L numbers, connected with the purely imaginary roots of the equations mentioned; v) development of numerical schemes for computation of the phase curves of geometries regarded and of iterative procedures for finding the differential phase shift provided by them; vi) laying down of criteria for the operation of configurations as phase shifters, magnetically controlled cut-off switches and isolators. Each of the maxims pointed out is elucidated in detail. [C21]

"Periodic FDTD modeling of 3D photonic crystals"

In this paper application of FDTD method supplemented with periodic boundary conditions to the analysis of three-dimensional photonic crystals is presented. For that purpose, a model of body-centered cubic dielectric lattice is introduced and investigated. Complex-looped FDTD algorithm is applied for the computation of a photonic bandgap diagram in the first irreducible Brillouin zone revealing dispersive properties of the lattice. [C22]

"Criteria for phase shifter operation of an azimuthally magnetized coaxial ferrite waveguide"

Three criteria: a physical, a mathematical and a functional one for operation of the coaxial waveguide, completely filled with azimuthally magnetized ferrite, under for normal TE01mode excitation, as a digital nonreciprocal phase shifter, are established. The first of them is deduced from the phase characteristics of configuration and determines the limits of the interval in which it provides differential phase shift for a specific value of the off-diagonal ferrite permeability tensor element. The second criterion associates the structure parameters with certain roots of its characteristic equation, expressed by complex confluent hypergeometric functions and with the related to them positive real L(c,ρ, n) numbers (c=3D 3, 0<ρ<1, n=3D 1). The third one specifies the limits of the domain of phase shifter operation. These are functions, representing in normalized form the dependence of phase shift at the cut-off frequencies and at the envelope lines, marking the end of the phase curves for negative ferrite magnetization from the side of higher frequencies, on the guide radius for a fixed central conductor thickness. [C23]

"TOA association for handheld UWB radar"

Handheld ultra-wideband radars can be used with advantage during rescue, surveillance or security operations by reason that they enable to track targets moving behind walls. The radar signal processing for that purpose represents a complex process with several processing phases. In this paper, the attention is devoted to the estimation of the correct input data for the localization phase. This is done by applying a new approach that combines the time of arrival (TOA) estimation and the data-association into a single step. The performance of the proposed algorithm is illustrated by processing of real radar signals. Here, the obtained results confirm that the proposed algorithm can provide good, stable and robust TOA estimation including deghosting task solution. [C24]

"A concept of decentralized fusion of maritime radar targets with multisensor Kalman filter"

The paper presents a concept and an algorithm of multisensor decentralized data fusion for radar tracking of maritime targets. The fusion is performed in the space of Kalman Filter and is done by finding weighted average of single state estimates provided be each of the sensors. The article presents both algorithms-Kalman Filter for tracking objects in single sensor and combining them together to find one fused state vector. Another approach for target tracking, namely neural target tracking is also recalled in the aspect of fusion. Two approaches for data fusion-centralized and decentralized-are stated and the latter is thoroughly examined. The discussion on main problems involved in fusing process in complex radar systems is then presented. This includes coordinates transformation, track association and measurements synchronization. Future plans of including neural tracking in data fusion are presented. The article is ended with summary of the issues pointed out in it. [C25]

"UWB radar object recognition for SLAM"

In situations where the environment is filled with dust or smoke, like in many emergency scenarios, UWB Radar is a possible technology to still sense the surrounding and build maps, thus helping firemen and other rescue personal. In this paper, a combination of two algorithms is presented. A basic simultaneous localization and mapping (SLAM) algorithm relying on simple indoor features is used to explore the environment and build a map. This algorithm is augmented by an object-recognition (OR) algorithm that is capable of recognizing and localizing complex shapes. These shapes can be used to improve the map resolution accuracy and resolve ambiguities. First tests using an m-sequence UWB Radar indicate the feasibility of this concept. [C26]

"Application of ground penetrating radar in the urban environment"

Several nondestructive testing methods have been studied to detect subsurface voids. However, few focus on deploying nondestructive methods in the congested and complex subsurface environment found in typical urban locations. This research identifies the challenges with applying Ground Penetrating Radar (GPR) techniques to locating subsurface voids and buried infrastructure in a complex urban environment. The study cataloged GPR signals representing reinforcements, concrete pipes, trolley tracks, and a large range of subsurface voids from surveys collected in downtown Louisville, Kentucky. Building upon this research, the team recreated a typical subsurface urban environment on the University of Louisville campus to develop a library of GPR images taken from known targets with defined parameters for training purposes. [C27]

"Precise SAR satellite orbit parameters determination based on Ground Control Points"

Aim to solve the georeferencing problem of spaceborne SAR imagery, accounting for the orbit physics model and the impact of the earth perturbations, some description models such as four parameters model and polynomial model could be applied to determine the satellite orbit parameters. However the orbit state vectors solved by 5 satellite state vectors supplied by header file in SAR data files could hardly acquire precise orbit parameters, which would greatly effect on the accuracy of co-registration, phase unwrapping, baseline estimation and the generation of Interferogram and DEM (Digital Elevation Model). In this paper, combined with R-D (Range-Doppler) conformation equation and earth ellipsoid equation, which explicitly describe the relationship of corresponding pixel between the 2D image coordinate and the 3D cartographic coordinate of ground targets, an advanced orbit model algorithm by adding few GCPs (Ground Control Points) to improve satellite state vectors is presented. All the correlative formulas are deduced and the orbit parameters can then be iteratively determined through solving a linear equation set consisting of the error equations from all GCPs under Recursive Least Square (RLS) algorithm. The algorithm is tested on an ERS SCL (Single Complex Looked) scene with a series of simulation experiments and the improved orbit parameters and contrasted with accurate SAR orbit data supplied by DEOS institution of Delft University in Holland, which could be demonstrated of validity and stability. [C28]

"Digital terrain model extraction from airborne LiDAR data in complex mining area"

Airborne light detection and ranging (LiDAR) proved to be an adequate technique to deliver highly accurate 3D mass points of the surface. However, the surface of mining area is complex with steep slope, dense vegetation, artificial mining facilities and buildings, which is different from the flat surface of city. The main processing workflow for DTM generation from LiDAR includes points filtering and DEM interpolation. In this article, five methods for removing object points from LiDAR data in mining area were compared. These methods, including Adaptive TIN (ATIN), Elevation Threshold with Expand Window (ETEW), Maximum Local Slope (MLS), Mathematical morphology (MM), Iterative Polynomial Fitting (IPF), analyze data points based on variations of local slope, elevation and height difference between points and the interpolated surfaces. Complex mining area data set with various cliffs of quarry, trees, houses, roads and small reliefs were selected to test the filtering methods. The results show that all methods can effectively remove most object points in complex mining areas. The ATIN and MM filter generated the best result in sharp cliff area of a quarry, whereas the other algorithms tended to remove the steep edge of quarry and roads. Depending on the filtering parameters, each method experienced various omission or commission errors. Quantitative assessment shows the ATIN and IPF based on the height difference between points and surface perform better. DEM interpolation assessment experiments indicate that interpolation biases were minute. Global statistics show that Modified shepard's method, Spline and Radial basis function interpolation methods have the lowest errors in the study area. [C29]

"Estimation of wetland aboveground biomass based on SAR image: A case study of Honghe National Natural Reserve in Heilongjiang, China"

Wetland is a significant component of the land ecosystems to discover the characteristics and ecological laws. Presently, a common method to estimate a regional wetland biomass is normally based on optical remote sensing images. The estimation of wetland biomass by Synthesize Aperture Radar (SAR) is a novel subject. As a new type sensor, SAR has advantages for wetland applications, therefore, it can be apply for generating some important information about wetland ecology and hydrology, especially with the complex ecological habitat of the transitional place between land and water, radar images can be significant tool for wetland biomass estimation. In this paper, as a case study of SAR application on Honghe National Natural Reserve (HNNR), the wet weight and dry weight field data of 28 quadrats of diverse vegetation in a growing season from the study area in 2009 were gathered, the ASAR image was acquired at the same time with field work. The backscattering coefficient of polarimetric radar and wet weight and dry weight data was taken as correlation variable, the fitting equations of regression models and water cloud model were built to estimate the wet weight and dry weight, a validation was made from 9 measured plots. The research shows the estimation of the wetland biomass by SAR image can be

a supplement to optical image with a scientific significance in ecology studying. [C30]

"Research on modeling and simulation of cruise missile interception system based on Object-Oriented Petri net"

Petri net is a tool suited for describing system with the feature of concurrence, asynchronization, distribution and undecision. This paper studied and realized a modelling method based on Petri net which integrated Object-Oriented approach and Petri net method, calling Timed Object-Oriented Petri net. It's more powerful to describe complex system but with less complex Petri net structure. We researched how to realize this method in computer simulation and applied this theory to the confrontation simulation of cruise missile interception system, which is a very complex system. [C31]

"Estimation of forest height, biomass and volume using support vector regression and segmentation from lidar transects and Quickbird imagery"

Lidar (light detection and ranging) remote sensing can accurately characterize forest vertical structure, such as canopy height, above-ground biomass (AGB) and timber volume; however, data acquisition is expensive. To reduce costs, one potential method is to integrate (small area) lidar transects and (large extent) optical imagery to estimate forest characteristics. Typically, multiple regression is used to link variables extracted from lidar transect data and optical imagery. Height information is then generalized from the area covered by lidar transects to other areas without lidar coverage. However, multiple regression models may not fully capture the complex relationship between variables. Fortunately, Support vector regression (SVR) provides a solution to deal with such complex nonlinear problems. Using a case study in Vancouver Island, Canada, SVR was applied to generalize canopy height from lidar transect(s) to the entire study area (2601 ha) based on a segmented Quickbird image. Results show that: (i) compared to typical multiple regression models, the SVR models provided better results for estimating canopy height; (ii) by using only one lidar transect (i.e., 8.8% cover), the SVR model generates an average canopy height estimation error of 6.2 m-which is less than a British Columbia forest inventory height class (9.0 m); and (iii) the final model estimates have relatively high correlations with field data for forest canopy height (R2: 0.81), AGB (R2: 0.76) and volume (R2: 0.64), while representing dramatically reduced acquisition costs. [C32]

"An image segmentation algorithm for SAR images based on wavelet packets frame transformation"

SAR (synthetic aperture radar) images are strongly disturbed by speckle noises, which brings difficulty to the segmentation of the SAR images. Some model-based SAR image segmentation approaches (such as the Markov random field model, fractal model) are too complex and time consuming. We propose an new method to segment the SAR images fast in this paper. First we transform the original SAR intensity image into some subimages using the wavelet packets frame transformation. Then we analyze the energy distribution in the transformed subimages and find that the energy of the speckle noise is mainly concentrated in the high frequency subimages. So we segment the SAR image based on the gray level of the low frequency subimages using a threshold classifying method. The result shows that this method can get a satisfying segmentation result and time saving. [C33]

"Deisgn of look-up table based architecture for wideband beamforming"

Wideband beamforming with a real-time array testbed will be studied in this paper. The algorithm and implementation architecture on wideband beamforming will be the main focus. The contribution of this paper can be summarized in the following three aspects. First, the channel imbalances among different RF chains will be taken into account. The equivalent complex baseband impulse responses of RF chains are measured from the AFRL TELA testbed. The second contribution is that the novel architecture of wideband beamforming is proposed. Look-up table (LUT) based architecture is exploited to replace the pre-steering delay component to avoid fractional delay-one implementation bottleneck. In addition, the general optimization issue for wideband beamforming is formulated as semi-definite programing (SDP), which can be efficiently solved by the convex optimization tool, e.g. CVX. [C34]

"Fusion of hyperspectral images and LiDAR data for civil engineering structure monitoring"

Investigation of civil engineering materials includes a wide range of applications that requires three-dimensional (3D) information. Complex structures shapes and formations within heterogeneous artificial/natural land covers under varying environmental conditions requires knowledge on the 3D status of the urban materials for better (visual) interpretation of polluted sources. Obtaining 3D information and merge them with aerial photography is

not a trivial task. It is thus, strongly needed to develop new approaches for near real time analysis of the urban environment with natural 3D visualization of extensive coverage. The hyperspectral remote sensing (HRS) technology is a promising and powerful tool to assess degradation of urban materials in artificial structures by exploring possible chemical physical changes using spectral information across the VIS-NIR-SWIR spectral region (400-2500nm). This technique provides the ability for easy, rapid and accurate in situ assessment of many materials on a spatial domain within near real time condition and high temporal resolution. LiDAR technology, on the other hand, offers precise information about the geometrical properties of the surfaces within the study areas and can reflect different shapes and formations of the complex urban environment. Generating a monitoring system that is based on the integrative fusion between HRS and LiDAR data may enlarge the application envelop of each technology separately and contribute valuable information on urban runoff and planning. The aim of the presented research is to implement this direction and define set of rules for practical integration between the two datasets. A fusion process defined by integrative decision tree analysis includes spectral/spatial and 3D information is developed and presented. [C35]

"Waveform diversity & knowledge based systems"

Summary form only given. Waveform diversity is an emerging technology that has dramatically altered the development of futuristic radar systems, as has knowledge based processing and control. With increasing numbers of radio frequency sensors and communications systems, battlefield scenarios have become more complex and continuously redefined. Our challenge will be to effectively use this technology to enhance overall performance of advanced radar systems operating within available spectrum in these battlefield environments. Technologies essential to this goal include cognition and knowledge based systems for waveform generation timing and control, and intelligent radar signal/data processing for detection, parameter estimation and track processing. Cognition is defined as the act or process of knowing, including both awareness and judgment. Awareness of the dynamically changing spectral environment and judgment for the selection of optimal waveform parameters and sensor placement will enable dramatically improved performance for target surveillance/reconnaissance in addition to enhanced interference mitigation. A confluence of factors and technologies now makes waveform diverse knowledge based systems a logical and affordable alternative to classically designed radars. [C36]

"A height-measuring algorithm applied to TERCOM radar altimeter"

Radar altimeter is applied to measure the height of an aircraft above the ground in terrain contour matching system(TERCOM). The total performance of the TERCOM is almost determined by the height-measuring algorithms embedded in the radar altimeter. When facing a complex terrain area with a large degree of fluctuation, the traditional radar altimetry height-measuring algorithm performance will be greatly affected,for the reason that wide-beam pulse radar altimeter illuminates widely. In order to solve the problem, this paper proposes a new algorithm named average-height algorithm,and the detailed derivation is carried out. Simulation and flying test has shown that it has good performance and can be applied to any kind of terrain. [C37]

"Support vector machine fusion of multisensor imagery in tropical ecosystems"

One of the major stakeholders of image fusion is being able to process the most complex images at the finest possible integration level and with the most reliable accuracy. The use of support vector machine (SVM) fusion for the classification of multisensors images representing a complex tropical ecosystem is investigated. First, SVM are trained individually on a set of complementary sources: multispectral, synthetic aperture radar (SAR) images and a digital elevation model (DEM). Then a SVM-based decision fusion is performed on the three sources. SVM fusion outperforms all monosource classifications outputting results with the same accuracy as the majority of other comparable studies on cultural landscapes. SVM-based hybrid consensus classification does not only balance successful and misclassified results, it also uses misclassification patterns as information. Such a successful approach is partially due to the integration of DEM-extracted indices which are relevant to land cover mapping in non-cultural and topographically complex landscapes. [C38]

"Research on design process for complex product"

The workflow is playing a more and more important role in collaborative design due to inherent complexity of the design process. The characteristics of the development for the complex product are studied and a multi-level, modular, integrated workflow is put forward. The functions which should be provided by the workflow is discussed and based on the function the framework of workflow is set up. Then the execution pattern which takes input/output template as the drive is studied. At last, a workflow management system (WFMS) for the development of radar is illustrated. [C39]

"The effects of input signal-to-noise ratio on compressive sensing SAR imaging"

Synthetic Aperture Radar (SAR) is an active and coherent microwave high resolution imaging system, which has the capability to image in all weather and day-or-night conditions. The high resolution required by various modes of SAR results in a huge amount of sampling data, which brings a demand for bigger storage. Recently, a novel concept based on Compressive Sensing (CS) theory asserts that an unknown sparse signal can be recovered exactly with an overwhelming probability even with highly sub-Nyquist-rate samples. In this paper, a new scheme for the test bed of CS based SAR imaging is proposed. Experimental results on some real raw SAR data reveal that there are some practical limitations on the use of CS based SAR imaging, especially for complex imaging scenes and systems with low Signal-to-Noise Ratio (SNR). [C40]

"A Digital Pulse Drive Circuit for Continuously Modulated Semiconductor Laser"

A digital designing way of laser drive circuit for continuously modulate the frequency, pulse width and amplitude of the output of semiconductor laser has been demonstrated. Complex programmable logic device (CPLD) was utilized to generate square waves with tunable frequency, the accurate delaying chip and logic circuit which are digital controlled were used to generate electrical pulses with adjustable pulse width. The pulses were amplified by the laser diode driver. The maximum output current of the driver can be up to 600 mA. When the signal was used to drive the semiconductor laser, the shape of the pulses generated by the laser is identical with the electrical pulses. The repetition rate and pulse width of the laser pulse can be continuously adjustable from 1 to 10 kHz and 3 to 20 ns, respectively. Furthermore, the time of rising and falling edges for the laser pulse were less than 2 ns. [C41]

"The pulse sequence pattern and signal processing of complex radars"

To the EW system, the conventional radar signal description is based on radar parameters and their features, which is hard to describe the modern complex radar. A new conception of Pulse Sequence Pattern (PSP), which uses a representative pulse sequence with multi-dimension parameters as the radar signal description, is proposed in this paper firstly. And the PSP of typical radar is described in detail. At last, the fast signal processing algorithm based on the PSP is given. The experiments and computer simulations show that the description of PSP is practicable and the recognition algorithm is more effective than the conventional method. [C42]

"A radar emitter identification method based on pulse match template sequence"

In the dense emitter environment, the existing radar emitter identification methods can not effectively and rapidly give the class of radars with complex modulation signal. So this paper proposes a new radar emitter identification method based on pulse match template sequence and gives the structure and algorithm of this method. Through computer simulation, this method can rapidly and effectively identity the class of radar emitter. [C43]

"A fuzzy adaptive tracking algorithm based on current statistical probabilistic data association"

In this paper, a new fuzzy adaptive maneuvering target tracking algorithm based on current statistic model is proposed. How to track a maneuvering target is a key problem of target tracking in clutter. Current statistical model needs to pre-define the value of maximum accelerations of maneuvering targets. So it may be difficult to meet all maneuvering conditions. The Fuzzy inference combined with Current statistical model is proposed to cope with this problem. Given the error and change of error in the last prediction, fuzzy system on-line determines the magnitude of maximum acceleration to adapt to different target maneuvers. Furthermore, the difficulties of the maneuvering target tracking lies in the uncertainty of state model, and the clutter make it more complex. The algorithm combines current statistical algorithm with probabilistic data association algorithm. At last, the results show this algorithm can estimate a maneuvering target in clutter efficiently. [C44]

"Application of a fast equivalent currents based algorithm for scattering center visualization of vehicles"

For the development of new radar sensor concepts in the automotive market comprehensive and reliable system simulation capabilities are highly desired. Since the radar channel includes both, desired and undesired contributions from the sensors environment, deterministic channel and wave propagation models are a crucial part of the whole simulation chain. Unfortunately, for some applications even asymptotic ray-based models exceed the available computational resources and further simplifications are required. Instead of brute-force ray tracing with a detailed geometrical description of the scene, one approach is based on a precomputed scattering center representation of complex objects. In this case, inverse synthetic aperture radar (ISAR) is a promising

technique to estimate the required number and positions of the scattering centers. The imaging process should be fast enough to enable an investigation of a large number of bistatic configurations. In the 2D case, for range and cross-range resolution, classical Fourier processing requires twodimensional scattering data in frequency and aspect domain, which can be quite costly. Therefore, an idea presented is adapted to the existing scattering simulation code and applied to the scattering center visualization of vehicles. [C45]

"Time-Reversal Processing and Autofocus of Targets Behind Complex Wall"

Through-the-wall radar imaging (TWRI) beyond a single wall is a growing area of study. A novel near-field time-reversal match filter deconvolution procedure was proposed to improve imaging behind complex periodic walls. Promising results with improved target resolution were shown. Future work will leverage such technique to tolerate errors in wall parameters leading to an autofocus approach. [C46]

"EM techniques for the detection of breast cancer"

Radar based microwave imaging technique has great potential for breast cancer detection. It has been demonstrated by recent experiments that the data adaptive radar microwave imaging reveals good image resolution. However, purely scattered energy based image reconstruction methods can face major challenges in differentiation since the fibroconnective and glandular tissues which could have similar dielectric properties as that of malignant tissues. It has been proposed that the morphological features of the tissue can differentiate the benign from malignant tissues due to their irregular, spiculated shapes. Thus to efficiently differentiate the healthy, benign and breast tissues, this paper proposes a method that combines a novel data-independent beamformer called MWDAS method with Matrix Pencil (MP) method to first localize the suspicious region and then extract the resonant frequency and damping factor of complex natural resonance (CNR) of the malignant tissues. We employ FD-TD based computational 2D and 3D breast models for testing our method. [C47]

"Computation of physical optics integral by Levin's algorithm on NURBS"

Non-Uniform Rational B-Splines (NURBS) are very powerful modeling tools for geometric design due to several reasons including fast and numerically stable algorithms and unified mathematical basis for representing complex objects [1]. Although target modeling is easy with NURBS, applying some numerical tools directly on NURBS is not so straightforward. Since the surface point function and derivative computation is simpler for rational Bezier surfaces (RBS), NURBS surfaces are converted to RBS by Cox-de Boor Algorithm for numerical implementations [2]. Therefore, solving a problem for RBS corresponds to solving it for NURBS surfaces. Indeed, in this paper, RBS are used for surface modeling and radar cross section (RCS) computations. The RCS computations are performed by employing Physical Optics (PO) approximation which is accurate at high frequency regions [3]. Although PO is a more efficient technique for scattering problems at high frequencies, when compared to full-wave techniques, it may be intractable due to rapid oscillations of the PO integral. In the literature, there are several methods to handle the oscillatory integrals including the stationary phase method, which is already applied to PO computations on NURBS surfaces [2, 4]. Another method proposed for highly oscillatory integrals is the Levin's method which was previously applied to PO problems, particularly RCS computation of targets modeled by quadrilaterals [5]. In this paper, the same approach is utilized on RBS. [C48]

"Simulation of the mutual couplings among multiple antennas on large platform using multi-region multi-solver domain decomposition"

Modern aircrafts are usually equipped with multiple antennas serving for different usages, including radar, communication, etc. Many of them have highly contrasting power levels and overlapping frequency bands. The mutual couplings among antennas may cause severe electromagnetic compatibility (EMC) problem, which prevents the multiple antennas from working simultaneously. This paper proposes a multi-region multi-solver domain decomposition method (MS-DDM) to simulate the EMC problem on electrically large platform. It has been successfully applied to analyze the mutual coupling between complex antennas mounted on a real F-16 aricraft at 2GHz frequency. [C49]

"Accurate evaluation of the time-domain effective height for short-pulse antennas"

A singularity-expansion-method (SEM) based approach is presented for the analysis of radiation processes in short-pulse antennas. Any time-domain electromagnetic field solver can be used to derive a minimal pole/residue spherical harmonic expansion of the equivalent currents excited on a suitable Huygens surface enclosing the radiating structure. In this way, the time-domain effective height of the antenna is evaluated in closed form as the superposition of non-uniform spherical wave contributions attenuating along with the time according to the real part of complex poles accounting for the natural resonant processes occurring in the structure under analysis. [C50]

"Detection of complex point targets in a MIMO radar system with distributed assets and partially correlated signals"

A complex point target is a mathematical model for a radar target that is not resolved in space, but exhibits varying complex reflectivity across different bistatic view angles. The complex reflectivity can be modeled as a complex stochastic process whose index set is the set of all bistatic view angles, and the parameters of this stochastic process follow from an analysis of a target model comprising a number of ideal point scatterers randomly located within some radius of the targets center of mass. Six different models are summarized here, with different assumed distributions on the locations of the point scatterers within the target. We develop data models for the received signals from such targets in a MIMO radar systems with distributed assets and partially correlated signals, and consider the resulting detection problem. The problem reduces to the familiar Gauss-Gauss detection problem with hypoexponential test statistic. A related problem of adapting the transmitted signals to the target model is discussed. [C51]

"Blind multipath separation for waveform recovery"

The separation of multipath signal components by spatial filtering in a narrowband antenna array is addressed for cases where diffuse scattering and array calibration errors may cause the spatial signatures of the received propagation modes to deviate significantly from the plane-wave array manifold. The distorted wavefronts may have complex spatial signatures that are difficult to accurately characterize and mutually resolve on the basis of array manifold models described by few parameters. Furthermore, the temporal signature of the source waveform may also be quite arbitrary, with no known deterministic or statistical properties that can be utilized for multipath separation. This problem calls for blind waveform estimation methods that rely on relatively mild assumptions. An alternative blind spatial filtering technique referred to as the Generalized Estimation of Multipath Signals algorithm, or GEMS, is introduced for this purpose and tested on experimental data provided by the high frequency (HF) radar program of the Defence Science and Technology Organization (DSTO), Australia. [C52]

"Digital beamforming with reduced number of phase shifting and time delay elements"

A bilinear representation of polynomials is shown to result in an efficient method for digital beamforming in phased arrays, with much reduced number of phase shifting elements. The proposed structure is also shown to extend to arrays with arbitrary complex weights. The number of phase shifting elements used is of the order of the square root of the number of phases used, with no limitations on the achievable patterns. Only phase shifters and combiners are used, with no splitters. The same concept applies to reduction of the number of delay elements in wideband beamforming, and also in reduction of the number of delay elements in continuous-time FIR filters. [C53]

"Preliminary results of ultra-wideband through-the-wall life-detecting radar"

It is often a difficult task of knowing the location or movement of people behind barriers. To address this problem, we develop a through-the-wall life-detecting radar (TWLDR) prototype. It is a kind of ultra-wideband (UWB) radar using impulse waveform, which can penetrate non-metallic walls to detect static and moving targets behind walls. We first introduce configurations of the radar system, then describe signal processing techniques, and present experimental results in different situations at last. Results indicate that the UWB TWLDR can penetrate non-metallic walls to detect people with different locomotion states such as standing, walking along cross-range direction, walking along range direction, and the signal processing algorithm could be applied to other complex environments. [C54]

"Autonomic subsystems for cognition in Passive Coherent Location"

In a previous paper we mentioned that Passive Coherent Location (PCL) can be thought of as Cognitive Radar. The deployment of PCL systems (also known as Passive Bistatic Radar-PBR) is fraught with difficulty, even in the situation of a spatially static network of transmitters and receivers. It is well known that PCL systems have to take into account the strong, direct signals of cooperative and opportunistic transmitters used, and try to use terrain or antenna nulls to mitigate the receiver dynamic range requirements. Receiver position in the terrain also influences the coverage. This results in a complex planning environment requiring propagation prediction tools to assist in selection of the best site. The situation becomes worse when the network of transmitter and receivers becomes dynamic. In this paper, we discuss the cognition and networking requirements for PCL systems consisting of moving transmitters and receivers, forming a cognitive, sensor network. We show that a sensible approach would use the structure of human intelligence, which consists of a higher level integrating function, together with autonomic, lower level, subsystems. [C55]

"Characterization of Doppler effects in the context of over-the-horizon radar"

This paper addresses the problem of the characterization of Doppler effect of maneuvering targets in the context of over-the-horizon radar. The received signal has a complex Doppler structure which is composed of several arrivals, each corresponding to a particular path. In essence, it consists of several close time-frequency components with non-linear signatures in the time-frequency domain. The nonlinearities are the projections of the target's motion vectors on the propagation paths. Estimating the time-frequency contents of all paths reveals the Doppler effects characterizing the target's trajectory. Analysis of such signals in the presence of strong clutter requires effective non-stationary signal processing techniques. In this paper, we propose a new technique based on local analysis of the phase information using warped high-order ambiguity function. The results depict resolvable multipath estimates which are very close to the ground truth. [C56]

"Blind source extraction of cyclostationary sources with common cyclic frequencies"

A new method for blind source extraction of cyclostationary sources is presented. It is assumed that the cycle frequencies of the sources are known a priori and some of the sources have common cycle frequencies. Necessary and sufficient conditions are introduced and Jacobi method for diagonalization of complex matrices is used to find the estimations. The proposed algorithm is applied to simulated data, and effectiveness and performance of the algorithm are verified. [C57]

"Bistatic scattering center models for the simulation of wave propagation in automotive radar systems"

Deterministic radio channel simulations for large and complex environments at very high frequencies are a challenging task. In this paper an approach is presented in which the computational complexity is significantly reduced by using scattering center models for the most complex objects. The scattering centers are described in form of directional, bistatic scattering intensities and can be computed for the isolated complex object in advance without considering the complete environment. Thus, the simulation performance benefit is due to a significant reduction of the complexity of the geometrical representation of the scene. The parameterization of the scattering centers itself is based on an efficient high frequency asymptotic field prediction tool incorporating Geometrical Optics and other techniques. The models are designed to study deterministically the wave propagation for vehicle based radar systems operating near 80 GHz. An example for a bistatic three-dimensional parameterization is given. Furthermore, a fast Inverse Synthetic Aperture Radar (ISAR) imaging technique is applied that can be used to find the most relevant scattering center positions on the objects. [C58]

"Performance prediction of Firefinder radar using high fidelity simulation"

Thales Raytheon Systems' PC Simulation (PCS) tool allows a rapid simulated evaluation of Firefinder radar performance from a personal desktop computer. Firefinder radars are designed to track hostile rocket, artillery and mortar (RAM) projectiles in order to accurately estimate weapon ground location. The Firefinder tactical code is used within PCS. This design provides a low risk path to rapid prototyping and evaluation of candidate software changes. PCS is used to evaluate candidate software changes to the Firefinder. Candidate design changes which perform well in PCS testing require minimum system level checkout before being checked into the tactical software baseline. The PCS tool contains a simulation engine which reads program control information from input data files. The PCS tool also generates and maintains simulated targets and clutter, simulates the radar signal processing function, performs Monte-Carlo "batch" processing, produces complex target trajectories internally or from an input text file and creates simulation data recording files identical in format to those created by the actual radar. This paper summarizes the capabilities of the lastest PCS. [C59]

"Signal modelling for ground moving target in complex image domain of multi-channel SAR"

For along-track multi-channel synthetic aperture radar (SAR), this paper proposes a novel ground moving target signal model in the high-resolution complex image domain. It is shown that moving targets can be divided into three types according to the 2D motion distribution and the SPP approximation conditions. Moreover, a single target can be split into two targets in the image. All types of targets will have the same Doppler interferometric effect along multichannel images, which is decided by the target's ambiguous Doppler frequency. Furthermore, with our derived signal model, the complex image properties, i.e., amplitude reduction, azimuth shift, azimuth defocus, range blur, 2D slant, second-order phase modulation, split, interferometry and the effects of 2D accelerations are analyzed for airborne and spaceborne SAR, respectively. Finally, some experimental results are also provided to demonstrate the effectiveness of the proposed signal model and analysis. [C60]

"Establishing a common phase reference for comparing synthetic data to RF range measurements"

Discrepancies can result when creating common data sets consisting of comparable synthetic and measured range complex scattered field samples when the phase references of each do not coincide. This can be especially true when using signal processing techniques to produce one dimensional (range profiles) or two dimensional (Synthetic Aperture Radar or SAR images) representations of the target scattered field where range bins and cross-range bins are formed. Range profiles and SAR images can be misaligned or have different bin amplitudes due to target scatterers in synthetic and measured scenarios shifted with respect to one another. Obtaining equivalent data samples requires attention to the measured data calibration process and phase reference location. This paper will address the common phase reference problem by an analysis of experimental data for specific targets and rotation system. Suggestions are provided for possible solutions to current challenges. The data analysis will include synthetic and measured range data comparisons, range calibration, and target position and range alignment processes using Theodolite laser measurements. [C61]

"Autonomous Lockout Map Construction Technique for Secondary Surveillance Radar Mode S network"

Secondary Surveillance Radar (SSR) Mode S is an air traffic control radar system with improved surveillance and datalink capability. Recently, SSR mode S network attracts attentions as a way to solve problems such as the interrogator identifier code problem or radio frequency (RF) signal environment pollution. In SSR mode S network, each site has lockout map. Lockout is a command from GS to aircraft. Aircraft stops replying to all-call if it receives lockout. Lockout map determines area where GS lockout aircraft. There are several problems in current lockout map. First, it is difficult to create optimum lockout map. Second, it becomes complex to allocate and manage lockout maps if many sites join network. As the number of sites increase, Mode S operator has to prepare many maps. To solve these problems, we propose the Autonomous Lockout Map Construction Technique for SSR Mode S network. This technique enables Mode S GS to autonomously construct optimum lockout map by exchanging aircraft and site information through network. In this paper, we describe the background and details of the proposed technique. Then we show simulation results for validating the proposed technique. [C62]

"Initialization of ballistic targets tracking filters with detection probability lower than unity"

Radar tracking of a projectile flying in the Earth's atmosphere is a very complex issue to cope with, due to the need of (suboptimal) nonlinear filtering techniques. Almost all cases found in literature assume that the target trajectory is observable from the firing point to the impact point on the ground, namely the trajectory observation gets under way from the first available measurement. The radar track initiation time is actually a stochastic quantity that has to be treated by means of a statistical procedure. In this paper a preliminary analysis of the effect of a more realistic filter initialization is proposed. [C63]

"Design and Realization of an Online Power Quality Monitoring System Based on GPRS"

In order to evaluate power quality more accurately, this paper presents a three-layer distributed online power quality monitoring system (PQMS), which uses the General Packet Radio Service (GPRS) wireless network as its communication channel. This PQMS consists of three parts: the power quality monitor (PQM), the monitoring software (MS) in upper computer and the web platform (WP). The PQM which is designed on the structure of DSP (Digital Signal Processor) + CPLD (Complex Programmable Logic Device) ensures the realtime and precise monitoring. Then the MS collects and analyzes the monitoring data. At the same time, GPRS network provides the communication channel for PQM and MS. The WP provides the monitoring data and the analysis results through internet, and supervisors can monitor and manage the power quality from a long distance. The detail design and its realization of each part are explained. Precision test of the PQM and field monitoring results with the PQMS are also discussed. [C64]

"Economic aspects of realization of the government programs of development of the technical systems"

In this paper the situation of information possibilities in Azov and Black Seas region is given. The search of optimal creation of complex distance monitoring system is proposed. [C65]

"Wearable Doppler radar with integrated antenna for patient vital sign monitoring"

A 2.45 GHz wearable Doppler radar unit with radio data link is presented for use in portable patient monitoring and emergency response. Unlike portable Electrocardiograms (ECG) or Photoplethysmography (PPG), the near-field Doppler unit enables monitoring of the person's heart rate without the need for electrical contact or optical access to the patient's skin. The Doppler unit is designed to be embedded in a clothing garment such as a shirt

or vest, or used by medical emergency personal in an instrumented blanket or medical stretcher. Since the Doppler unit is placed directly on or behind the patient's torso, the extraneous signals due to relative motion artifacts is greatly reduced. Low-cost design is achieved by employing PWB microstrip elements for the integrated patch antenna, microwave oscillator, and tuning elements. Also, since the distance between the Doppler unit and the patient is fixed, it was possible to tune the detection phase to enable the use of a single mixer diode and eliminate the need for quadrature detection. Measured heart data from this technique shows clear waveform substructure similar to PQRST complex features found in captured ECG data. [C66]

"Passive hindrances suppression using complex polyphase signals"

Using complex signals we get possibility of indemnification of passive hindrances in the single channel system of radio monitoring due to the use of correlation and spectral characteristics of certain class of complex signals. [C67]

"A complex SAR image compression algorithm combining set-partitioning and context prediction"

This paper presents a new wavelet transform coding algorithm for complex Synthetic Aperture Radar (SAR) image compression. It uses a improved recursive set-partitioning procedure to compress the large blocks which are abundant in zero bits, and uses entropy coding based on adaptive context prediction model to compress the small blocks which contains non-zero bits. The experiment results showed that the new algorithm gained better compression efficiency than SPECK. We also compared with common complex SAR image compression algorithm in references using professional parameters in SAR, such as Means Phase Errors (MPE), complex spatial correlation efficient, the new algorithm gets better performances too. [C68]

"System performance prediction of Firefinder radar"

Thales Raytheon Systems' PC Simulation (PCS) tool allows a rapid simulated evaluation of Firefinder radar performance from a personal desktop computer. Firefinder radars are designed to track hostile rocket, artillery and mortar (RAM) projectiles in order to accurately estimate weapon ground location. The Firefinder tactical code is used within PCS. This design provides a low risk path to rapid prototyping and evaluation of candidate software changes. PCS is used to evaluate candidate software changes to the Firefinder. Candidate design changes which perform well in PCS testing require minimum system level checkout before being checked into the tactical software baseline. The PCS tool contains a simulation engine which reads program control information from input data files. The PCS tool also generates and maintains simulated targets and clutter, simulates the radar signal processing function, performs Monte-Carlo "batch" processing, produces complex target trajectories internally or from an input text file and creates simulation data recording files identical in format to those created by the actual radar. This paper summarizes the capabilities of the lastest PCS. [C69]

"A novel range alignment algorithm for ISAR"

A novel technique is proposed for range alignment in inverse synthetic aperture radar(ISAR) imaging. The correlation of complex High Range Resolution Profiles of two echoes is calculated as the quality measure of range alignment, and its applicability is analyzed. The shifts introduced by the echoes are obtained in the frequency domain without interpolation, so the computation burden is greatly reduced. In addition, the shift is implemented by introducing a phase ramp in the frequency domain, which removes the integer steps in the time domain. [C70]

"Parameters extraction of crop based on PolSAR Data"

It is beneficial to extract the parameters of the objects by rich information of PolSAR (Polarimetric Synthetic Aperture Radar) data. With polSAR data of Radarsat-2, the polarimetric character of winter wheat in booting and milk stage is studied based on polarization theory. The results show that: there is a great difference between the polarimetric characters of two stages due to the change of wheat structure. Winter wheat growth can be retrieved by entropy, which changes in different way in the two stages. In booting stage, with LAI increasing, the scattering mechanism tends to be more complex. While in milk stage, with plant density increasing, the scattering mechanism tends to be simpler. The eigenvalue of λ2 is a valuable parameter to retrieve soil moisture with crop cover. Results show the potential advantage of polarimetric radar. [C71]

"Scattering Centers Extraction of Radar Target Using Biquaternions"

Scattering centers estimation results are significant for radar target recognition in high frequency section. This paper introduces biquaternion theory into full-polarization scattering centers extraction of radar target. Firstly, we define full-polarization scattering centers as a biquaternion model. It makes a close connection between

polarization parameters. Then, we propose Bihan's BQ-MUSIC thought to extract scattering centers' position parameters. Simulations illustrate that our theory gets better estimation results compared to polarization MUSIC algorithm of complex model. [C72]

"A new method based on the BP neural network to improve the accuracy of inversion of the vegetation height"

The error in the estimation of the ground interferometric phase will reduce the accuracy of the inversion of the vegetation height in three-stage vegetation inversion method. Aiming at this problem, the new vegetation height inversion method based on the BP neural network is proposed. The new method directly fits the nonlinear mapping relationship between the complex correction coefficients and the vegetation height, so it reduces the height inversion error caused by the error in the estimated ground interferometric phase. The new method has better performance than the three-stage vegetation height inversion method, and the experiment results validate the superiority of the new method. [C73]

"LTR analysis and signal processing for concealed explosive detection"

This paper presents the methodology for Concealed Weapon and Explosive (CWE) detection using Ultra Wideband (UWB) radar. The framework of the approach is based on the study of the Late Time Response (LTR) of the complex human-explosive object which occurs when the illuminating signal is characterised as UWB. The LTR is analysed using methods for extraction of its natural resonant frequencies which constitute a unique signature. Therefore it is investigated if the explosive or grenade resonant frequencies can be retrieved by the human-grenade LTR. [C74]

"Krylov space iterative solvers on graphics processing units"

CUDA architecture was introduced by Nvidia three years ago and since then there have been many promising publications demonstrating a huge potential of Graphics Processing Units (GPUs) in scientific computations. In this paper, we investigate the performance of iterative methods such as cg, minres, gmres, bicg that may be used to solve large sparse real and complex systems of equations arising in computational electromagnetics. [C75]

"Measurements of complex dielectric permittivity and magnetic permeability of carbon-coated Ni capsules"

With advance of multiferroic composites it becomes increasingly interesting to measure both complex dielectric permittivity and magnetic permeability simultaneously and preferably at high frequencies. In this work both of these parameters in case of carbon-coated nickel nanocapsules (Ni@C) embedded into organic matrix were measured in a waveguide set-up in 26-36 GHz frequency range. [C76]

"Measurements of the complex permeability of yttrium iron garnet substrates near ferromagnetic resonance"

This paper describes a simple method of measurements the complex permeability of yttrium iron garnet (YIG) substrates. The permeability of YIG is measured near a ferromagnetic resonance. The method is based on the measurements of resonant frequencies and Q-factors of YIG substrate placed into two structures: single post dielectric resonator and split post resonator. The obtained results are presented. [C77]

"Optimization parameters of dielectric in aperture-coupled stacked patch antenna on bandwidth"

The present paper described a method of analysis that can be applied to these geometries, as well as related configurations. The paper presents a model of the antenna on which the simulation was conducted on the impact parameter on bandwidth. The influence of the changes of the value of these parameters of individual layers on the bandwidth was talked over. Paper shows the analysis of multilayer microstrip antennas process is very complex and time consuming and compare between calculation and measurements. One of the most important parameters which have been calculated is the bandwidth. The paper describes a clear advantage of multilayer antennas over monolayer ones, where the bandwidth is significantly narrower. [C78]

"A compact double-ridged horn antenna for ground penetrating radar applications"

A compact double-ridged horn antenna for ground penetrating radar applications in the frequency range of 1-7 GHz will be presented in this work. Within this contribution the design, simulation and fabrication of such an antenna will be considered. Among the varying design parameters are linear and exponentially tapered walls as

well as variations of the curvature of the dielectric waveguide between the two ridges. In addition an absorber structure and a complex shaped metallic back plate have been introduced to further improve the return loss. The primary design goal is a broad bandwidth while maintaining compact dimensions. Two modifications have been introduced in this antenna design in contrast to the standard TEM horn. By protruding the ridges from the aperture plane and filling the space between the ridges with dielectric material it is possible to lower the operating frequency without increasing the size of the original setup. The proposed design has been applied to subsurface radar application in both, field simulations by means of CST Microwave Studio and measurement in a GPR test scenario. The fabricated antenna has been verified by anechoic chamber measurements. The performance of the antenna with respect to the detection of subsurface objects will be verified by various experiments. [C79]

"Design of broadband complex impedance-matching networks and their applications for broadbanding microwave amplifiers"

In this paper design a method is presented for broadband matching of complex impedances using distributed circuit elements. The method is a combination of the classical analytic network theory approach for lumped element matching networks and of the numerical optimization techniques. The aim is to create distributed element matching networks for Rf transistors in order to design broadband amplifiers in a systematic way. The design method is demonstrated by several realized and tested microstrip matching circuit in the 1.5….2.5GHz frequency range, which are well applicable for amplifier design. A microwave amplifier example operating in the 1…2GHz band is shown as well. [C80]

"Optimal sidelobes reduction and synthesis of circular array antennas using hybrid adaptive genetic algorithms"

In this article, a hybrid optimization method has been proposed consisting of Adaptive Genetic Algorithms (AGAs) and Constrained Nonlinear Programming (NLP) to solve the problems of performance optimization of circular array antenna consist of parallel center feeding short dipoles elements with two complex nonlinear optimization problems. In the first problem, the hybrid optimization algorithm is used to reduce the value of sidelobe level in the circular array radiation pattern by finding the optimal values of the excitation coefficients of each element in the circular array. In the second problem, a synthesis of circular array with different forms of the desired radiation pattern is considered. Several examples are considered here to verify the validity of this method. The results obtained by this method show that it is possible to obtain an array radiation pattern with low sidelobe level of -40dB in the first problem. In the second problem, it is shown that it is possible to obtain a wide flat main lobe of 60obeam width, and two nulls on both sides of the main lobe with 10owidth for each. Comparisons were made between the results of this method and the results obtained by Standard Genetic Algorithm (SGA), and it is clearly shown that this method is more efficient and flexible in solving the problems of performance optimization of circular array antenna. [C81]

"Principles of the electromagnetic modelling of some microwave components, based on the circular waveguides with azimuthally magnetized ferrite"

The principles of electrodynamic analysis of the characteristics of the ferrite control components (nonreciprocal digital phase shifters, cut-off switches and isolators) which use circular waveguides, entirely filled with azimuthally magnetized ferrite or containing a coaxial disc- or ring-shaped area of the medium alluded to and a dielectric one, surrounding it or taking up its hollow, resp., and work in the normal TE01mode, are enunciated: i) employment of complex confluent hypergeometric and eventually also of real cylindrical functions; ii) indispensability of inventing of numerical methods for evaluation of some special functions of the mathematical physics: the Euler gamma function, its logarithmic derivative and the confluent functions in the complex field, as well as of the cylindrical ones in the real domain; iii) elaboration of techniques for numerical solution of complicated transcendental equations, involving complex confluent and possibly real cylindrical functions, too; iv) introduction of a new class of real numbers, called L numbers, connected with the purely imaginary roots of the equations mentioned; v) development of numerical schemes for computation of the phase curves of geometries regarded and of iterative procedures for finding the differential phase shift provided by them; vi) laying down of criteria for the operation of configurations as phase shifters, magnetically controlled cut-off switches and isolators. Each of the maxims pointed out is elucidated in detail. [C82]

"Analysis of rectangular microstrip structures by the method of moments"

Rectangular microstrip structures (RMS) are widely used in various microwave devices. Using the method of moments and principle of partial images, various techniques are created to determine charge distribution in 2D models of microstrip structures (their cross-section). In this paper, a technique for calculating surface charge

distribution and total capacitance of complex 3D rectangular microstrip structures is proposed using the mentioned method and principle. To demonstrate feasibility of the proposed technique, three RMS were investigated. Obtained results are compared with the data published by other researches. Total error is typically less than 5%. [C83]

"The performance of the IFM receiver in a dense signal environment"

The capabilities of multichannel IFM system for working in dense and complex signal environment have been presented in the paper. The present electromagnetic environment in microwave frequency band is filled by the complex simultaneous or overlapped signals. High performances are required from microwave receivers worked in these difficult conditions. The IFM receiver is possible to fulfill these requirements. The analysis and measurement results for simultaneous signals have been presented in the paper. The measurements for varied frequency and signal power of two simultaneous signals using multichannel IFM receiver was done and measurements results have been presented. The instantaneous frequency measurements for complex signals using dual channel IFM receiver have been done. The measurements results for LFM and FSK signals have been presented in the paper. The frequency measurement errors depend on the structure of the frequency discriminators, especially on the delay line length and microwave detectors parameters. [C84]

"Advanced switch-mode concepts using GaN: The class-S amplifier"

Efficiency of power amplifiers for the wireless infrastructure is presently a hot topic. Switch-mode type amplifiers and/or more complex concepts, e.g. Doherty or envelope tracking (ET) are being explored intensively, exploiting the potential of GaN technology. This paper contributes recent results on a related approach, the class-S concept, which offers also compatibility with digital baseband processing. Its potential is evaluated based on realizations for the 450 MHz frequency band with GaN MMICs. [C85]

"Complex dielectric permittivity of composites based on dielectric matrixes with inclusions of carbon nanotubes"

Complex dielectric permittivity of composites based on two-component epoxy adhesive with different volume concentration of inclusions of multilayer carbon nanotubes and particles of fine-dispersed graphite was determined from the transmission spectra of the microwave radiation interacting with the sample under investigation. Complex dielectric permittivity of multilayer carbon nanotubes and particles of fine-dispersed graphite was determined as a result of reverse problem solving with utilization of the dependency of complex dielectric permittivity of composites on the inclusions volume fraction. It was shown that in creating composites based on dielectric matrixes with inclusions of particles of fine-dispersed graphite and carbon nanotubes the last ones provides the greater of the real part of dielectric permittivity and the lesser of the imaginary part of dielectric permittivity. [C86]

"Self-Organizing Networks: State-of-the-art, challenges and perspectives"

In this paper, a general overview of Self-Organizing Networks (SON), and the rationale and state-of-the-art of wireless SON are first presented. The technical and business requirements are then briefly treated, and the research challenges within the field of SON are highlighted. Thereafter, the relation between SON and Cognitive Networks (CN) is covered. At last, the application of Algorithmic Information Theory (AIT) as a possible theoretical tool to support SON in addressing the growing complexity of networks is discussed. [C87]

"Human detection and tracking via Ultra-Wideband (UWB) radar"

This paper presents an algorithm for human presence detection and tracking using an Ultra-Wideband (UWB) impulse-based mono-static radar. UWB radar can complement other human tracking technologies, as it works well in poor visibility conditions. UWB electromagnetic wave scattering from moving humans forms a complex returned signal structure which can be approximated to a specular multi-path scattering model (SMPM). The key technical challenge is to simultaneously track multiple humans (and non-humans) using the complex scattered waveform observations. We develop a multiple-hypothesis tracking (MHT) framework that solves the complicated data association and tracking problem for an SMPM of moving objects/targets. Human presence detection utilizes SMPM signal features, which are tested in a classical likelihood ratio (LR) detector framework. The process of human detection and tracking is a combination of the MHT method and the LR human detector. We present experimental results in which a mono-static UWB radar tracks human and non-human targets, and detects human presence by discerning human from moving non-human objects. [C88]

"A spectral space-variant approach for structure indexing in Spotlight TerraSAR-X data"

Modern space missions equipped with SAR instruments provide high spatial resolution data. In such data features of urban objects, man-made structures, as well as natural targets can be identified. We propose a descriptive model based on the frequency spectra of the complex signal, that integrates the radiometric, geometric, and texture features, for scene and target indexing, to cope with the problem of large database queries and information retrieval. Considering the properties of the Spotlight imaging mode in particular, a phase correction algorithm is applied to the data, prior to feature extraction. The assignation of a particular scene to a certain class is done using a Bayesian Support Vector Machine classifier. The method allowed for the recognition of more than thirty targets and structures in the scenes. [C89]

"Super-resolution UWB radar imaging algorithm based on extended Capon with reference signal optimization"

Near field radar employing UWB (Ultra Wideband) signals with its high range resolution provides various sensing applications. It enables a robotic or security sensor that can identify a human body even in invisible situations. As one of the most efficient radar algorithms, the RPM (Range Points Migration) is proposed. This achieves fast and accurate estimating shapes of surfaces, even for complex-shaped targets by eliminating the difficulty of connecting range points. However, in the case of a complicated target surface whose variation scale is less than wavelength, it still suffers from image distortion caused by multiple interference signals mixed together by different waveforms. As a substantial solution, this paper proposes a novel range extraction algorithm by extending the Capon, known as FDI (Frequency Domain Interferometry). This algorithm combines reference signal optimization with the original Capon method to enhance the accuracy and resolution for an observed range into which a deformed waveform model is introduced. The result obtained from numerical simulation proves that superresolution UWB radar imaging is accomplished by the proposed method, even for an extremely complex-shaped targets including edges. [C90]

"A Least-Squares Algorithm for Multipath Estimation Using an UWB-IR Link"

This paper introduces a modified complex to real amplitude least-squares (CRALS) algorithm for the estimation of dense multipath in an UWB-IR channel. The traditional CRALS is ineffective for UWB-IR signal due to its wide bandwidth and large off period. This algorithm is modified to resolve three closely spaced paths in a correlation window. One novelty of the modified algorithm is that region-based processing is used for the initial estimate in place of coordinate descent processing used in traditional algorithm, and so the long iteration due to large off period is saved. The other novelty is that the procedures are simplified because of no necessity to increase the penalty term to infinity in UWB-IR case. Its efficiency is compared to the generalized maximum-likelihood estimator (GML) by simulation in different signal to noise ratios (SNR). The reason for its efficiency improvement comes from fewer effective spectrum samples and region-based processing of correlation results. Real measurement is conducted to verify this algorithm's performance. Its estimation error of time difference of arrival (TDOA) is about 0.18ns. [C91]

"Meshless RPIM modeling of open-structures using PMLs"

Meshless methods are emerging as a new class of numerical techniques for modeling complex electromagnetic problems. To apply them to open structures, effective absorbing boundaries need to be developed. In this paper, the perfectly matched layer (PML) absorbing boundary condition is implemented into the meshless radial point interpolation method (RPIM) for accurate meshfree modeling of electromagnetic radiation problems in time-domain. Two benchmark radiating structures, a parallel waveguide and a conical unipole antenna, are presented to validate the effectiveness of the implementation. Comparisons are made between the numerically computed results and the measured results from previous reports and good agreements are found. In contrast to conventional FDTD technique, the RPIM modeling with the PML condition requires much less computational efforts for antenna radiation problems, thanks to its capability of conformal modeling and multi-scale solutions. [C92]

"Classification of radar signals using time-frequency transforms and fuzzy clustering"

A method based on Smoothness Pseudo Wigner-Ville distribution and kernel principle component analysis is proposed to extract features of radar emitter signals. Then, these discriminative and low dimensional features achieved were fed to the classifier which is designed based on fuzzy Support Vector Machines (SVMs). In simulation experiments, the classification of two-class LFM signals was compared with four kernel functions. And the classifier attains over 83% overall average correct classification rate for five radar signals. Experimental results show that the proposed methodology is efficient for complex radar signals detection and classification. [C93]

"Analysis of image fusion and classification for high resolution SAR data on-line"

SAR and optical remote sensing image, with highly complementary characteristics, can enhance the integration of information utilization of remote sensing data. Adopting the new Cosmo-Skymed SAR high-resolution image data, we inhibit speckle impact using enhanced Lee filtering. Then we fused this image with a CBERS image using local use standard deviation based on wavelet packet method. Because of fully integrating the characteristics of each image, it can retain the spectral characteristics and details of properties to the maximum extent, improve signal-to-noise ratio, and be conducive to information extraction. The experiments show that the automatic classification accuracy significantly increased and classification Kappa coefficient increased from 0.47 to 0.93 after fusion of Cosmo-Skymed and CBERS02 data. Meanwhile, This paper employ a geospatial information processing concept model complied interoperable system framework and an implementation approach for accessing geospatial information openly by chaining individual service module to assemble complex geospatial processing and executing the processing model to deliver information. [C94]

"Analysis of wide-band aperture-coupled microstrip antenna array by CN-FDTD"

The Finite Difference Time Domain (FDTD) method is widely used for radiation and scattering problems in electromagnetics due to its ability to model heterogeneous and complex geometries. And a single wideband simulation results can be provided. In this paper a three-dimensional implementation of the lumped-element by Crank-Nicolson finite-difference time-domain (CN-FDTD) algorithm has been presented to simulate a wide-band aperture-coupled microstrip antenna array with an "hour glass" shape aperture. The difference equations allow arbitrary lumped elements to be inserted into one FDTD cell, preserving the full explicit nature of the CN-FDTD scheme. As a validation of the results by the proposed method, the results by commercial software are also reported. Compared with the results of the two methods, the reasonably good agreement is found. Consequently, the accuracy of CN-FDTD application for antenna design with lumped elements in this paper is verified. [C95]

"System of locating and recognizing characters in complex background"

In this paper we propose a locating and recognizing character method in complex background, a system based on this method is built. First, through color reduction to reduce the color to some main colors, then decompose the image into a series of binary images according to the representative colors. After the image decomposition, connected component analysis and combination of character area are used to locate the character area. Finally, the characters are recognized on the basis of feature extraction. The experimental results show that the method can quickly locate character area and has a high positioning accuracy; therefore, the final recognition rate is high. [C96]

"Fast two-dimensional imaging of scattering centers using the nonuniform FFT"

Radar imaging of target scattering centers can be of great diagnostic utility. Conventionally, the radar image has been produced by a technique widely used in computer-aided tomography (CAT), e.g. the filtered backprojetion (FBP) algorithm. FBP reconstruction produces high quality images by handling the measured data directly in polar format. However, the FBP algorithm is more computationally complex than the direct Fourier methods. This paper develops fast two-dimensional (2-D) imaging of scattering centers using a nonuniform fast Fourier transform (NUFFT) algorithm. The proposed method is first compared to the conventional FBP approach on simulated data and then applied to real data sets measured on the RCS test range. Results suggest that the NUFFT method can produce more precise images and requires much less computational time than the FBP algorithm. [C97]

"System integration issues in Apollo 11"

"Houston, Tranquility Base here. The Eagle has landed." Two obscure errors almost prevented these words from being spoken. The errors were not made by the crew of Apollo 11 or by the controllers in Houston, nor were they made during the mission. Rather, they were made by engineers and managers, years before the flight. How they happened, and how they went substantially undetected and effectively ignored, is a pair of lessons in system integration that avionics engineers must never forget. The Apollo Program is justly famed as a giant leap for the techniques of management of complex system design and implementation. Nonetheless, these tools were used by human beings and so, necessarily, imperfectly. One of the most challenging tasks in any complex system is controlling and testing the interfaces between major components that are developed by different organizations. Among the management tools deployed by NASA were ICDs (Interface Control Documents). The author has not been able to determine whether this phrase was first coined for the Apollo program or the Mercury and Gemini programs that preceded it, but it was certainly a major tool in Apollo. One of the errors

under discussion here was caused by a blatant failure to update an ICD in response to an engineering change, which can be classed as a management error of omission. The other is much subtler, involving a question of how previously unsuspected vulnerabilities (to crew procedures, in this case) should be communicated when they fall outside the scope of an ICD, yet turn out to have relevance to the way the interface is used. This becomes a problem because an ICD is a top-level document limited to specifying the design parameters of one subsystem insofar as they are of concern to one other subsystem. It's not surprising that the symptoms caused by the latter problem have been totally misunderstood by almost everyone from President Nixon on down, and only partially understood even by Buzz Aldrin,--who along with Neil Armstrong had to deal with them at the time. This misunderstanding is so widespread that almost everyone with any acquaintance with the Program Alarms during the Apollo 11 landing believes that the LM's Primary Guidance Navigation System (PGNS) "failed" in some way and had to be rescued by human intervention. That is the exact opposite of the truth, which is that performance margins built into this very robust system quarantined the effects of the errors so that the landing could proceed with the designed level of human involvement, specifically dodging the "field of boulders" that the PGNS could know nothing about. This paper is largely a retelling of the higherlevel parts of a paper, Tales from the Lunar Module Guidance Computer by the author's colleague Don Eyles [1], but with the orientation changed from a historical narrative to a cautionary tale with recommendations for modern avionics development management. Results of more recent research by the author and two colleagues are also incorporated. [C98]

"The FAA handbook on microprocessor selection and evaluation in airborne systems"

Under the management of the Aerospace Vehicles Systems Institute (AVSI), the FAA initiated a project to study the safety concerns surrounding the use of complex commercial off-the-shelf (COTS) microprocessors and systems-on-chips (SoC) in safety-critical airborne systems. Additionally, several aerospace companies cooperated with the FAA in providing oversight, direction and technical contributions throughout the course of this project. The major product of this work is the "Handbook for the Selection and Evaluation for Microprocessors for Airborne Systems" to be published by the FAA as a set of recommendations for both regulatory personnel and systems manufacturers. This paper describes the technological trends occurring in modern COTS microprocessors and SoC that have prompted the FAA to better understand the implications of their use in airborne systems. This paper also briefly describes the purpose and structure of the Handbook and provides supplemental information regarding the evaluation platforms and analyses that were the basis for its recommendations. [C99]

"An adaptive beamforming method based on properties of cyclostationary signals"

Blind beamforming, which consists of recovering signals only from observed instantaneous linear mixtures without a priori information about array manifold, is an important problem in many practical applications including radar, sonar, wireless communication and so on. For blind separation of cyclostationary signals encountered usually in communication, recently, reference [1] proposed a novel approach (ATH3) under the assumption that the cyclic correlation functions of signals are all real number. In this paper, we relaxed this assumption to signals with complex cyclic correlation functions, which is usually this case in practice, and proposed a method to accomplish blind adaptive beamforming. Several numerical simulations also are provided to illustrate the effectiveness of the proposed method. [C100]

"Bistatic Radar Cross Section of an complex target on sea surface"

This paper deals with modeling interaction between Electro-Magnetic (EM) wave and the complex target. The first objective is to estimate monostatic and bistatic Radar Cross Section (RSC) of a complex target. The second objective is to present a new approach to compute the RCS of complex target (typically a boat). The target is modeled in 3D using computer aided design (CAD) to generate triangular facet meshing, as does CATIA software. From the triangular mesh, we propose to implement a parallelepiped mesh technique. This new mesh approach allow to introduce more precesely target in its environment and can be used in remote sensing domain. [C101]

"Instantaneous Frequency estimation of multicomponent signal based on complex argument distribution"

Instantaneous Frequency estimation of multicomponent signal with nonlinear frequency modulation is a challenging problem in time frequency analysis community. A new time frequency distribution named complex argument distribution is introduced to resolve this problem due to its capabilities of high concentration and low cross-term artifacts. A instantaneous frequency estimation algorithm based on this new distribution and Viterbi estimator is proposed in the paper. Experiments result show the performance of estimation algorithm with simulated data and radar data. [C102]

"Toward System Oriented Runway Management"

Decisions about what airport configuration should be used and when the configuration should be changed are currently made manually by personnel in the Air Traffic Control (ATC) Tower (ATCT) or Terminal Radar Approach Control (TRACON). Over time, each airport has adapted unique local procedures related to airport configuration management, creating a challenge for both studying airport configuration management and developing decision support technologies. At many airports, the airport configuration decision is based primarily on the weather forecast and historical experience. While configuration changes to respond to weather changes are relatively straightforward, when traffic demand motivates a configuration change, the change is often made in reaction to observing aircraft queues and delays, or not made at all, rather than proactively based on forecast traffic situations. Consequently, significant opportunity exists for automation to support airport configuration decisions that will improve airport capacity and efficiency. Moreover, NextGen technologies and procedures will cause the definition of airport configuration to expand to include how metroplex resources other than the runways are utilized. As the metroplex configuration decision space becomes more complex, the need for supporting automation will become even greater. System Oriented Runway Management (SORM) is a concept in which the configuration and use of metroplex resources are explicitly planned with a holistic perspective of the operations within the metroplex as well as the needs of the metroplex within the context of the overall National Airspace System (NAS). System Oriented Runway Management is also a significant new research initiative by the NASA Airspace Systems Program that addresses the need for automation to achieve the SORM concept. This paper introduces the SORM concept and initial research to develop automation to support airport configuration planning. [C103]

"Ship detection based on compound distribution with Synthetic Aperture Radar images"

Considering the variability of Synthetic Aperture Radar (SAR) imaging (different sensor, resolution) and complex condition of sea surface, the traditional single statistical model may be no longer a good choice to fit the distribution of actual sea clutter in SAR image. Based on the characteristic of Gamma distribution which is suitable to model uniform area, and G0 distribution which is adaptive to the general homogeneous and heterogeneous area, this paper established a compound distribution of G0 and Gamma model to fit the characteristics of various types of sea conditions, and use the moment estimation to improve the computational efficiency as well. Meanwhile, the algorithm combines the Constant False Alarm Rate (CFAR) detection based on dichotomy method in order to figure out the difficulties in solving the analytical expression of compound distribution. TerraSAR-X and ERS-2 images were adopted for investigating the algorithm. Experiment results illustrate that the method can achieve good performance. [C104]

"Unsupervised classification of PolInSAR image based on Shannon Entropy Characterization"

In this paper, we propose a new method for unsupervised classification of polarimetric synthetic aperture radar interferometry (PolInSAR) images based on Shannon Entropy Characterization. Firstly, we use polarimetric H (entropy) and a parameters to classify the image initially. Then, we reclassify the image according to the span of Shannon Entropy Characterization. Finally, we fuse the results of the two previous steps and merge them to the specified number of clusters. The effectiveness of this method is demonstrated on CETC38 PolInSAR data and E-SAR PolInSAR data. [C105]

"Detection of moving target based on fractional Fourier transform in SAR clutter"

Based on the analysis of the characteristics of SAR target echo and the time excursion of fractional Fourier transform (FRFT), the Article has put forward a time-delay balance method based on FRFT to detect the slowly moving target in SAR echo according to the characteristics of SAR ground clutter. Calculation on the FRFT of echo signal and the FRFT of echo signal after short delay time results in two complex signals, in which, the modules of static backgrounds are just totally same, and in the range of moving target, the amplitude of module will cause an offset, therefore, when calculate the difference of the modules of two complex signals, the static background could be balanced and the moving target could be detected effectively. Simulation analysis indicates that the method in the Article shows its advantages in a background with strong clutter. [C106]

"A new approach to distributed passive radar imaging by 2-D NUFFT"

This paper studies distributed passive radar imaging of two-dimensional (2-D) scene. The echoes and the reflectivity of target are confirmed to be a Fourier transform pair. However, due to the space configuration based on the illuminators of opportunity, the echoes are sampled non-uniformly, which lead to the non-equispaced property of space-spectrum distribution. In this case, direct 2-D FFT reconstruction doesn't apply now. To retain the fast computing of image reconstruction like FFT, non-uniform fast Fourier transform (NUFFT) is introduced to

avoid complex interpolation. We generalize NUFFT to 2-D NUFFT to tackle the problem that the space-spectrum is unequally-spaced in both directions of μ and v. This new 2-D NUFFT method is compared with polar-coordinate method in efficiency and accuracy using both the analytical and numerical approaches. Simulations demonstrate that 2-D NUFFT can reduce the computational complexity while ensuring image reconstruction accuracy. So it's a promising strategy for realtime imaging of distributed passive radar. [C107]

"A new polarization filter based on weighted combination"

Conventional polarization filters can mitigate an interference by using the orthogonal vector of the interference polarization, but leading to distortion of the target signal in its amplitude and phase. A null phase-shifting polarization filter can reconstruct the original target signal. However, it needs some complex operations, such as a linear polarization-vector translation and compensations in amplitude and phase. In this paper, a weighted combination polarization filter is proposed, which retains the original target signal while suppressing the interference within one step. The simulation results show that the new filter is an effective means to remove the interference in the polarization domain. [C108]

"A non-local approach for SAR and interferometric SAR denoising"

Recently, non-local approaches have proved very powerful for image denoising. Unlike local filters, the non-local (NL) means introduced in decrease the noise while preserving well the resolution. In the proposed paper, we suggest the use of a non-local approach to estimate single-look SAR reflectivity images or to construct SAR interferograms. SAR interferogram construction refers to the joint estimation of the reflectivity, phase difference and coherence image from a pair of two co-registered single-look complex SAR images. The weighted-maximum likelihood is introduced as a generalization of the weighted average performed in the NL means. We propose to set the weights according to the probability of similarity which provides an extension of the Euclidean distance used in the NL means. Experiments and results are presented to show the efficiency of the proposed approach. [C109]

"Aspects of multivariate statistical theorywith the application to change detection"

This paper proposes a new method for change detection measurement including whole SAR imaging modes such as PolIn- SAR, partial PolInSAR and InSAR in a set of multi-temporal multidimensional SAR images. The method is based on the special case of Kullback-Leibler (KL-divergence) test, known as Mutual Information. In order to develop an algorithm, firstly the joint distribution of PolInSAR data set, based on the second order statistics has been derived. Such a derivation accounts for the whole multi-temporal SAR images. Then the mutual information is used to measure the difference between the joint density of multi-temporal PolSAR data sets and their marginal density known as complex Wishart distribution. A comparison between the proposed and the other well-known change detection (e.g. cross correlation) technique is shown by means of real data, describing the advantages due to the fact that the proposed change detector involves almost every facet of the applied change detection. [C110]

"An integrated approach to determine parameters of a 3D volcano model by using InSAR data with metamodel technique"

In this paper, an integrated approach is presented to determine the suitable parameters of a magma-filled dyke, which causes observable deformation at the ground surface. By this approach, the finite element method (FEM) and metamodel techniques are combined. FEM is used to establish the numerical model of the dyke and to produce the data required to identify metamodel parameters. Parameter identification problems are also known as parameter estimation or inverse problems. The metamodel technique is employed to make the whole procedure efficient in the identification phase. The identification approach is carried out by a systematic routine based on particle swarm optimization (PSO) algorithm. The approach is tested with synthetic data generated by analytic models. Moreover, it has been also applied to Stromboli Volcano (Italy) as an example, and the ground deformation data is acquired by using interferometry SAR technique. With the approach, the parameters can be successfully estimated with acceptable degree of accuracy. The results also indicate that only one kind of geophysical data are not sufficient for solving such a complex problem. [C111]

"Visual tracking of multiple interacting objects through Rao-Blackwellized Data Association Particle Filtering"

A multiple object visual tracking framework is presented, which is able to manage complex object interactions, missing detections and clutter. The main contribution is the ability to deal with complex situations in which the interacting objects can change their dynamics while they are occluded. This is achieved by explicitly estimating

putative locations of the occluded objects. The tracking is modeled by a Rao-Blackwellized Data Association Particle Filter (RBDAPF), which has a tractable substructure that allows to analytically compute the object positions, while the object-measurement associations are approximated by Particle Filtering. Besides improving the accuracy, this filter decomposition reduces the computational cost, since the complexity with the number of objects becomes linear instead of exponential. The Particle Filter efficiently manages the measurements from visible and occluded objects, the clutter, and missing measurements to estimate the correct data associations that lead to a robust tracking. Experimental results on surveillance videos show that the proposed RBDAPF framework is able to track multiple interacting objects in complex situations. [C112]

"Doppler processing of coherent radar backscatter for ocean surface wave measurements"

The technique for extracting wave period and wave direction from a navigation radar backscattering intensity is well developed but the determination of spectral density or wave height is hindered by the complex nature of the modulation transfer function. In contrast to backscattering intensity, Doppler velocity from coherent radar is the radial velocity of the scattering objects. Its oscillatory component is contributed by ocean waves. The spectral peak component of Doppler velocity is close to the peak wave period measured by a nearby buoy and the significant wave height can be accurately calculated. With radar range coverage on the order of ten dominant wavelengths, reliable assessment of peak wave period and significant wave height is achievable with radar data as short as one second. Wave direction can also be determined with a scanning system. [C113]

"Tropical land cover change detection with polarimetric SAR data"

There is an increasing need for fast and accurate data on tropical land cover status, and a baseline for land cover monitoring. Remotely sensed SAR data are not sensitive to cloud cover and can be useful for such purpose. Polarimetric SAR data are available in orbital systems, such as RADARSAT-2, and still have to be tested for the classification of tropical land cover and the detection of land cover change, particularly forest conversion. This work presents a study of RADARSAT-2 polarimetric images, acquired in two different dates (September 2008 and October 2009), to assess their potential in classifying forest and non-forest classes in Brazilian Amazonia. SAR images were acquired following different orbit and incidence angles, which anticipated varied conditions for images interpretation and classes discrimination. The complex SAR data were classified based on the distance of Wishart, and information from field campaigns was used for the training and test samples. Classification results were compared to evaluate possibilities for change detection in the forest cover. Classification accuracy figures were around 80%. The use of RADARSAT-2 images allowed the mapping of land cover and land cover change, considering forest and non-forest classes. [C114]

"On the use of Support Vector Machines for land cover analysis with L-band SAR data"

This study investigates a new technique for land cover analysis by means of the Support Vector Machines. Intrinsic spatial variability within SAR images, beyond that caused by speckle, is of high interest for land cover characterization and classification. However, its use is still an ongoing issue due to its complex multi-scale nature. On the other hand, classification algorithms based on statistical learning methods such as the supervised Support Vector Machines (SVM) approach are implemented in a wide range of data mining applications. SVM can also be used as a technique for feature selection. In this paper, a new tool using the Recursive Feature Elimination SVM-based process (SVM-RFE) and the textural Haralick's parameters is introduced. The real contribution of textures within the land cover classification can be understood. A small set of textural parameters is determined at local scale while being optimal for the land cover discrimination. In this study, orthorectified 50m resolution data acquired by the L-band PALSAR/ALOS sensor are used. [C115]

"The Semi-Analytic Mode Matching algorithm for GPR wave scattering from multiple complex objects buried in a dielectric half space"

The Semi-Analytic Mode Matching (SAMM) algorithm is a quick and efficient computational method that can model wave scattering from multiple objects in half spaces. This algorithm relies heavily on the appropriate choice of coordinate scattering centers (CSCs) for its modal expansions. Here, the radius of curvature method of finding CSCs is extended to "tune" the CSC loci. Because the CSC locations are essentially frequency independent and independent of the dielectric contrast between scatterer and background, it is worthwhile to analyze carefully particular scattering object shapes and store the optimal CSC locations for future use. Scattering from multiple targets buried within half spaces can be constructed from simpler simulations of the individual targets taken independently in uniform media-combining these initial simulations correctly can greatly reduce overall computational time and increase robustness in full simulations. Excellent results are found comparing SAMM and Finite Difference Frequency Domain (FDFD) for multiple 2D scattering objects 0.1-15 wavelengths in size located beneath half spaces. [C116]

"Fusion of LiDAR data and orthoimage for automatic building reconstruction"

Recent years LiDAR data is widely used for constructing 3D terrain models which provide realistic impressions of the urban environment. This paper presents an automatic method for extracting 3D building model by the fusion of LiDAR data, 2D building outlines and orthoimage. 2D building outlines is generated by classifying the LiDAR data to terrain and off-terrain points, then detecting building edges points through step-structure detector and generalization. 2D building boundaries are added on the DSM (Digital Surface Model) from LiDAR data to generate complex buildings by using CSG with the Boolean operations of union, intersection and differences. [C117]

"Retrieval of Aerosol optical thickness and size distribution from PARASOL in Pearl River Delta area"

AOTs(Aerosol optical thicknesses) and aerosol size distribution functions in Pearl River Delta area are derived from PARASOL (Polarization and Anisotropy of Reflectances for Atmospheric Science coupled with Observations from a LIDAR)multi-directional, multi-spectral polarized signals. Based on analyzing the products of AERONET(Aerosol Robotic Network), aerosol size distribution function and complex refractive index over Pearl River Delta area are received. After that, the particular aerosol model is abstracted. The land surface polarized contribution is calculated using semi empirical model as a function of surface type and NDVI, and the pure atmospheric contribution is computed with a radiative transfer code. Compared with the products of the ground-based AERONET, the derived AOTs are underestimated against AERONET measurement. The retrieved size distribution for the radii bigger than 0.2 micron is also underestimated due to that polarization is insensitive to coarse model aerosol. [C118]

"SAR complex image analysis: A Gauss Markov and a multiple sub-aperture based target characterization"

In this paper we discuss Gauss-Markov Random Field (GMRF) based on multiple sub-aperture decomposition method for the analysis of targets in complex-valued high-resolution SAR data. Gauss-Markov Random Field (GMRF) model with a quadratic energy function as a parametric analysis parameterizes the spectogram of the signal, whereas sub-aperture decomposition method exploits the holographic property of the spectrum at the cost of reducing resolution. This analysis helps to understand, characterize and analyze complex-valued SAR data and provides temptation to use complex-valued SAR data over detected data. [C119]

"Compressive sensing for high resolution differential SAR tomography-the SL1MMER algorithm"

Differential SAR tomography extends the synthetic aperture principle into the elevation and time directions for 4-D imaging. With modern meter-resolution space-borne SAR systems like TerraSAR-X (TS-X), systematic tomographic imaging of urban infrastructure and its deformations becomes feasible. We demonstrate the potential of TS-X data for this purpose and introduce several novel concepts. Since building deformation in general is nonlinear, e.g. due to thermal dilation, we start from a tomographic system formulation that is general enough to allow for the inclusion of motion models (linear, periodic, etc.). By appropriate warping of the time axis we map the motion model function to become linear and lead to a peak in the spectral domain. For the differential tomographic inversion itself we propose a 2-D compressive sensing (CS) based approach-"SL1MMER". We demonstrate the super-resolution power and the robustness of SL1MMER both with simulated and with real data. We also show that it provides an attractive compromise between parametric and non-parametric methods. A full reconstruction of a building complex and its seasonal deformation from a stack of TS-X spotlight data is finally presented. [C120]

"A new method of denoising processing for synthetic aperture radar return signal"

In this paper, a denoising processing method for synthetic aperture radar raw return signal is proposed based on the DFT-DWT transform. Compared with presented transforms of DFT and DWT, the DFT-DWT transform is more efficient to extract the SAR raw return signal which is a complex 2-D signal with different properties between the two directions. After removing the out-ofband and high-frequency part of the SAR return signal's DFT-DWT transform, the noise can be eliminated efficiently. Experimental results verify that the SAR denoising processing method has a practical value for suppressing the suppression jamming and detecting the weak targets. [C121]

"Dynamical Weather Radar Beam Blockage Correction"

Error of quantitative rainfall estimations due to partial or total weather radar beam blockage is important in

complex orographic areas. A simple method named dynamical weather radar beam blockage correction different from the operational "look-up" table method is presented. The dynamical correction method is implemented with the multiplicative factor between two antenna elevation angles. Case study of quantitative rainfall estimation shows that the dynamical beam blockage correction is effective if the beam blockage azimuths are less than 10 degrees. [C122]

"A novel airport surface surveillance based on multi-video fusion"

Airport surface surveillance is an important issue guaranteeing the safety. Traditionally, this depends on the SMR (Surface Movement Radar) or ASDE (Aerodrome Surface Detection Equipment). However, these equipments are very complex and expensive, which is not suitable for the simple airports. On the other hand, video is a type of common and cheaper equipment and can be mounted largely in the airports. If the video also provides the ability of motion detection while guaranteeing the precision, it can be yet regarded as a substitute for non-cooperative radar like SMR and ASDE. This paper proposed such a solution based on optical flow field detection, dynamic fuzzy clustering and multi-sensor fusion. Experiments show that the solution is not only feasible but also with high detection precision. [C123]

"Frequency based oscilloscope triggering scheme"

This paper presents a novel frequency based oscilloscope triggering technique for measurements involving complex waveforms that are challenging even today. Proposed technique is capable of providing stable triggering even in the case of complex periodic waveforms category where commonly used level triggering scheme fail to perform adequately and may be used in problem of estimating many typical signal processing situations, such as Doppler estimation of radar and sonar returns, vibration measurements, geophysical data processing, and surveillance observations of the electromagnetic spectrum. For stable display of a signal in an oscilloscope, it must be triggered at its base frequency. In this technique, frequency of all harmonics present in test signal is retrieved using FFT and the base repetition rate of the signal is found by selecting the frequency of lowest harmonics present in the test signal. Numerous complex test waveforms are generated and their harmonic contents are analyzed in the virtual environment of LabVIEW™ software. To verify the efficacy of the proposed technique, it is implemented using LabVIEW™ software and PCI DAQ card. It is found that the proposed technique is equally effective in detecting the base repetition rate of complex as well as simple waveforms. Technique proposed in this paper would be of interest to instrumentation design engineers. [C124]

"Parallelized Physical Optics computations for Scattering Center Models in radio channel simulations"

Scattering Center Models (SCMs) are an approach to efficiently characterize electromagnetic scattering of complex shaped objects in terms of a distribution of equivalent sources. SCMs have been widely used in the area of radar target modeling, particularly for object characterization and classification. Recently, the SCM approach has been adapted to model the electromagnetic properties of vehicles embedded in a comprehensive environment for the simulation of automotive radar channels. In this paper the application of SCMs for deterministic simulations of communication channels in automotive environments is presented. The main advantage of this concept is a drastic reduction of complexity for the ray tracing simulations. Instead of using a full geometrical description of the scene, the most complex objects are replaced by an equivalent SCM and a strongly simplified surface model. The SCM of an object is determined in advance, independent from the surrounding environment. In order to achieve a precise parameterization of individual Scattering Centers (SC), the Physical Optics (PO) approximation can be applied. Unfortunately, in contrast to a parameterization based on the Geometrical Optics (GO) contribution only, this approach requires field computations for a large number of observation directions. To handle this computational challenge, a parallelization concept is presented, which is based on multi-core architectures and on the utilization of Graphics Processing Units. [C125]

"Evolutionary Computational Tools Aided Extended Kalman Filter for Ballistic Target Tracking"

Tracking a ballistic target in its reentry mode by considering the radar measurements is a highly complex problem in nonlinear filtering. Kalman Filter (KF) is used to estimate the position of target when the measurements are corrupted with noise. If the measurements are nonlinear (radar measurements) then Extended kalman filter (EKF) is used. For obtaining reliable estimate of the target state, filter has to be tuned before the operation which is offline. Tuning an EKF is the process of estimating the process noise covariance matrix (Q) and measurement noise covariance matrix (R). This paper presents a new method of tuning the EKF using different evolutionary algorithms. [C126]

"Ionospheric phase contamination correction method using Generalized S-Transform"

This paper analyzes the instantaneous frequency (IF) estimation properties of S-Transform (ST) and proposes the reason of the poor estimation performance for ST at low frequencies. A Generalized S-Transform (GST) which has better performance than the ST at low frequencies is therefore introduced in the IF estimation. It is the first time applied in the phase contamination correction of Over-the-horizon-radar (OTHR) in this paper. The effectiveness of the GST has been studied by using the data of high frequency surface wave radar (HFSWR) with artificially added phase perturbations. Through the comparisons on the calculation complex and the effectiveness of contamination correction with the Pseudo Wigner-Ville Distribution (PWVD) method and the Modified Adaptive Short Time Fourier Transform (MASTFT) method in the referred literatures, the GST method used in this paper has much better performance. [C127]

"Millimeter wave FMCW radar system simulations including a 3D ray tracing channel simulator"

In this paper a millimeter-wave radar system simulation environment for frequency-modulated continuous-wave (FMCW) radar using a 3D ray tracing channel simulator is presented. Therefore we use Agilents' RF design environment ADS®for system simulation and calculate the channel impulse response based on the data received from a 3D ray tracer in a Matlab®co-simulation. To reduce computing time the whole signal flow is processed in a complex baseband representation and scattering center models are used as substitute for complex polygon targets as further improvement. Nevertheless all effects occurring at harmonic bands and at DC due to nonlinearities in the transmitter and receiver circuits are well reflected in the simulation. A typical road scenario is simulated and the results show the capabilities of the simulation technique in terms of speed and accuracy. [C128]

"Net based waterside security applications: From small solutions to maritime security networks"

The protection of military harbours is a complex task. A force protection system integrates several sensors and databases for ashore and waterside surveillance: • passive sensors (acoustic, magnetic, CCTV, IR, FO fence) • active sensors (Radar, Diver Detection Sonar) • remote / autonomous vehicles for inspection and surveillance • chart database • information database Additionally a network-based waterside security application should integrate several additional sources and services e.g.: • WEB based Automatic Identification System (AIS) • Satellite based AIS • Access to online databases e.g. weather information, ship register data • C4I data e.g. MCCIS (NATO C4I system) or JoCIS (EADS export C4I system) Also, new technical possibilities of modern multi touch HMI approaches and aspects of user centric man machine interface design will be discussed. [C129]

"Short term DC breakdown and complex permittivity of Al2 O3-and MgO-epoxy nanocomposites"

Electrical insulation based on epoxy resin is commonly used in high voltage applications. Examples are transformers, terminations, plugs or connectors. But, it is also used in high voltage applications where energy transportation or distribution is not the main purpose, e.g. in medical and industrial X-ray systems, or radar. This paper addresses the changes in the structure due to the introduction of surface functionalized nanoscale particles, namely magnesium oxide and aluminum oxide. Short term DC breakdown tests were performed alongside dielectric spectroscopy. The BD strength was measured for negative DC ramp voltages. Dielectric properties have been acquired by broadband dielectric spectroscopy. The base polymer is a commercially available bisphenol A epoxy with anhydrite hardener. As filler material magnesium oxide powder was used with an average particle size of 22 nm and alumina filler with 50 nm average diameter. Both particle types were modified with a silane coupling agent, in order to achieve a uniform dispersion of particles in the host material. Neat epoxy samples were used as a reference. Both composites showed remarkable DC breakdown strength for low fillgrades. A possible explanation for this unique behavior is given and the differences between samples filled with aluminum oxide and magnesium oxide are discussed. [C130]

"Design of mismatched filters for oversampled signals"

Most of the prior work in the field of sidelobe suppression filtering for radar pulse compression focused on the design of mismatched filters for binary codes. However, in practice these binary codes are spectrally shaped to obtain analytic signals. The spectrally shaped binary code can be sampled at as low as the Nyquist rate, but in practice it is oversampled to avoid aliasing. The spectral shaping determines the necessary bandwidth and hence the sampling rate for the waveform. One of the spectrally efficient modulation techniques is based on quadriphase coding. As this spectrally shaped waveform is analytic, design of the mismatched filters in complex domain is needed. In this paper, application of minimax constrained complex LMS algorithm is proposed for the design of mismatched filters for oversampled signals. [C131]

"Continuous ant algorithm based on cooperation in radar network optimization"

From the perspective of deployment features and defense area partition, we establish the static radar network

and optimal deployment model, and based on this model, we put forward the issue of high-dimensionally continuous spatial deployment. From the standpoint of ant colony optimization, and aimed at improving Continuous Multi Ant-Colony Optimization (CMACO) in which pheromone is normally distributed, we raise a Algorithm based on cooperation which faces high-dimensionally intelligent optimization. In this method, introduces queue interaction in search of ant colony, connects the mechanism of head ant guide and mass recruitment, and finally realizes cooperated search under high-dimension form. The practice of optimal design shows that this algorithm can be applied into high-dimensional, complex, and much restrained optimal problem, moreover, the optimal time takes less than that of traditional intelligent method, satisfying the warning demand of reentry stage. [C132]

"Influence of the CNT length on complex permittivity of composite laminates and on radar absorber design in X-band"

Due to the high aspect ratio, CNT dispersed in polymer matrix composites makes large electric dipoles bringing about high dielectric constant, as well as dense percolation networks for electric conductivity. The length scale of the CNT has the definite influence on the internal structures of percolation networks, affecting the characteristics complex permittivity of the composites. In a Dajllenbach type radar absorber made of a dielectric composite, the optimal thickness of lossy layer is dependent on the characteristics of complex permittivity. In this work, radar absorbers composed of E-glass composite laminates with CNTs of different length scales were developed in X-band. The design result demonstrates the influence of the CNT length on complex permittivity of composite laminates and on microwave absorber characteristics. [C133]

"Modeling of 3D pencil beam radar (PBR) volume coverage and 3D DMC"

The actual three dimensional radar purposes are to detect the target in three dimensions range, height and azimuth angle. The objective target for this paper is to simulate and study the three dimensional 3 D radar pencil volume coverage and the evaluation of the 3 D detection map contours (DMC) in complex environment. Also, the 3D DMC and 3D volume coverage are examined for different polarizations, such as horizontal, vertical, and circular. The results show that greater DMC and volume coverage are obtained in case of using horizontal polarization than the vertical and circular polarizations, also the vertical polarization produces greater ranges and greater DMC than the circular polarization assuming that the same radar parameters and same environment for the two cases, the free space and interference conditions. Also the accuracy measurements for the elevation and azimuth angles are better when using the Pencil beam coverage. The applications of the 3D (PBR) are widely used and interested for ATC radars and the EWR for homeland defense and protection because they are offering the prediction of radar performance and radar sitting. The detection and tracking facilities are obtained simultaneously which improve the target processing time and minimizing the cost. [C134]

"Particle Swarm Optimization aided unscented kalman filter for ballistic target tracking"

Tracking of a ballistic target in its reentry phase by considering the radar measurements is a highly complex problem in nonlinear filtering. Kalman Filter (KF) is used to estimate the positions of the target when the measurements are corrupted with noise. If the measurements (range and bearing) are nonlinear then Unscented Kalman filter (UKF) can be used. For obtaining reliable estimate of the target state, filter has to be tuned before the operation, which is offline. Tuning is the process of estimating the process noise covariance matrix (Q) and measurement noise covariance matrix (R) of the filter. This paper presents tuning of UKF using Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) for ballistic target tracking. Simulations results show that the superiority of PSO tuned UKF over conventional UKF. [C135]

"3D simultaneous multi-beams radar processing by using planner array antennas"

In this study a planner array with beam forming and beam shaping techniques are designed in order to develop and simulate 3D simultaneous-multi-beams (3DSMB) radar. Two targets are obtained, firstly developing 3D radar with 4 simultaneous-pencil beams, secondly, developing 3D with 4 simultaneous-different beams, such as Pencil, Fan, Transmit, and Intermediate beams. The new development in this paper provides in conjunction with enhanced processing techniques superior innovative war-fighting solutions to the dramatic change in the nature of threats (i.e. Missile, Anti Radar Missile, Jammers, and heavy clutter). A new software package is developed for the 3DSMB Radar in order to obtain the lobbing pattern coverage for a complex topography, because the previous studies didn't obtain the lobbing pattern for the 3D radar. Also, the cost will be much cheaper for the new mentioned development because instead of using different radars for different tasks and different targets platforms, the new development will be one radar processing different tasks and different targets platform at the same time, in addition to minimizing size and increasing processing speed and saving processing time. [C136]

"Microwave backscatter of ship signatures on SAR imagery"

Speckle characteristics was analyzed by computing the ENL (Equivalent Number of Looks) for sub images of 30 by 30 pixels from four RADARSAT-2 dual polarization products, two single look complex (SLC) products acquired in wide swath single beam mode with dual polarization of HH+HV and two ScanSAR Wide (SCW) products acquired in ScanSAR Wide beam mode with dual polarization of HH+HV, which lie in the sea area around Iberian Peninsula. The speckle analysis indicates that ENL value combined with the intensity value of the SAR image should be a feasible short cut to find ship signatures out of SAR image. Based on the ENL analysis of speckle characteristics, a data set for ship signature has been derived, from which the ship signature was measured by polarimetric synthesis since the polarimetric SAR signature is an effective way of utilizing the amplitude and phase information to characterize the polarization properties of microwave backscatter. Driven by the need for a realistic microwave backscatter of ship signature model, the detailed behavior of a single ship in different polarizations and different incidence angles will be investigated by the Ray-Optical method which was developed by Burkholder et al. The purpose of this paper is to pave the way for a further improved scatter matrix model. [C137]

"Application of GPRS technology in water quality monitoring system"

The method of water quality monitoring applied by XueYe reservoir is sampling in the scene and analyzing at the laboratory at present. Based on analyzing key problem of water quality monitoring, automatic water quality monitoring system based on GPRS is provided in this paper. Considering features of water quality monitoring, the general structure and network framework of the system, and the way of access to GPRS of data monitoring center are designed based on GPRS technology. Water quality parameters collected by multi-parameter water quality probe are transmitted to data processing and monitoring center through GPRS wireless communication network of mobile. The system collects, transmits and processes water quality parameters automatically, so production efficiency and economy benefit are improved greatly. Practice has proven GPRS technology can achieve well within the complex environment of poor water quality unmonitored, and more specifically applicable to the collection point, data transmission automatically generate the field of water analysis equipment data transmission and monitoring. [C138]

"Complex permittivity estimation from free space RCS measurement"

Non-destructive and non-contacting estimation of the complex permittivity of the solid materials has been proposed using the monostatic RCS measurement from the specular reflection surface. In order to isolate the surface reflection contribution from the total scattering response, time gating method is utilized. The frequency domain RCS is measured first at a certain frequency band, and the corresponding time domain result is calculated via inverse Fourier Transformation. After identifying the surface reflection contribution and selecting it with a certain time width, Fourier transformation is used to obtain the desired surface response in the frequency domain. These RCS results are then utilized to estimate the surface reflection coefficients and their permittivities. The proposed method has been tested to evaluate the permittivities of cubic granite and synthetic phantom material, and the results are compared with those obtained by a coaxial probe method. Good agreement has been found between them and the validity of our method has been confirmed. [C139]

"Separating respiration artifact in microwave doppler radar heart monitoring by Independent Component Analysis"

With a microwave radar, chest wall movements originating from cardiac and respiratory activity can be recorded non-contactly. A major challenge is how to separate the desired low-amplitude cardiac signal from large-amplitude artifacts, such as respiration. Commonly, the separation is performed with a narrow band-pass filter. This causes the signal edges to be rounded, which complicates the accurate timing estimation in the heart rate variability (HRV) analysis. In addition, the harmonics of the respiration signal might fall into the same frequency spectrum as the cardiac signal. In this study, we recorded data with two radars and studied signal separation using a complex-valued Independent Component Analysis (ICA). After ICA, the respiratory signal is greatly attenuated, although still present, in two of the independent components (ICs). However, respiration harmonics are reduced as well, and thus, the residual respiratory signal can be removed by filtering. [C140]

"Indoor location estimation system based on evolutionary matching"

The indoor Real Time Location Systems (RTLS) is attracting more and more attention while a series of challenging problem still exists such as the real-time performance, location precision, and the large amount of disturbance signal brought by complex indoor circumstances. However, existing location estimation technology cannot satisfy the requirements of indoor RTLS. In this paper, a high-precision indoor location estimation

technology based on Ultra Wideband and evolutionary matching mechanism is proposed, based on which an indoor location service platform is built with intelligent alerting strategy based on Newton collision graphic engine. Experimental results show that the proposed method improves not only the location estimation accuracy but also the ability to eliminate the multipath signals with low computational cost. [C141]

"A Multi-Objective Antenna Placement Genetic Algorithm for matched array synthesis on complex platforms"

A Multi-Objective Antenna Placement Genetic Algorithm (MO-APGA) has been proposed for the synthesis of matched antenna arrays on complex platforms. The total number of antennas required, their position on the platform, location of loads, loading circuit parameters, decoupling and matching network topology, matching network parameters and feed network parameters are optimized simultaneously. The optimization goal was to provide a given minimum gain, specific gain discrimination between the main and back lobes and broadband performance. This algorithm is developed based on the non-dominated sorting genetic algorithm (NSGA-II) and Minimum Spanning Tree (MST) technique for producing diverse solutions when the number of objectives is increased beyond two. The proposed method is validated through the design of a wideband airborne SAR. [C142]

"Terrain classification based on structure for autonomous navigation in complex environments"

One of the main challenges for autonomous navigation in cluttered outdoor environments is to determine which obstacles can be driven over and which need to be avoided. Especially in off-road driving, the aim is not only to recognize the lethal obstacles on the vehicle's way at all costs, but also to predict the scene category thereby giving a better decision-making framework for vehicle navigation. This paper studies terrain classification based on structure relying on sparse 3-D data from LADAR mobility sensors. While most of recent methods for LADAR processing are purely found on the local point density and spatial distribution of the 3-D point cloud directly. We, on the other hand, introduce a new approach to analyze the point cloud by considering local properties and distance variation of pixels inside edgeless areas. First of all, the edgeless areas are extracted from segmenting the 3-D point cloud into homogeneous regions by Graph-Cut technique. Secondly, the neighbor distance variation inside edgeless areas (NDVIE) features are obtained by calculating the euclidean distance of neighbor distance variation inside each region. Through extensive experiments, we demonstrate that this feature has properties complementary to the conditional local point statistics features traditionally used for point cloud analysis, and show significant improvement in classification performance for tasks relevant to outdoor navigation. [C143]

"MIMO radar with spatial-frequency diversity for improved detection performance"

The Multiple Input Multiple Output (MIMO) radar concept exploits the independence between signals at the array elements unlike beamforming which presumes a high correlation between signals either transmitted or received by an array. Radar Cross Section (RCS) of a complex target varies with both transmitted frequency and target geometry. By widely separating transmit and receive antennas, MIMO radar systems observe a target simultaneously from different aspects resulting in spatial diversity, thus improving the detection performance. Also by utilizing different frequencies, independent RCS of the target can be observed, thus resulting in frequency diversity. In this paper, the spatial and the frequency diversities are studied together to bring out the combined benefits. The system proposed will not only have several antennas appropriately spaced but also several operating frequencies appropriately spaced, providing a better detection performance than conventional MIMO radar systems for the same transmission power. The simulation results exhibit a better detection performance of the proposed system as compared to MIMO radar systems with only spatial diversity. [C144]

"Quasi-Analytical method for estimating low false alarm rate"

This paper proposes a new approach for estimating low false alarm rate (FAR) using Quasi-Analytical (QA) method. The results from both theoretical analysis and simulation show that QA estimation is unbiased with obvious simulation speed improvement with respect to Monte Carlo (MC) and Conventional Importance Sampling (IS) for typical application cases. Furthermore, unlike IS approaches that rely on complex optimization procedures for optimal IS parameters or sub optimal parameters, the QA is simple to implement and computationally effective. [C145]

"UWB radar signal processing for through wall tracking of multiple moving targets"

Through wall tracking can be very helpful in the situations where the entering of a room or a building is considered hazardous and it is desired to inspect its interior from outside through the walls. In majority of such cases, the tracking of multiple moving targets is needed. The radar signal processing for this application has to

deal with several supplementary tasks in comparison with a single target tracking. Their solution is included in the complex signal processing procedure introduced in this paper. The experimental results obtained by the real radar signal processing confirm good performance properties of the proposed procedure. [C146]

"Accurate time-domain modelling of MEMS antennas for wireless telemetry systems"

A singularity-expansion-method-based technique for the accurate time-domain modelling of reconfigurable MEMS antennas for wireless telemetry applications is presented. Closed-form expressions of the radiated electromagnetic field in time domain are derived in terms of the newly introduced incomplete spherical Bessel functions depending on the complex frequencies of the natural resonant processes occurring in the antenna. [C147]

"Monostatic scattering from an object near an ocean-like surface from an efficient fast numerical method"

The rigorous computation of the monostatic scattering from an object near a one-dimensional sea surface (2D case) needs to solve a problem involving a high number of unknowns. By using a recently developed fast numerical method, called E-PILE+FBSA (Extended Propagation-Inside-Layer Expansion combined with Forward-Backward Spectral Acceleration), the monostatic scattering of such a complex scene can be investigated. Two canonical objects are considered in this paper: the cross and the cylinder. Results allow us to understand the physical mechanisms involved in the coupling between the object and the sea surface. [C148]

"OTHR-SW Coordinate Registration method based on sea-land transitions: Clutter model definition"

In previous works we proposed a Coordinate Registration (CR) method of the received echo by pulsed, monostatic Over The Horizon Sky Wave Radar (OTHRsw). This method takes advantage from the a priori geo-morphological knowledge of the surveillance area (especially the coastline profile) and from the pronounced difference between the sea and land normalized backscattering coefficients. In this paper we present a model of surface clutter, its software implementation and its role in the simulation tool under development intended to recreate the complex OTHR scenario in order to analyze the performances of the proposed CR method. A brief introduction about the radar scenario is given; the main clutter model hypotheses are outlined; the adopted space-time distributions processes are motivated; the key-parameters for the model configuration are described; some examples of simulated clutter scenarios are proposed; the achieved results are finally shown. [C149]

"A novel UWB Radar super-resolution object recognition approach for complex edged objects"

In this paper a novel approach for object recognition (OR) by backscattered Ultra Wideband (UWB) signals on the basis of a reference data set is presented. The aim of this robust OR is succeeded by UWB imaging, classifying and finally applying a maximum probability recognition algorithm. To provide super-resolution even under multi-scattering conditions, an advanced wavefront detection algorithm with subsequent high resolution imaging technique is performed. After postprocessing a joint moment based feature, texture feature and geometrical feature recognition algorithm is applied. The simulation-based performance evaluations show a very precise imaging and a perfect maximum probability recognition rate with additional outstanding robustness. First tests using an m-sequence UWB Radar indicate the feasibility of this concept. [C150]

"Study on the Time-Frequency Two Dimensional CFAR Algorithm for Moving Targets on Ground in PRC-CW Radar"

PRC-CW radar is mainly used to detect moving targets on ground. Ground clutter heaves fiercely, and its distribution is complex, which makes it difficult to detect targets correctly from time domain. The characteristics of moving targets and ground clutter differ in frequency domain. And the spectrum of targets may change with time, so, this paper designs the time-frequency two dimensional constant false alarm rate(CFAR) algorithm. Based on the analyze of pulse compression and moving targets detection(MTD) of this type radar, the two-dimensional CFAR algorithm is proved to be feasible via simulation. The results of simulation show that, the algorithm can measure the velocity and range of targets correctly. The clutter and noise are also restrained effectively. [C151]

"Experimental study on super-resolution 3-D imaging algorithm based on extended capon with reference signal optimization for UWB radars"

Near field radar employing UWB (Ultra Wideband) signals with its high range resolution is promising as various sensing applications. It enables robotic or security sensors that can identify a human body in invisible situations.

As one of the most promising radar algorithms, the RPM (Range Points Migration) is proposed. This offers an accurate 3-D (3-dimensional) surface extraction for various target shape. However, in the case of a complicated target surface whose variation scale is less than wavelength, it still suffers from image distortion caused by multiple interference signals with different waveforms. As a substantial solution, this paper proposes a novel range extraction algorithm by extending the Capon, known as frequency domain interferometry (FDI). This algorithm combines reference signal optimization with the original Capon to enhance the accuracy and resolution for an observed range into which a deformed waveform model is introduced. The results obtained from numerical simulations and an experiment prove that super-resolution UWB radar imaging is achieved by the proposed method, even for an extremely complex-surface target, including edges. [C152]

"Adaptive receivers for explorative UWB pulses"

Adjustment of receiver systems of radar stations to characteristics of reflection of complex radar-tracking targets allows considerable increasing of signal to noise ratio in the process of application of UWB pulses. Methods of signal processing based on measuring of characteristics of reflection and mathematical models of targets are offered. [C153]

"Design of a correlated Lognormal distributed sequence generator based on Virtex-IV series FPGA"

Proposed is a hardware correlated Lognormal distributed sequence generator based on the Virtex-IV XC4VFX100-10 FPGA. The random number is generated by the improved Tausworthe architecture and the non-correlated Gaussian random sequence is generated by Box-Muller algorithm. The correlated Lognormal distributed sequence is generated by zero memory non-linearity transformation with the proposed digital architecture. The complex cepstrum is used in the proposed frequency filter to generate the correlated coefficient. The logarithmic and exponential functions are calculated with CORDIC IPCore. The implementation on FPGA occupies 4210 slices, 4 block RAM and 2 DSP48s. The numeral experiment show the feasibility and accuracy of the proposed method. This proposed Lognormal distributed sequence generator can be used as a key component in a hardware radar echo and clutter simulator. [C154]

"A Study of Suppressing Strong Clutter in Radar Signal Based ICA"

It is great difficult to handle the clutter in Radar signal processing. To reduce the influence of clutter, the paper firstly attempts to use FastICA algorithm by separating the target signal and clutter to suppress the strong clutter. The pretreatment of increasing the dimension and dividing the frequency is used before Fast ICA algorithm because of the special radar complex signals. In the same matched filter conditions, Fast ICA algorithm is proved effectively through the increased peak side lobe ratio (PSLR) and signal clutter ratio (SCR). [C155]

"Calibration and characterization of a CW radar for blade tip clearance measurement"

The calibration and characterization of a blade tip clearance sensor is proposed for gas turbine applications. This sensor is based on continuous-wave microwaves that operates at 6GHz in the version for large frame turbines. The calibration of such a sensor is a difficult problem because of the complex interaction between the microwaves and the blade tip geometry. Different geometrical parameters can influence the calibration results, which drives us towards using both the actual blade geometry and probe positioning. This study presents the calibration process of this sensor using a precision test setup. Moreover, the optimization of probe positioning is discussed in order to limit the measurement errors due to axial shift of the rotor during engine operation, which is the major source of errors for tip clearance measurement. Finally, the measurement error corresponding to an optimal probe positioning is characterized. [C156]

"Model of multi-sensor data fusion and trajectory prediction based on echo state network"

Radar receives more and more attention as an important means of access to information, and multi-sensor data fusion and track prediction become a new discipline. Compared with single radar, multi-radar system has the advantage of improving reliability of the system, enhancing the system when coverage, etc. However, this technology faces new problems when utilizing information in the complex environment. In this paper, we used the nearest data association algorithm (NNDA) to extract tracks from multifarious radar data and three spline interpolation method to make different measuring data track registration to the unity of time axis. Through the same period of fuzzy track correlation, we realized the same target track of extraction, calculated the relative radar accuracy by using the least square fitting, and applied radar tracking precision to be the integration of the weighted average method through the fusion of track-to-track reference. Finally, based on the knowledge of neural network technology, we used echo state network (ESN) to predict data, as ESN network training algorithm is very good in effectively solving nonlinear dynamic system specifically of uncertainty model. Through simulation

test, we concluded that the multi-sensor data fusion and trajectory prediction model precision accuracy is 43.18 m for uniform motion model; for a sudden turn or variable targets, precision accuracy is 122.7m; for complex moving targets, precision accuracy is 165.3m. [C157]

"UAVSAR Active Electronically-Scanned Array"

The Uninhabited Airborne Vehicle Synthetic Aperture Radar (UAVSAR) is an L-band (1.2-1.3 GHz) repeat pass, interferometric synthetic aperture radar (InSAR) used for Earth science applications. Using complex radar images collected during separate passes on time scales of hours to years, changes in surface topography can be measured. Due to variations in aircraft attitude between passes, antenna beam steering is required to replicate the radar look angle from pass-to-pass. This paper describes an Active Electronically Scanned Array (AESA) that provides beam steering capability in the antenna azimuth plane. The array contains 24 transmit/receive modules generating approximately 2800 W of radiated power and is capable of pulse-to-pulse beam steering and polarization agility. Designed for high reliability as well as serviceability, all array electronics are contained in single 178cmЧ62cmЧ12cm air-cooled panel suitable for operation up 60,000 ft altitude. [C158]

"Presentation of the field surface wave generated by an antenna at the interface of two homogeneous media"

In circumstances where the dispersion of the permittivity can be neglected, the tangential component of the surface wave is expressed through the Laplace function of two complex arguments algebraically. This reduces the computation time of the surface wave at a given point to a few milliseconds, and to determine the current in the radiating antenna, as well as the dielectric constant of the underlying surface, for the time of the order of several seconds. Obtain estimates of the surface wave field for the most typical parameters of soils. These calculations can be used to select regularizators inverse GPR for quantitative calculations of the parameters of the soil and for the qualitative interpretation of GPR data. [C159]

"Robust environment perception based on occupancy grid maps for autonomous vehicle"

For a purposes of reduction of driving workload, traffic accidents, and so on, autonomous vehicle systems, which can drive even though no human driver rides on, have been developed all over the world. Recently, it is considered that a part of such techniques play an important roll to energy saving. To navigate the autonomous vehicle in a complex environment, it is necessary to extract static objects precisely and robustly. Moreover, about dynamic objects, it is not enough to consider its existing position, and it is considered that estimating its motion and predicting its future position are strongly demanded. In this paper, for a solution of such problems, we propose an environment perception method using a LIDAR based on Occupancy Grid Maps. [C160]

"Coherent change detection with complex logarithm transformation on SAR imagery"

A satellite-borne SAR (synthetic aperture radar) is quite promising technique for high-resolution geosurface measurement. Recently, the feature extraction method based on the CCD (coherent change detection) has been developed, which detects a small surface change on the geosurface by using the phase relationship between the plural complex SAR images of the same region in different observations. Aiming at fast and accurate detection of the surface change, the logarithm transformation method, has been proposed. This method can determine the appropriate threshold for the change detection, while enhancing the detection probability and suppressing the false alarm rate. However, it does not employ phase information of the estimated coherence function, and its detection probability deteriorates, especially in the case when target has small surface changes. To overcome this problem, a novel transformation index is proposed considering the phase difference of the coherence function. The results from the experiment modeling of geosurface measurement verify the effectiveness of the proposed method, even in the lower SNR (signal to noise ratio) situations. [C161]

"Precise calibration techniques for complex SAR systems based on active phased array antennas"

In recent years, the antenna technology for spaceborne synthetic aperture radar (SAR) systems has developed from passive slotted waveguide arrays (e.g. ERS-1/2 or X-SAR) to active phased arrays (e.g. ASAR/ENVISAT or TerraSAR-X), offering electronic beam steering capabilities required for acquisitions in different swath geometries and for operation in ScanSAR and Spotlight modes. Furthermore, with an increasing number of operational applications and services, the requirements on radiometric and geometric calibration become increasingly demanding. Hence, product quality is of crucial importance and the success or failure of a mission depends essentially on the method of calibrating the SAR system in an efficient way. In example of TerraSAR-X the paper describes a precise and efficient calibration method applicable for complex spaceborne SAR systems based on an active phased array antenna. [C162]

"Pseudo-noise waveform synthesis for SAR applications"

The paper presents the research carried out at Warsaw University of Technology on area of waveform design for Noise Synthetic Aperture Radar (SAR). The aim of the article is to present the method of creating complex pseudo-noise waveform with reduced side lobes of autocorrelation function in observation area. [C163]

"Enhanced monopulse radar tracking using empirical mode decomposition"

Monopulse radar processors are used to track targets that appear in the look direction beamwidth. The target tracking information (range, azimuth angle, and elevation angle) are affected when manmade high power interference (jamming) is introduced to the radar processor through the radar antenna main lobe (main lobe interference) or antenna side lobe (side lobe interference). This interference changes the values of the error voltage which is responsible for directing the radar antenna towards the target. A monopulse radar structure that uses filtering in the empirical mode decomposition (EMD) domain is presented in this paper. EMD is carried out for the complex radar chirp signal with subsequent denoising and thresholding processes used to decrease the noise level in the radar processed data. The performance enhancement of the monopulse radar tracking system with EMD based filtering is included using the standard deviation angle estimation error (STDAE) for different jamming scenarios and different target SNRs. [C164]

"S band radar target detection in an extreme advection duct event"

Mesoscale numerical weather prediction models coupled with modern parabolic equation radar performance models have allowed the resolution of four dimensional radar performance in challenging non homogeneous near surface refractivity fields at the time and location of the modeller's choice. Large scale offshore flow of warm and dry air over colder seas produces strong surface ducting. Large land-sea temperature differences can produce near shore sea breezes and surface based ducts. This paper describes modelled radar performance in such a complex ducting structure over the Persian Gulf during large scale northwest flow. The refractivity field was resolved by the Coupled Ocean Atmosphere Mesoscale Prediction System and the notional radar performance was modelled by the Advanced Refractivity Effects Prediction System. The results indicate strong spatially dependent enhancements and degradations in radar performance relative to a standard atmosphere. [C165]

"Spread Spectrum Digital Beamforming (SSDBF) radar"

Spread Spectrum Digital Beamforming (SSDBF) overcomes the CSWAP and the scalability in bandwidth-and-frequency limitations of Conventional Digital Beam Forming (CDBF) by eliminating the requirement of "one digital transceiver per element" while enabling fully capable digital beamforming with minimum hardware (and consequently minimum volume and heat dissipation) per element. SSDBF enables low-cost/low-profile/low-power digital beam forming phased arrays that scales in frequency (L through Ka and higher), bandwidth (100's MHz) and subarray size (100's elements per subarray) with a single down-converter, single digital receiver and single Nyquist-rate ADC for the entire subarray. It achieves this by replacing the MMIC T/R module at each element with much simpler bi-phase re-modulating hardware, and by re-modulating and aggregating the return signal incident at each element such that it can perfectly recover the complex baseband-equivalent of the RF signal of each element without mutual interference and with negligible noise performance degradation. The bi-phase re-modulator at each element can be extremely small and low power and amenable to implementations as simple as a single RF switch mounted directly at the antenna element with associated ON/OFF switch control logic built on the back. Thus SSDBF truly enables flat, thin, lightweight conformal phased arrays and has the potential of reducing phased array costs by, possibly, multiple orders of magnitude relative to CDBF state-of-the-art. The SSDBF parameters and waveforms are flexible, programmable and can be tailored and adapted, practically, to support any radar or communications applications. In a project for DARPA, Applied Radar is developing an X-band SSDBF-based radar prototype in which the SSDBF features and performance have been demonstrated. In this paper, we describe the SSDBF method for a radar application including simulation, indoor testbed and open-range test results. [C166]

"Analog beamspace super-resolution radar processing"

Current monopulse radar does not resolve multiple sources within the main beam, a scenario that arises in a number of radar applications such as ballistic missile defense, where the incoming missile complex consists of a large number of objects; air defense, where a detection may correspond to a single plane or multiple planes; cruise missile defense for low angle target tracking in multipath; etc. This paper describes a superresolution technique designed for radar applications requiring resolving multiple targets within the main beam given a single snapshot of multiple beam data. The technique enables the practical implementation of such super-resolution

algorithm by first forming multiple beams in the analog domain to provide data and degree-of-freedom (DOF) reductions without significant loss of information. Super-resolution is then achieved through the use of matrix processing techniques operating on the digitized beamspace data. The overall procedure can be considered a generalization of the monopulse processing scheme to the multi-target case. [C167]

"Characterization of layered media using full-waveform inversion of proximal GPR data"

Full-waveform inversion of proximal ground penetrating radar (GPR) data is used to determine the electromagnetic properties of layered media. The radar system consists of a vector network analyzer combined with an off-ground horn antenna operating at ultra wideband. The GPR wave propagation is modeled for a multilayered medium using a recursive Green's function computed in the frequency domain. The antenna and its interactions with the layered medium are modeled using a linear system of complex transfer functions. GPR signals were acquired in laboratory above a two-layered sand medium and two concrete slabs separated by a thin air layer (simulating a fracture). Subsequent inversions permit to retrieve the electromagnetic properties and the dimensions of these thin-layered media. For humid sand, GPR-derived dielectric permittivities showed a good agreement (RMSE = 1.65) with measured volumetric water contents. Dimensions of the three-layered concrete medium could be retrieved with a millimetric accuracy. The method is promising for the non-destructive characterization of multilayered media, including thin layers, owing to the full-waveform inversion of the radar data in a large frequency bandwidth. [C168]

"PS-InSAR time series analysis for measuring surface deformation before the L'Aquila earthquake"

L'Aquila area has a high topography and complex geological structures, and is covered with thick vegetation and snow in areas of high topography. To monitor the characteristics of crustal deformation in this region before the 2009 L'Aquila earthquake, we apply StaMPS software to analyse 20 descending ASAR images acquired between September 2003 and March 2007 and 39 ascending ASAR images acquired between February 2003 and March 2009. In this paper, two mean LOS deformation velocity maps are acquired for this area, which reveal the same deformation pattern. Several deformation gradient in this area can be clearly identified, furthermore, we discover that most faults in this region may strike approximately NW-SE and dip <; 90° to SW. We also draw the conclusion that descending SAR images are superior to ascending ones in monitoring crustal deformation with InSAR in this region. [C169]

"Investigating co-seismic deformation of the 2008 Wenchuan earthquake with ALOS SCANSAR interferometric observations"

On May 12th, 2008, a destructive earthquake of magnitude 8.0 struck Wenchuan. The seismic region is located at the transition zone between Qinghai-Tibet Plateau and the Sichuan Basin, which has a complex geological tectonic background. In this paper, we intend to investigate the Wenchuan earthquake using the Differential Interferometric SAR(D-InSAR) technique. Due to the large scale of the crustal deformation affected by the disastrous earthquake, SCANSAR images show more advantages than conventional strip-map mode images. And taking account the vegetation conditions, the L band images are suitable than the C band images for our study. Therefore, we choose to use ALOS SCANSAR interferometric observations to obtain a preliminary co-seismic displacement filed of the Wenchuan earthquake. [C170]

"Segmentation of lakes from the local background on the surface of Titan using Cassini SAR images"

Synthetic Aperture Radar (SAR) images of Titan, the largest satellite of Saturn, reveal quasi-circular to complex features which are interpreted to be liquid hydrocarbon lakes. One of the major problems hampering the derivation of meaningful texture information from SAR imagery is the speckle noise. It overlays real structures and causes gray value variations even in homogeneous parts of the image. A filtering technique is applied to obtain the restored SAR images. Our method is based on probabilistic methods and regards an image as a random element drawn from a prespecified set of possible images. The TSPR (Total Sum Preserving Regularization) filter used here is based on a membrane model Markov random field approximation with a Gaussian conditional probability density function optimized by a synchronous local iterative method. The despeckle filter can be used as intermediate stage for the extraction of meaningful regions that correspond to structural units in the scene or distinguish objects of interest like lakes. [C171]

"Preliminary result of polarization property analysis using fully polarimetric GB-SAR images"

Korea Institute of Geoscience and Mineral Resources (KIGAM) and Kangwon National University (KNU) ground-based synthetic aperture radar (GB-SAR) team has been developed a fully polarimetric and interferometric GB-

SAR system over past several years. The objective of this paper is to investigate an application of the obtained fully polarimetric GB-SAR images and an effective polarimetric analysis method to extract polarization properties from different terrain targets as a preliminary study. We utilized an unsupervised classification method for analyzing of a fully polarimetric GB-SAR image, in particular, Cloude and Pottier's method and a combined H/A/α_ and the complex Wishart classifier method based on the H/A/α_ polarimetric decomposition theorem. [C172]

"Evaluation of two region based classifications in Tapajys National Forest using the ALOS/PALSAR polarimetric and interferometric coherences"

The use of phase information present in complex multi polarized images may increase the classification results. Thus, the coherence is one attribute that may be extracted from these images and used to distinguish some land cover classes. Therefore, its discriminatory capability for land use and land cover classification is analyzed. The analysis is based on the classification results of a region classifier, which needs a segmented image as one input. The influence of this kind of image input is also evaluated using of two segmentation algorithms, the SegSAR and the SPRING region growing. Two ALOS/PALSAR images acquired over Tapajos National Forest in the Brazilian Amazon were classified. The classifications were quantified by the overall accuracy, the kappa values and its variance. The classification improvement using the coherence information with intensity images was noticed for every image set. [C173]

"Deformation in Hawaii's volcanoes obtained from a ScanSAR-to-stripmap Small BAseline Subset technique"

We investigate the displacement phenomena affecting Mauna Loa and Kijlauea volcanoes at Big Island (Hawaii, USA), by applying an advanced ScanSAR-to-stripmap differential Synthetic Aperture Radar Interferometry (InSAR) approach. The implemented method, based on the application of the well-known Small BAseline Subset (SBAS) technique, allows the generation of LOS mean deformation velocity maps and corresponding time series, leading us to characterize the complex deformation of Mauna Loa and Kijlauea volcanoes. The presented analysis relies on the use of a SAR dataset composed by 49 ASAR ENVISAT satellite images, relevant to both stripmap and ScanSAR operational modes, acquired on descending orbits (track 200) from January 2003 to September 2008. Moreover, in order to assess the quality of the proposed combined ScanSAR-to-stripmap approach, we perform a comparison between the achieved DInSAR results and the LOS-projected GPS displacement measurements. [C174]

"Phase retrieval in SAR interferograms using diffusion and inpainting"

A high-contrast inpainting scheme based on the Complex Ginzburg-Landau equation recently applied successfully to image restoration is applied to SAR interferograms to improve their quality and therefore final quality of Digital Elevation Models (DEMs). The new technique attempts to recover the phase values in low coherence regions through diffusion and inpainting. After phase unwrapping low coherence regions are masked and discarded and a Complex Ginzburg-Landau (CGL) inpainting scheme is applied to regions where phase values are missing. We demonstrate that the residues reduce and the proposed algorithm leads to a higher Signal-to-Noise Ratio (SNR) if compared with MCF algorithm. The restoration technique has been applied to ERS-1 and ERS-2 data sets acquired on July 1995. Results appear to be very promising: the proposed algorithm provides good performances especially in presence of strong noise level and low coherence areas with relatively small dimensions. [C175]

"Composite scattering from electric-large target over randomly rough surface in numerical approaches"

Numerical study of radar echoes from the targets in environmental clutters has been of great interest in many applications. In this paper, the bidirectional analytic ray tracing (BART) method for composite scattering from three-dimensional (3D) electrically large complex target above a randomly rough surface is reported. Analytic tracing of polygon ray tubes in bidirectional tracing is developed to precisely calculate the illumination and shadowing of facets, which exempt large patches of the target from any finer meshing. It significantly reduces the complexity relevant to the target electric-size. Numerical examples of angularly composite scattering from a three-dimensional electrically large, e.g., a ship-like target over a randomly rough surface are presented and discussed. [C176]

"Multiresolution despeckling of VHR SAR images based on MRF segmentation"

In this work, maximum a posteriori (MAP) despeckling, implemented in the multiresolution domain defined by the

undecimated discrete wavelet transform (UDWT), will carried out on very high resolution (VHR) SAR images and compared with earlier multiresolution approaches developed by the authors. The MAP solution in UDWT domain has been specialized to SAR imagery. Every UDWT subband is segmented into statistically homogeneous segments and one generalized Gaussian (GG) PDF (variance and shape factor) is estimated for each segment. This solution allows to effectively handle scene heterogeneity as imaged by the VHR SAR system. Segmentation exploits a Tree Structured Markov Random Field (TSMRF), which is a low complexity MRF segmentation that allows the estimation of the number of segments and the segmentation itself to be carried out at same time. Experiments performed on a single-look VHR X-band SAR images demonstrate that the segmented approach is effective whenever the classical circular Gaussian model of complex reflectivity may no longer hold. [C177]

"Shadow region imaging algorithm using array antenna based on aperture synthesis of multiple scattered waves for UWB radars"

Ultra-wide band (UWB) pulse radar has a definite advantage over optical ranging techniques, as to applicability to the harsh optical environment, such as the dark smog, or strong back-light. We have already proposed the extended Synthetic Aperture Radar (SAR) algorithm employing the multiple scattered waves, which aims at enhancing the reconstructible region of the target boundary including the shadow. However, it still suffers from the shadow region in the case of the target with a sharp inclination or deep concave boundary, because it assumes the antenna scanning whose real aperture size is too small. To resolve this difficulty, this paper proposes an extension algorithm using the array antenna model. While this extension is quite simple, the effectiveness of the proposed method is nontrivial regarding to the expansion of the imaging range. The results from numerical simulations verify that our method remarkably enhances the visible range of target surfaces without a priori knowledge of target shapes or a preliminary observation of its surroundings. [C178]

"Image partitioning with kernel mapping and graph cuts"

A novel multiregion graph cut image partitioning method combined with kernel mapping is presented. A kernel function transforms implicitly the image data into data of a higher dimension so that the piecewise constant model of the graph cut formulation becomes applicable. The method yields an effective alternative to complex modeling of the original image data while taking advantage of the rapidity of graph cuts. A variety of noise models are, thus, considered by a single model. Using a common kernel function, we minimize the objective functional by iterating (1) regions parameters update and (2) image partitioning by graph cut iterations. A comparative performance evaluation is carried out over a large set of experiments using synthetic grey level data. Besides, a set of tests with real images such as SAR and medical images is shown to demonstrate the validity of the method. [C179]

"Quantifying the results of wind and rain on ifsar tree height estimation"

The horizontal and vertical (3D) structure of Earth's forested ecosystems are of great significance to their ecological functioning and societal uses. An IfSAR approach is one methodology whereby a forest's structure and height in particular can be successfully estimated. Critical to the successful estimation is a high correlation between multiple SAR images. Regardless of a forest's location on the Earth, wind and precipitation can significantly alter a forest's appearance to a SAR system operating in either the L or C bands and so too decrease this necessary correlation. In order to investigate and quantize the decorrelation induced by factors such as wind and rain, we have developed a model for the repeat-pass interferometric SAR response of a forest including the application of a wind field and / or a rain storm. The simulation consists of multiple interconnected parts including the generation of fractal tree geometries, a wind simulator to apply apply variable wind forces to the generated trees, an electromagnetic model to allow us to calculate a Single Look Complex value for the SAR return of the combined target, an image forming technique based on antenna array theory, and an image processing algorithm. Results present polarmetric coherence as a function of platform look angle, wind speed, and moisture content. An important feature of this research is the usage of a physically based realistic wind model that is based on measurements of wind effects on trees as well as realistic models of fluid flow and simple harmonic branch segment resonators. Allowing branches to bend and move out of the plane of the incident wind field enables our model to capture numerous features of a physical tree blowing in the wind. This realistic model is necessary for a realistic simulation of the effects that wind has on a given InSAR imaging system as expressed in this study by the interferometric coherence. [C180]

"Compressive sensing SAR imaging with real data"

As an active and coherent microwave high resolution imaging system, Synthetic Aperture Radar (SAR) has the capability to image in all weather and day-or-night conditions. Recent advent of theory of Compressive Sensing (CS) has introduced a novel concept that an unknown sparse signal can be recovered exactly with an

overwhelming probability even with highly sub-Nyquist-rate samples. In this paper, a new scheme for the test bed of CS based SAR imaging is proposed. Experimental results on some real raw SAR data reveal that there are some practical limitations on the use of CS based SAR imaging, especially for complex imaging scenes and the systems with low Signal-to-Noise Ratio (SNR). [C181]

"Oil-slick observation using single look complex TerraSAR-X dual-polarized data"

In this study single look complex (SSC) TerraSAR-X dual-polarized data are firstly exploited for sea oil slick observation purposes. An electromagnetic model which, based on the Co-polarised Phase Difference between the HH and VV channels (CPD), allows describing the X-band sea surface scattering with and without surface slicks is proposed. Following this rationale, the polarimetric approach is firstly developed and applied to X-band Synthetic Aperture Radar (SAR) data in which both certified oil slicks and look-alikes are present. Experimental results demonstrate, for the first time, that X-band dual-polarimetric SAR data are suitable for sea oil slicks observation purposes and witness the paramount importance of the TerraSAR-X dual-polarimetric mode for such application. [C182]

"Metallic objects and oil spill detection with multi-polarization SAR"

In this study, two innovative physically-based approaches have been developed to detect man-made metallic objects and oil slicks in polarimetric SAR data. They are based on the different sea surface scattering mechanisms expected with and without oil slicks and metallic objects. Experiments, accomplished over Single Look Complex (SLC) Level 1.1 quad-pol L-band ALOS PALSAR SAR data, demonstrate the effectiveness of the two approaches for oil slick and metallic target detection purposes and witness the capability of ALOS PALSAR data for such applications. [C183]

"Polarimetric through-the-wall imaging"

A novel full polarimetric beamforming algorithm for Through-the-wall imaging (TWI) is proposed in this paper. The far field layered medium Green's functions are incorporated in the beamformer for the quad-polarizations (VV, HV, VH and HH). Due to the incorporation of the layered medium Green's function, the imaging algorithm not only takes into account the wall reflection, bending, and delay effects but also accounts for the complex EM scattering mechanism due to the presence of the wall. By employing the Green's functions, the solving of a nonlinear equation, needed to find the wave propagation path, is avoided. Similar method can also be generalized to multilayered composite walls such as a hollow-core concrete wall. Simulation results show that the proposed method can provide high quality focused images for TWI applications. [C184]

"Simulation of Faraday rotation on longer wavelength spaceborne polarimetric InSAR"

The effects of Faraday rotation (FR) on longer wavelength (i.e. L or P-Band) spaceborne linearly full-polarized inferfermetry synthetic aperture radar (Pol-InSAR) processing are addressed. A model for linearly full-polarimetric InSAR data subject to Faraday rotation is investigated. Due to Faraday rotation, the received signal in each channel will be contaminated by backscattering signals from other polarimetric channels, which consequently reduce the coherence of the two single look complex SAR images received by the same channel for PolInSAR processing. The numerical simulation results are presented, which indicates that Faraday Rotation has significant impact on the coherence of the interferograms, especially for the spaceborne longer wavelength Pol-InSAR system. [C185]

"A novel method of SAR terrain target scattering signal simulation"

Synthetic Aperture Radar (SAR) raw signal simulation is crucial for SAR system design and processing algorithms. This paper proposes the simulation method of SAR scattering signal of big area terrain target. At first, the SAR imaging principle is analyzed. Then, the space-borne SAR scenario model is constructed. The echoes of point target are calculated, which is impulse response of the SAR signal acquisition system. In tradition, the Radar Cross Section (RCS) simulation parameters of terrain target calculation is based on the scattering model expressions of a random roughness surface and the electromagnetic wave shadow theory. The approach of this communication utilizes the practical SAR SLC (Single Look Complex) or MGD (Multi-Look Ground-range Detected) image as terrain target backscattering coefficient, instead of the traditional method aforementioned. Then, 2D-FFT method is utilized to improve simulation efficiency significantly. The results of simulation prove the validity of the approach. [C186]

"Advanced classification of UXO using fully polarimetric GPR and frequency-polarization features"

The classification of buried UXO has been a difficult task due to the large amount of false alarms resulted from

troublesome clutter objects. This paper closely examined scattering characteristics of such clutter objects by using numerical simulations. From the numerical study, we found that some clutter objects, which mainly causes the false alarms, produce multiple resonances at different frequencies and different polarizations. Based on these observations, we developed new classification algorithms which utilize the frequency-polarization dependent responses of complex targets in order to discriminate UXO-like objects form such trouble some clutters. The developed algorithms were tested by experiments in a test plot. In the test, the new classification algorithms clearly discriminated such clutters from UXO-like targets. In this paper, we present the simulation results for scattering characteristics of complex clutters and the new classification algorithm based on frequency-polarization dependent responses will be discussed. Finally, results from experimental verification will be presented. [C187]

"On radar sounding applications for Enceladean ice"

Due to the nature of observations taken by planetary spacecraft, many surface and atmospheric studies have been performed at the icy moons of the outer planets, which have left the many seemingly complex interior processes in these bodies left unexplored and unexplained. It is notably difficult to access the interior regions in which planetary formation and dynamics take place. This paper presents the possibility that radar measurements could contribute to the understanding of interior structure, particularly that of Enceladus, the small but notably dynamic icy moon of Saturn. The application of such radar may lead to discoveries concerning formation mechanisms and surface processes. Additionally, radar sounding will contribute measurements that aid in diagnosing the dynamics system at work in the subsurface-perhaps most notably, the source reservoir and/or dynamics of the observed water plume at the moon's south pole, in addition the moon's role as a whole in the Saturnian system. [C188]

"A physically-based approach to observe man-made metallic objects in dual-polarized SAR data"

An electromagnetic model to observe man-made metallic objects in dual-polarized SAR data has been developed. The model predicts that man-made metallic objects and sea surface, being characterized by completely different symmetry properties, call for a different and well-distinguishable HH-HV correlation. Following this rationale, a simple and very computer-time effective filtering technique has been developed to observe man-made metallic objects in full-resolution dual-polarized SAR data. Experiments accomplished over Single Look Complex (SLC) Fine Quad Polarization RADARSAT-2 SAR data confirm the effectiveness of the proposed approach. [C189]

"Physical optics-based method to compute the radar signature of complex objects over a sea surface"

In this paper, a model based on asymptotic methods is proposed in order to compute the scattered field from a complex maritime scene. The basic idea is to combine the geometrical optics and the physical optics technique. The sea surface is generated by using the Elfouhaily directional wave spectrum to obtain a realistic scene. Both the target and the sea surface are meshed with triangular patches in order to compute the scattered field. Simulated results are presented to validate this model through a simple configuration by comparisons with the method of moment. Then more complex scenes for different sea states and different kind of targets (PEC or inhomogeneous) are investigated. [C190]

"Remote sensing image synthesis"

For remote sensing data, the testing analysis tools is difficult since the ground-truth data are not available in many cases. To address this issue, a novel method for image synthesis is presented for use as a evaluation test-bed. Given the scale-dependent, non-stationary nature of remotely sensed data, a new modeling approach that combines a resolution-oriented hierarchical method with a regional label-oriented binary tree structure is introduced to synthesize such complex data. In this paper, we are proposing on first synthesizing a label field, which contains the complex structural characteristics, then synthesizing the texture based on the generated label field for a more accurate modeling. Experimental results using operational RADARSAT SAR sea-ice image data show that the proposed method is capable of modeling complex, nonstationary scale structures, thus making it well-suitable to produce reliable, realistic remote sensing imagery. [C191]

"Hybrid numerical scattering field analysis embedded into simulations of complex radio based systems-Examples, capabilities and limitations"

Navigation, radar and communication systems rely on radio signals. Objects in the vicinity of these systems can create distortions. This paper describes the advanced system simulation by the integrated scattering analysis by

numerical methods and the adapted system signal processing. The simulation procedure and the criteria for a suitable method are described. Practical cases are outlined. [C192]

"Microwave tomography for GPR diagnostics of reinforced concrete"

In recent years, innovative strategies such as inverse-scattering or data fusion have been suggested for the processing of GPR datasets in complex scenarios. In this framework, high-resolution concrete inspections are a challenge regarding the treatment of radar data because of the size of the datasets and the complex structures involved. In addition, the achievable depth of inspection is in many cases restricted to unacceptable limits because of the material properties of concrete and the "masking effect" of the upper layers of rebar. Thus, the application of innovative approaches to high-resolution concrete data seems to suggest itself. In this framework, this work deals with the processing of a high-resolution, dataset acquired on a concrete retaining wall via an inverse scattering technique. In particular, we show how the adoption of a strategy based on signal processing techniques and an inverse scattering approach is able to provide the mapping of the two layers of rebar. [C193]

"Electromagnetic simulation of electrically large scenarios using the incoherent transmission line matrix method: Theory and application"

Electromagnetic simulations in electrically large scenarios often require a huge amount of computation time and memory, due to the need for small discretization and therefore high numbers of discretization cells. We present the incoherent transmission line matrix (ITLM) approach which allows discretization intervals in the order of the wavelength or even larger. This is achieved by frequency averaging of the computed energy densities and neglecting interference phenomena. This results in an approximation comparable to geometrical optics. In complex environments the ITLM method requires less numerical effort than ray tracing. The paper discusses the theoretical foundations as well as a validation of the method by solving a benchmark problem and, as a practical application, by modelling the propoagation of a radar signal in an automobile production hall. [C194]

"Modeling and Simulation of Single-Look Complex Images for Distributed Satelliteborne Interferometric Synthetic Aperture Radar"

The significance of modeling and simulating the single-look complex (SLC) images for the distributed satellite borne interferometric synthetic aperture radar (DS-InSAR) system is addressed. Moreover, the simulation modeling for the DS-InSAR SLC images is presented in details, including the geometric model and the radar signal model. Furthermore, an implementation method for DS-InSAR SLC images simulation is proposed, which has the advantage of lower computation loads and higher efficiency compared with the traditional simulation methods. The intensity images and phase interferograms can consequently be generated from the simulated SLC SAR images. Computer simulation results are numerously presented, with the simple conic scenario and the digital elevation model (DEM) of natural terrain. It is straight forward that the simulation results demonstrate the effectiveness of the modeling and simulation method presented in this paper. [C195]

"Modeling of Complex Radar Target for High-Resolution Synthetic Aperture Radar Image Simulation Based on GRECO"

The electromagnetic scattering models of complex radar targets, e.g. aircrafts, vehicles etc, are of great significance to Automatic Target Recognition (ATR) of Synthetic Aperture Radar (SAR) imagery. Based on the Graphical Electromagnetic Computing (GRECO) technique, a novel implementation method of complex radar target modeling for the simulation of high-resolution SAR image is proposed. The three-dimensional (3-D) scattering modeling of the complex radar targets is founded on the basis of GRECO. Furthermore, high-resolution SAR image simulation is implemented through echo simulation and image formation procedure with the 3D scatting data generated by using GRECO. Computer simulation results of an aircraft target are provided, with high-resolution millimeter wave SAR system parameters, which illustrate the radar image characteristics such as foreshortening, layover as well as shadowing. The datasets of simulated SAR images with different elevation and azimuth angles are presented, verifying the effectiveness of the method of the paper. The simulated high-resolution SAR images could be applied in ATR research as the input source data. [C196]

"Angle Estimation with Automatic Pairing for Bistatic MIMO Radar"

In this paper, a new joint direction of departure (DOD) and direction of arrival (DOA) estimation method is presented for bistatic multiple input multiple output (MIMO) radar. Because all the diagonal elements of the transmitting and receiving invariance matrices are located on the unit circle of the complex plane, we construct a complex matrix so that the DOD and DOA pairing is given automatically by the real and imaginary parts of its complex eigenvalues. Thus this method can be applied under any condition of target distribution, which does not

suffer from incorrect pairing problem as existing methods in literature. Simulation results show that the new method provides satisfactory performances but with drastically reduced computations compared with previous work. [C197]

"Improved Background Prediction Algorithm for IR Small Targets Detection"

For detection problem of infrared dim small targets in complex background, an adaptive filtering algorithm based on the improved M-estimation is put forward to suppress background clutter. In the proposed algorithm, target pixels and observed noise form the mixed interference of background estimation. In order to better estimate the background, the proposed algorithm introduces the correction factor to reduce the influence of target pixels and introduces the forget factor to entreat the non-homogeneous backgrounds. The experimental results to real images show that the proposed algorithm can better suppress background and preserve target information than the commonly-used median filtering algorithm and the LMS filtering algorithm. As a result, the proposed algorithm can detect effectively IR small targets in complex background. [C198]

"A New Type of Automatic Ship Detection Method"

A new type of automatic ship detection algorithm is proposed in this paper. By determining whether the local area is heterogeneous, simplex two-parameter CFAR algorithm based on Gauss-distribution or both two-parameter CFAR algorithm based on Gauss-distribution and two-parameter CFAR verification algorithm based on K-distribution are used to detect targets. This new type of algorithm keeps both the ability of traditional two-parameter CFAR algorithm' good features, such as small computation quantity, easy to implement and so on, and the detection accuracy in complex sea conditions at the same time. [C199]

"A RSS based indoor tracking algorithm using particle filters"

In recent years, the location finger printing techniques draws more attention for the indoor location systems because of the easiness for deployment. The Kalman filter is also applied for indoor tracking system using the location information estimated by location finger printing technique, while the performance would be weak in some more complex indoor environment. In this paper, we develop a new indoor tracking algorithm using received signal strength directly and particle filter is applied for the nonlinear tracking model. The numerical simulation shows the new algorithm outperforms the tracking algorithm using Kalman filter in the former research. [C200]

"Research on Radar Emitters Classification with Fuzzy Support Vector Machines"

In this paper, a novel method based on kernel principle component analysis is proposed to extract features of radar emitter signals image of Choi-Williams distribution. Then these discriminative and low dimensional features obtained were fed to the classifier designed for different radar LFM signals which is based on fuzzy support vector machines (FSVMs). In simulation experiments, the classifier attains over 90% overall average correct classification rate. Experimental results show that the proposed FSVM classifier is efficient for different complex radar signals detection and classification. [C201]

"Amplitude Phase Algorithm for SAR Signal Processing"

In space borne SAR systems some form of data compression is required to reduce the bandwidth of the downlink channel. In the present paper we have represented the complex SAR raw data with amplitude-phase (AP) and then applied the devised algorithm. It is observed that the phase information of the compressed data is preserved to the great extent. The quality of the reconstructed data is compared in terms of the important performance evaluation parameters like signal to noise ratio (SNR), standard deviation of the phase (PSD), mean phase error (MPE) and the compression ratio (CR). The amplitude-phase algorithm is compared with that of Block Adaptive Quantization (BAQ) algorithm. The evaluation procedure is carried out in two domains, raw data domain and image domain. Numerical experiments were carried out using ERS-2 satellite data supplied by European Space Agency (ESA) showing that amplitude-phase algorithm provides us with more compression ratio (CR) choices than BAQ and for certain CR, AP algorithm provides at least one choice whose performance is better than or equal to that of BAQ. These two algorithms neither affect spatial resolution nor generate geometric distortion. Both of them have only a little effect on radiometric resolution. [C202]

"Automatic reconstruction of cities from remote sensor data"

In this paper, we address the complex problem of rapid modeling of large-scale areas and present a novel approach for the automatic reconstruction of cities from remote sensor data. The goal in this work is to automatically create lightweight, watertight polygonal 3D models from LiDAR data (Light Detection and Ranging)

captured by an airborne scanner. This is achieved in three steps: preprocessing, segmentation and modeling, as shown in Figure 1. Our main technical contributions in this paper are: (i) a novel, robust, automatic segmentation technique based on the statistical analysis of the geometric properties of the data, which makes no particular assumptions about the input data, thus having no data dependencies, and (ii) an efficient and automatic modeling pipeline for the reconstruction of large-scale areas containing several thousands of buildings. We have extensively tested the proposed approach with several city-size datasets including downtown Baltimore, downtown Denver, the city of Atlanta, downtown Oakland, and we present and evaluate the experimental results. [C203]

"A streaming framework for seamless building reconstruction from large-scale aerial LiDAR data"

We present a streaming framework for seamless building reconstruction from huge aerial LiDAR point sets. By storing data as stream files on hard disk and using main memory as only a temporary storage for ongoing computation, we achieve efficient out-of-core data management. This gives us the ability to handle data sets with hundreds of millions of points in a uniform manner. By adapting a building modeling pipeline into our streaming framework, we create the whole urban model of Atlanta from 17.7 GB LiDAR data with 683 M points in under 25 hours using less than 1 GB memory. To integrate this complex modeling pipeline with our streaming framework, we develop a state propagation mechanism, and extend current reconstruction algorithms to handle the large scale of data. [C204]

"Design and implementation of an improved channelized architechture"

When complex signals go through poly-phase digital channelized receiver, in order to ensure there are no blind spots and frequency aliasing, the maximum decimation factor per channel can only be half of the number of the channels. In this way, the entire receiver has to process at least twice as much data as before. This directly sets much higher requirements to the processing rate of signal processors. What is more, the sampling rate of analog-to-digital converter today is far beyond the processing rate of signal processor. With the expectation to fill the gap between the processing rate of signal processor and the sampling rate of DAC, this paper developed a parallel computing architecture. This method analyses the law of the convolution in the non-blind spots digital channelized receiver and the filter bank structure is achieved by using two modules. Besides, this design ameliorates the source problem of processors efficiently by adopting parallel computing on multi-processors. Experimental results proved that the proposed method performs well in improving the characteristic of ultra-wideband channelized receiver, especially complex signals involved. [C205]

"True time-delay bandpass beamforming: A new implementation"

Beamforming as a basic approach of array signal processing has been widely used in many important applications such as radar, sonar, and communications. Typical algorithms include time-delay-based and FFT-based, and various implementation structures have been developed. For bandpass sampled signals, a true time-delay beamformer involves three processes: signal demodulation to obtain its complex envelop; delay of the complex envelop; and phase rotation of the delayed complex envelop. Those processes can be realized using FIR filters. In this paper, a few improvements are proposed for the above bandpass beamforming implementation, including a new way of filter coefficient selection and a polyphase filter structure. The new implementation generates exactly identical results as the conventional zero-padding interpolation beamformer, and meanwhile can readily fit into a low-power, highly-parallel processing unit such as FPGA. [C206]

"Blind extraction of noncircular complex signals using a widely linear predictor"

Real valued blind source extraction based on a linear predictor is extended to the complex domain using recent advances in complex domain statistics. It is shown that, in general, the mean square prediction error of the algorithm depends both on the covariance matrix and the pseudo-covariance matrix of the source signals. To fully utilise the available information, it is thus natural to adopt a widely linear predictor to extract the latent sources from the observed mixture. This way, we derive a new algorithm for the extraction of general complex signals and provide simulation results using benchmark complex data. [C207]

"Electromagnetic Earth environment-new radio diagnostic"

Electromagnetic emissions observed in the nearest Earth environment are a superposition of natural emissions and various types of man-made noises. Also, as a consequence of catastrophic events on the Earth surface such as: thunderstorm activity, earthquakes, volcanic eruptions, electromagnetic signals are registered on board low orbiting satellites. Therefore, a more accurate physical description of such a complex and dynamic system calls for a long term multi-point and multi-scales coordinated monitoring of space environment. The magnetised solar-terrestrial space plasma is a highly non-linear medium, which exhibits many different types of turbulence

and instabilities. A study of mass, energy, and momentum transport in the solar terrestrial plasma is directly related to the study of space plasma turbulence. The wide range wave in situ diagnostics and new generation multi-point and multi-type sensor diagnostics, as the LOFAR-LOIS system can be a good tool for monitoring such complex system. Ground-based multi-frequency and multi-polarisation netted radio and radar facilities and observation clusters in space will be helpful to find solutions to problems in space physics and to detect long-term environmental changes. The presentation will give the overview of physical problems relates to diagnostics the plasma turbulence in near Earth environment and will present the new observation techniques devoted to the space plasma diagnostics; as in situ wave measurements combined with ground based LOIS netted radar registration. [C208]

"OTHR impulsive interference characteristics and detection based on AR model"

A novel impulsive interference (IMI) detection algorithm based on AR model is proposed in this paper, aiming at detecting the IMI and estimating its position in the echo samples received by Over-the-horizon Radar (OTHR). The key to the algorithm is the exploitation of the IMI's spectrum characteristics which is regarded as complex sinusoid and modeled as autoregression(AR). When getting the AR model, the amount of the contained sinusoid signals and their frequency parameters can be estimated by the transfer function, where the frequency is just corresponding to the IMI's position. This algorithm's operational performance is evaluated using experimental data sets from a high frequency surface wave (HFSW) OTHR system, and is proved to be suitable for most types of IMIs. [C209]

"A Novel Method for Ship Detection Based on NSCT and ACO"

Ship detection is an important section of Synthetic Aperture Radar's marine applications. Through analyzing the distribution characteristics of ship targets and speckle, a novel ship detection method based on NSCT and ACO is proposed for SAR image processing. First, apply NSCT adaptive threshold method to de-noise the SAR images, then detect the edges by ACO, last ship targets can be precisely detected. Simulating results indicate that this method can not only pickup contour information of ship objects in complex speckle efficiently, but also keep ships structure well, show ideal antijamming competence, guarantee the detection accuracy. [C210]

"Vision-based railroad track extraction using dynamic programming"

Most of the common driver assistant systems for detection of obstacles work on unstructured environments. These environments generally include many non-planar surfaces which pose a big challenge for vision systems. Similar problems exist for railroad environments which often contain complex shapes and surfaces like hills and vegetation along railroad tracks. In railroad transportation, the main task of a train driver is to carefully focus on the track. Therefore the field of view of a train driver must contain the space between two rails in front of the train and the near lateral area (left and right side) of these rails. In this paper, we present an algorithm to extract the train course and railroad track space in front of the train using dynamic programming in railroad environments. We use dynamic programming to compute the optimal path which gives the minimum cost to extract the railroad track space. The proposed algorithm extracts the left and right rails using dynamic programming simultaneously. Our method does not need any static calibration process. For this purpose, a camera system was installed in front of a locomotive. Experimental results show the effectiveness of the algorithm. [C211]

"Recurrent Grid Based Voting Approach for Location Estimation in Wireless Sensor Networks"

With the advent of location aware sensor applications, precise location discovery has become an important technology in wireless sensor networks. Inter Peer communication in the sensor network has been modeled as the graph with constraints defined in terms of proximity. Recurrent grid based voting approach (RGBV) has been introduced to estimate the location of unknown nodes in the network. Voting scheme is adopted on an iterative basis for the nodes. For each node, region of interest (ROI) with the maximum votes is figured out as the collection of two-dimensional points after recursive voting. Convex hull is generated from this set of points to frame the actual ROI. Additionally, minimum bounding rectangle algorithm has been applied to figure out the centroid of the region. The centroid thus estimated is the required location of unknown node. Our methodology is shown to have fast convergence with low estimation error, even for complex networks. The simulation results demonstrate that the proposed method is promising for the current generation of sensor networks. [C212]

"Genetic Algorithms for PRI ambiguity resolution in Passive Emitter Tracking"

Passive emitter tracking (PET) is an accurate technique to localize an emitter through time difference of arrival (TDOA) multilateration by a network of sensors. It suffers from pulse repetition interval (PRI) ambiguity when two successive pulses are closer than the distance between the receivers. The problem can be undertaken by

minimizing an error function (X2), and ambiguity can be solved by using coarse direction of arrival (DOA) information; but X2becomes a very complex function of position for low PRI (airborne radars). Traditional approaches to solve ambiguity can be time consuming. An alternative approach is presented which exploits the characteristics of genetic algorithms (GA), suitable for the optimization of particularly complex functions. This technique becomes more efficient than the standard methods for low PRI. [C213]

"Simulation, measurement and validation of amplitude and phase matching performance between transmitter and receiver subsystems in dual-channel high-resolution polarimetric radar"

Stringent requirements for the matching performance between the channels of high-resolution multi-channel radar for superb target detection and classification capabilities have to be met. This paper focuses on the investigation on the amplitude and phase matching performance between two transmitters and two receivers in a dual-channel polarimetric agile radar system. The system will be used to estimate all elements of the polarization-dependent backscattering matrix simultaneously in 3 meters resolution cells. The paper presents breakthroughs in designing such complex radar systems based on very up to date methods used for system level simulations, for measurements and for cross-validation between simulations and measurements. The measurement results of the developed transmitters and receivers demonstrate the validity of our design approach for obtaining the needed matching performance between transmitters and receivers in such a dual-channel radar system. [C214]

"Performance assessment techniques for doppler radar physiological sensors"

This paper presents a technique for assessing the performance of continuous wave Doppler radar systems for physiological sensing. The technique includes an artificial target for testing physiological sensing radar systems with motion analogous to human heart movement and software algorithms leveraging the capabilities of this target to simply test radar system performance. The mechanical target provides simple to complex patterns of motion that are stable and repeatable. Details of radar system performance can be assessed and the effects of configuration changes that might not appear with a human target can be observed when using this mechanical target. [C215]

"Development of RCS simulation software for electrically large complex cavities based on the secondary development of UG"

A shooting and bouncing ray (SBR) based software is developed by the secondary development of Unigraphics (UG). The core algorithm of ray tracing is based on the optimized non-uniform rational B-splines (NURBS) curve-surface intersection algorithm built in UG, which results in very high accuracy of ray path tracing without meshing, thus keeping the accuracy of the original cavity model. It is also efficient even if work with a complex cavities because of avoiding of shielding process. Both geometry modeling of cavity and its scattering simulation are integrated into a uniform platform, which forms an easy-using integrative and universal environment for electromagnetic modeling of complex cavities. In this paper, the developed software for complex cavity scattering modeling has been introduced with some numerical results to demonstrate the accuracy and efficiency. [C216]

"An improved hybrid technique for computing the RCS of dihedral corner reflector with a protrusion"

For the EM scattering problems of electrically large dihedral corner reflector with electrically small protrusion, the traditional MoM-PO hybrid method cannot efficiently consider the complex multi-reflection effects among the PO regions. Based on the classical MoM-PO method, an improved hybrid method is presented to calculate the multi-reflection contribution in the PO region efficiently by introducing the method of SBR based on RDN notion that avoids the complex iterative procedure. Simulation results agree with the numerical results very well. [C217]

"A simple method for estimation of maximum spurious radiation level from phased array antennas"

According to the new ITU regulation on unwanted spurious emissions from radar transmit antenna, it has become compulsory to measure transmit antenna patterns at spurious frequencies. However, the complex nature of phased array antennas, involving a large number of antenna elements with element-by-element phase-control for beam-scanning, usually makes it difficult to measure all the radiation patterns at spurious frequencies. This paper introduces our approach to this problem, where, under the principle of pattern multiplication, the spurious radiation maxima are estimated by the multiplication between calculated array-factors and measured element-factors, both at spurious frequencies. Among those antenna element types we have examined, this paper deals with the case for dipole antenna as the most typical array antenna element. [C218]

"Processing of synthetic Aperture Radar data with GPGPU"

Synthetic aperture radar processing is a complex task that involves advanced signal processing techniques and intense computational effort. While the first issue has now reached a mature stage, the question of how to produce accurately focused images in real-time, without mainframe facilities, is still under debate. The recent introduction of general-purpose graphic processing units seems to be quite promising in this view, especially for the decreased per-core cost barrier and for the affordable programming complexity. The authors explain, in this work, the main computational features of a range-Doppler Synthetic Aperture Radar (SAR) processor, trying to disclose the degree of parallelism in the operations at the light of the CUDA programming model. Given the extremely flexible structure of the Single Instruction Multiple Threads (SIMT) model, the authors show that the optimization of a SAR processing unit cannot reduce to an FFT optimization, although this is a quite extensively used kernel. Actually, it is noticeable that the most significant advantage is obtained in the range cell migration correction kernel where a complex interpolation stage is performed very efficiently exploiting the SIMT model. Performance show that, using a single Nvidia Tesla-C1060 GPU board, the obtained processing time is more than fifteen time better than our test workstation. [C219]

"Analysing the elements of SAR polarimetry matrixes"

The various applications have been promised by the new generation of the spacecraft SAR data (i.e. Radarsat2 and TerraSAR-X), as the classification, the decomposition, and the modelling of the polarimetric synthetic aperture radar (SAR) data has been improved in recent years. This work is based on the fact that in order to extract the various patterns in distinctive field of studies, all the scattering matrix components are informative source of data. Different cross products of the complex scattering matrix channels (HH, HV, VH, and VV) that are involved in the phase and amplitude information are joined together to build instructive features. In the vector space, Fisher class separability algorithm will be tested, and the features with the best class separability, large distance between classes, and small within-class variances will be selected. As we measured the classification effectiveness of the individual features, we needed to choose a subset of the informative features from the nine originally available features. Finally, we combined all the educational information contents in order to classify desired images with the best overall accuracy. [C220]

"Real-time tracking of transceiver-free objects for homeland security"

The increasing demand in homeland security speeds up the development of innovative and non-invasive systems to localize and track moving objects in complex environments. In this paper the real-time localization of transceiver-free targets is addressed by means of learning by example methodology that exploits the received signal strength indicator available at the nodes of a wireless sensor network as input data. This approach uses neither dedicated sensors nor active devices put on the target to localize both idle and moving objects. The definition of a customized classifier during an offline training procedure enables the real-time generation of a probability map of presence by processing the output of the support vector machine. Some selected experimental results validate the effectiveness of the proposed methodology applied in real scenarios. [C221]

"Linear FM Signal Detection Performance from Discrete-Time Observations"

Detection performance of a complex linear FM signal from a finite number of noisy discrete-time observations is discussed. The computation method of spectrum peak SNR is given. The detector statistic based spectrum peak SNR is constructed and the probability density functions (PDF) of spectrum peak SNR under the 'noise-only' hypothesis and the 'noise-and-signal' hypothesis are examined respectively. Simulation results verify the analysis. [C222]

"An Improved Automatic Ship Detection Method in SAR Images"

This paper provides an improved automatic ship detection algorithm, which uses two-parameter CFAR algorithm based on Gauss-distribution to process the homogeneous imaging local area, and uses two-parameter CFAR algorithm based on K-distribution to process the heterogeneous imaging local area again. This improved algorithm keeps both the ability of traditional two-parameter CFAR algorithm' good features, such as small computation quantity, easy to implement and so on, and the detection accuracy in complex sea conditions at the same time. [C223]

"Validation of a smart antenna prototype: Model and experiments"

In this paper, the architecture of a smart antenna prototype is described and its functionality assessed. The system prototype is composed by an 8-elements linear array of dipoles with a finite reflecting plane and the adaptive behavior is obtained modifying a set of array weights with electronically-driven vector modulators. In order to real-time react to complex interference scenarios, the system is controlled by a software control module based on a particle swarm optimizer. To demonstrate the feasibility and the effectiveness of the proposed

implementation, a set of representative results concerned with realistic interference scenarios is reported and discussed. [C224]

"Quasi-simultaneous measurements of scattering matrix elements in polarimetric radar with continuous waveforms providing high-level isolation in radar channels"

This paper presents a new type of sounding signals for polarimetric FM-CW radar and corresponding de-ramping technique for processing, which provide the possibility for simultaneous measurement of all backscattering matrix elements and have high-level isolation between branches of the polarimetric receiver. The radar transmitter forms sounding signal, which has orthogonally-polarized components with orthogonal waveforms. The radar receiver is splitting orthogonally-polarized components of the scattered signals in two parallel receiver channels. Every such channel includes two parallel independent branches, which use wave-form orthogonality of the orthogonally-polarized components of sounding signal to split further signal components for simultaneous estimation of all four complex elements of the polarization backscattering matrix of radar object. The isolation between pairs of such branches in one receiver channel strongly depends on the time interval when scattered signals with orthogonal waveforms occupy the same frequency band. In this paper we propose to use a pair of LFM-signals as orthogonally-polarized components of the sounding radar signal. Both have the same form but are shifted in time relatively to each other. Our analysis shows that such time shift between the components of sounding signal prevent the frequency overlap between polarimetric components of scattered signal. As result, standard de-ramping processing technique can be used in the receiver, providing high level isolation between receiver's branches that simultaneously estimate all elements of the radar target backscattering matrix. [C225]

"Comparison between Pseudomeasurement and DD2 filters in exoatmospheric Ballistic Missile engagement"

This paper deals with the problem of exoatmospheric tracking of a Ballistic Missile (BM) from an interceptor (or pursuer) moving towards the ballistic target. During the terminal guidance phase of the engagement, the on-board seeker provides noisy measurements of range, azimuth, elevation and range rate (or Doppler). Using the available seeker observations, the position and the velocity of the target can be estimated by a nonlinear tracking filter. Filter initialization is realized by means of a ground radar that tracks the ballistic target until the first measurement from the seeker becomes available. Then a proportional navigation guidance law is applied in order to guide the path of the interceptor towards the intercept point of the purser and the BM. The performance of the interceptor missile guidance system is influenced by the seeker and the autopilot dynamics that, in this paper, are both modeled with single lag transfer functions. Effects of different kinds of nonlinearities (i.e. saturation of lateral acceleration and saturations at the seeker) in the guidance loop are considered as well. The Extended Kalman Filter (EKF) has probably been the most widely used estimation technique for this complex nonlinear filtering problem. Nevertheless it is known that the EKF, which is based on a first order Taylor approximation of the equation of motion and/or the measurement equation, has a bias in its estimate and could in addition have convergence problems; both of these drawbacks are due to the underlying approximations. In this paper two filters are compared for the problem of tracking a BM during its exoatmospheric portion of flight: the Pseudomeasurement filter and the second order divided-difference filter (DD2 filter). A full three-dimensional engagement scenario has been simulated to assess the performance of the two considered estimation techniques and to determine the miss distance accurately. The simulation results show that both filters have adequate perfo- rmance for the proposed problem. [C226]

"Effects of frequency-dependent attenuation on time delay estimation techniques applied to ground penetrating radar data"

In this paper, the effects of frequency-dependent attenuation on the performance of some time delay estimation techniques applied to ground penetrating radar (GPR) data are investigated. Being based on a complex power law of frequency for dielectric permittivity, the adopted signal model deviates from the damped exponential model and it is this mismatch that is likely to deteriorate the performance of the employed techniques. At first, we carry out a sensitivity study by determining the variations of the relative root mean square error of the time delay estimates as a function of the SNR and the quality factor Q for three algorithms, namely, root-MUSIC, ESPRIT and the matrix pencil method (MPM). These variations reveal a systematic error which is quantified by means of a first-order approximation and is found to be the ratio of the phase delay to the group delay. Then, this error is used to compensate for the bias introduced by the model mismatch with the aim of improving the estimates. [C227]

"Time frame selection for High PRF Pulsed Doppler radar ISAR image formation"

Inverse Synthetic Aperture Radar is a signal processing technique used to obtain high resolution images of

targets. In ISAR imaging high cross-range resolution is obtained by exploiting the radar to target relative motion. The radar target kinematic affects the data grid spacing and shape in the Fourier domain (acquisition surface). When the grid is rectangular with equally spaced points, the ISAR image is focussed and it has predictable resolution properties. The object of this paper is to investigate the relationships between the acquisition surface and both the resolution and defocusing properties of the ISAR image given the radar-target kinematic. A distortion parameter that depends on the kinematic properties is defined and compared to image focus quality indicators. Simulation results are also shown considering a complex target model. [C228]

"RELAX-based autofocus algorithm for high-resolution strip-map SAR"

This paper addresses the non-iterative quality phase gradient autofocus (QPGA) technique which was originally proposed to remove one-dimensional phase errors in spotlight-mode synthetic aperture radar (SAR) imagery. By enriching the source pool, the method is modified in a way suitable for autofocus in stripmap-mode SAR system with the advantage of being independent of any priori assumptions. Unlike the QPGA the potential candidates, i.e., dominant scatterers located along azimuth in each specific range bin, are automatically selected by exploiting the one-dimensional RELAX algorithm. Furthermore, RELAX is capable of estimating the size of blur window which is, in fact, associated with the Doppler spread of signal spectrum. The corresponding model includes four parameters i.e., complex amplitude, delay, Doppler center and spectral width. The proposed method has been applied to data extracted by a ground-based rotating coherent Doppler radar operating in strip-mapping mode SAR, with the aim of high-resolution clutter detection. [C229]

"Comparison of covariance estimators for nongaussian multipulse detectors"

In recent years, multi pulse nongaussian signal model has been one of the most frequently used signal model on radar detection. A suboptimum receiver for that model has been already developed. In order to realize that detector the correlation properties of the underlying clutter have to be estimated. Although there are several estimators proposed for that, they are not widely used. One of the main reasons of this is that there is not enough comparison analysis between these estimators. So the suitable estimator for selected application is not known. In this paper these correlation estimators are compared under complex clutter scenarios. [C230]

"The application of the principle of chirp scaling in processing stepped chirps in spotlight SAR"

A new approach for processing stepped chirps in spotlight SAR is presented in this manuscript, which is based on exploiting the principle of chirp scaling (PCS). In particular the PCS is integrated in a polar format algorithm (PFA), obtaining a more efficient solution compared with the existing interpolation based technique. The main contribution is the implementation of the azimuth scaling with the bandwidth synthesis embedded in, and it is developed dedicatedly for dealing with stepped chirps. The signal processing flow is investigated in detail, with no interpolations but only FFT's and complex multiplications involved, and point target simulation has validated the new approach based on PCS is feasible and more efficient than the existing interpolation based approach. [C231]

"Detection of scatterer multiplicity in spaceborne SAR tomography with array errors"

Processing of multibaseline/multitemporal SAR data from complex urban or infrastructure areas is of increasing interest. In this framework, the detection of single and multiple layover scatterers is an important problem, for an extensive and accurate signal interpretation. Recently, an hybrid 3D adaptive tomography-complex data domain model fitting detection method has been proposed. In this work, the basic method is tested with simulated data corrupted by non-idealities, in particular residual atmospheric compensation errors. Afterwards, the analyzed effects specific of the presence of the data non-idealities are taken into account for a more robust design of a detection method based on the same principle. The effectiveness of the algorithm is experimented with real satellite C-band data. [C232]

"Automatic recognition of man-made objects in SAR images using support vector machines"

Over the past two decades the remote sensing technology is applied in a large scale in environmental research and policy, i.e. water pollution monitoring and conservation of soil, etc. The methods for recognition of man-made objects in remote sensing images are providing capabilities for mapping and monitoring crucial objects or sites in environmental management, i.e. hazardous chemicals storerooms, oil depots, etc. However, the task of recognizing key man-made objects from large images is time consuming and complex. In the paper we aim at developing an automatic and fast image processing method for the recognizing man-made objects in synthetic aperture radar (SAR) images, which is a supervised learning approach based on support vector machines. Firstly, a sample image data set which contains several classes of interested man-made objects is manually extracted from SAR images. Then we train the image data set by least squares support vector machines. After

cross-validation and an exhaustive grid search, a model that can predict target label of data instances in the testing set is obtained. Finally we can implement classification in random image set using above prediction model and recognize the man-made objects. This approach needs no a priori knowledge, and only a set of train examples for the learning step is needed. [C233]

"Urban DEM generation from airborne Lidar data"

Digital surface model (DSM) can be acquired from airborne Lidar (light detection and ranging) directly. But for the production of digital elevation model (DEM) from the point cloud, the filtering of the point cloud should be carried out in order to remove points representing surface of non-ground objects. According to the deficiencies of slope based method and characteristics of Lidar data in urban area, a novel filtering algorithm for Lidar data that combining slope based method and region growing is presented in this paper. This method can improve precision and efficiency of filtering, and is very suitable for Lidar data of complex urban area. Experiment results show that the proposed method can remove objects in complex urban area effectively and rapidly. [C234]

"Application of Mathematical Morphology to automatically extract roads on radar images"

The new constellation of remote sensing satellite COSMO/SkyMed will guarantee a combination of spatial and temporal resolution never reached by previously systems. The full exploitation of this system can allow the development of new applications, like these aiming at providing insight into the magnitude of a disaster and a detailed assessment of the damages as required by first responders for planning relief actions. [C235]

"Space-borne high resolution SAR tomography: experiments in urban environment using TS-X Data"

Synthetic Aperture Radar (SAR) tomography aims at retrieving the 3-D reflectivity from multi-pass SAR data. It is essentially a spectrum estimation problem. As a consequence, complex values of a specific range cell in a SAR image stack as a function of baseline are closely related to the Fourier transform of the reflectivity function in the elevation direction. The new generation of SAR satellites, like TerraSAR-X, allow for the first time the building up of high-resolution SAR data stacks on a regular basis. TerraSAR-X in its high resolution spotlight mode provides data with 0.6 m slant range resolution. It has already been shown that persistent scatterer interferometry (PSI) benefits enormously from this new quality of data. The data stacks used for PSI in urban areas can also be used to derive tomographic information. This paper presents the first demonstration of space-borne high resolution tomographic reconstruction of multiple scatterers in a resolution cell situation in urban areas. Different spectrum estimation strategies such as the Singular Value Decomposition (SVD) and Nonlinear Least Squares estimation (NLS) are evaluated and compared using both simulated data and TerraSAR-X spotlight data over Las Vegas with special consideration of the difficulties caused by sparse and irregular samples. The nuisance of ill-conditioning is investigated and regularization tools are utilized to overcome this problem. For validation, the spectrum estimation results with TerraSAR-X data are compared to the plausible ground truth. In a second step of processing model selection criteria such as the Bayesian Information Criterion (BIC), Akaike information criterion (AIC) and Minimum Description Length criterion (MDL) are implemented on the spectral estimates to determine the number of scatterers inside a resolution cell. The probability of correctly detecting the number of scatterers and the accuracy of the corresponding elevation estimates are evaluated from simulated data.- Additionally, model selection results with TerraSAR-X data are analyzed. Finally, SAR tomography, as a straightforward extension to PSL is integrated into DLRs PSI-GENESIS processor to support deformation estimation and solve the ambiguity due to multiple scatterers inside a resolution cell. First processing results using TerraSAR-X data are presented that confirm the capability of space-borne high resolution SAR tomography for resolving multiple targets within the same azimuth-range cell and to map the 3-D scattering properties of the illuminated scene. [C236]

"Urban structuring using multisensoral remote sensing data: By the example of the German cities Cologne and Dresden"

The urban landscape is a highly complex and small-structured, heterogeneous area as a result of permanent human settlement. Urban structure is scale-dependant and can be expressed on various levels of detail by satellite imagery. Very high resolution satellite (VHR) sensors are capable of mapping and monitoring cities-on house/block level-with their high degree of landcover diversity. However, detection of morphological features such as shape and elevation of single objects is performed much better when a digital surface model (DSM)-e.g. derived by airborne laserscanning-is incorporated. An object-oriented methodology for the joint analysis of optical satellite data and a digital surface model is presented for the classification of the urban morphology in terms of urban structural types. These are spatial units-mostly on block level-with aggregated information on the classified single features like landcover/landuse and urban fabric. Hence, a hierarchical, modular segmentation

and classification workflow is implemented to extract the required information. The methodology is applied on two study areas in the cities of Cologne and Dresden, Germany, and a validation of the capability of the potential for transferability of the rulebase is shown. [C237]

"Distributed waveforms for networked meteorological radars"

Distributed waveforms for resolving ambiguities for Doppler weather radar systems are presented in this paper. The novel approach is a network-based technique where spatially distributed monostatic radars are used to mitigate ambiguities in the measurements. The networked waveform system offers many advantages. First, it decouples the range ambiguity and velocity ambiguity from each other, whereas range and velocity ambiguities are coupled together in a waveform for single radar. Second, the networked waveform can be designed to measure very high velocities without the need for complex waveforms and advanced processing at each radar node. This minimizes the computational load on each node. Third, it can be used with low cost transmitter that has limited ability to support complex waveforms as opposed to a significantly expensive single radar system with complex waveforms. Fourth, the networked waveform system can be designed to meet a specific requirement over the coverage region without being restricted by limitation of an individual radar node in the network. Fifth, the distributed waveform enables direct estimation of dealiased wind field, which is critical for kinematic analysis of storm structure. Based on the results obtained from simulation it is observed that distributed waveform can provide high unambiguous velocities. A distributed waveform was implemented with a four node radar network and preliminary results show that the networked approach is a viable solution. [C238]

"Constant-modulus partially correlated signal design for uniform linear and rectangular MIMO radar arrays"

A method for generating partially correlated signals that result in arbitrary rectangular transmit beampatterns in a MIMO radar system is described. These signals are computed using frequency-offset complex exponentials (1-D) or Kronecker products of frequency-offset complex exponentials (2-D), followed by pointwise multiplication of the transmit signal vectors by a scalar pseudo-noise spreading sequence. Except for the spreading sequence, which can be pre-computed, the signals are given in closed form and thus require no numerical optimization. The transmit beampattern shape is controlled by one scalar parameter in 1-D and two scalar parameters in 2-D. The transmit beampattern is the convolution of a rectangle with a sincsquared function in 1-D, and the separable product of such functions in 2-D. The signals are constant-modulus, have desirable temporal autocorrelation properties, and are simple to compute. [C239]

"Sparse Signal Representation for Complex-Valued Imaging"

We propose a sparse signal representation-based method for complex-valued imaging. Many coherent imaging systems such as synthetic aperture radar (SAR) have an inherent random phase, complex-valued nature. On the other hand sparse signal representation, which has mostly been exploited in real-valued problems, has many capabilities such as superresolution and feature enhancement for various reconstruction and recognition tasks. For complex-valued problems, the key challenge is how to choose the dictionary and the representation scheme for effective sparse representation. We propose a mathematical framework and an associated optimization algorithm for a sparse signal representation-based imaging method that can deal with these issues. Simulation results show that this method offers improved results compared to existing powerful imaging techniques. [C240]

"Simulation of the front-end of a MEMS based ultra narrow band tomographic imaging system"

This paper describes a simulation architecture used to simulate an ultra narrow band radar tomographic imaging (UNBRaTI) system. The work is being performed at Rochester Institute of Technology. The paper lays the groundwork for an effort to develop a systems level approach for the simulation and analysis of an UNBRaTI system using traditional radio frequency (RF) components as well as micro-electro-mechanical systems (MEMS) based components. The utility of the approach is its ability to apply sound systems engineering principles and techniques to compare and contrast traditional RF components with MEMS based components and their effects on system level performance. The simulation has been architected for ease of scalability in order to analyze basic to complex system configurations. [C241]

"A signal level simulator for netted radar waveforms evaluation"

When evaluating the performances of radar waveforms, it is crucial to understand how the signal is affected by multiple interactions with the environment and the system hardware. Analysis of complex radar systems, such as multistatic and netted designs (see Fig. 1) is often intractable without the application of a dedicated radar simulation system. Recent research into radar simulation has focused primarily on synthetic aperture radar (SAR) systems and is not entirely applicable to traditional radar systems concerned with the location and tracking of

remote targets. A complete simulator has been designed for the accurate simulation of raw returns in complex, multistatic and netted radars and is applicable to pulsed and continuous wave (CW) systems, and both active and passive radar systems. The flexible simulator for multistatic radars (FERS) can be used to simulate radar systems with arbitrary waveforms and arbitrary numbers of receivers, transmitters and scatterers. In this paper, algorithms for the simulation of raw radar return signals are presented, based on interpolation and modification of the transmitted signal and modelling of the radar hardware and environment. The algorithms are expected to be especially valuable for the simulation of emerging radar technologies, such as Passive Coherent Location (PCL), netted radar and phased array radar. Preliminary results, presented in this paper, suggest that these algorithms can simulate physical systems with excellent accuracy. [C242]

"Software Architecture and Design for Airport Scene Surveillance Radar Data Processing System"

Airport scene surveillance radar has high data rate and huge echo data, and it needs to complete target tracking, data storing and displaying quickly. So the airport scene surveillance radar data processing software system is complex, it needs to support multi-sensor data fusion, distributed data services, remote control, and multi-surveillant terminals etc. Based on orthogonal software architecture, this paper proposes new software architecture: object-oriented component orthogonal architecture, and the airport scene surveillance radar data processing system was designed by this. After the system development and test, it proves that the software architecture is reasonable and applicable. [C243]

"Using complex-valued ICA to efficiently combine radar polarimetric data for target detection"

Target detection in sea clutter is a challenging problem in radar detection, specifically, when the Doppler return of the target and clutter are collocated. Polarization diverse radars provide additional information that enhances target detection. In this paper, we use an effective independent component analysis (ICA) approach, adaptive complex maximization of non-Gaussianity (A-CMN), to efficiently combine polarimetric radar data prior to detection. We show that A-CMN estimates the polarimetric scatter coefficients for the single target in clutter case, thereby providing matched-filter performance without the need for clutter or target models. The detection performance using ICA is evaluated with sea clutter collected with the McMaster IPIX radar off the coast of Canada. We also demonstrates the ability of this approach to adapt to the changing sea clutter conditions using simulation results. [C244]

"Performances of variable step-size adaptive algorithms in non-Gaussian interference environments"

Two variable step-size normalized least mean square (VSS-NLMS) algorithms, namely the non-parametric VSS-NLMS and switched mode VSS-NLMS, are reformulated into complex signal form for STAP applications. The performances of these two VSS NLMS algorithms in Gaussian and compound-K clutters are evaluated via a phased array space-slow-time STAP example. We find that the misadjustment behaviors are inconsistent with the excess MSEs which is a better measure of STAP performance. Both VSS-NLMS algorithms outperform conventional fixed step-size (FSS) NLMS algorithms with fast convergence and low steady-state excess MSE. The SM-VSS-NLMS provides a better performance compromise than the NP-VSS-NLMS with much lower steady-state excess MSEs and slightly slower convergence speeds. The performance gain of both VSS algorithms reduces in heavy-tailed clutter environments than that in Gaussian clutters. Their robustness against impulsive interference is better than conventional FSS-NLMS. [C245]

"Tracking a ballistic target by multiple model approach"

Radar tracking of a ballistic object flying in the Earth's atmosphere is a very complex issue to cope with, due to the need of (suboptimal) nonlinear filtering techniques. When the characteristics of the target are poorly known, and an identification problem is added, a solution is represented by a multiple model approach. This paper investigates the problem by evaluating a number of parameters which affect the solution. The multi modal approach is compared with a generic extended Kalman filter. A theoretical limit for the performance is computed by means of the posterior Cramer-Rao lower bound. [C246]

"Automatic road extraction from LIDAR data based on classifier fusion"

The ultimate goal of pattern recognition systems in remote sensing is to achieve the best possible classification performance for recognition of different objects such as buildings, roads and trees. From a scientific perspective, the extraction of roads in complex environments is one of the challenging issues in photogrammetry and computer vision, since many tasks related to automatic scene interpretation are involved. Roads have homogeneous reflectivity in LIDAR intensity and the same height as bare surface in elevation. Proposed method

in this paper is based on combining multiple classifiers (MCS) is one of the most important topics in pattern recognition to achieve higher accuracy. Majority Voting and Selective Naive Bays are two methods that used for fusion of classifiers. [C247]

"Asymptotics of Multi-Fold Vandermonde Matriceswith Applications to Communications and Radar Problems"

We study the performance of signal estimation and reconstruction systems, that exploit the linear minimum mean square error (LMMSE) technique. This model often occurs in signal processing and wireless communications; some examples are radar applications, MIMO communications, or sensor networks sampling a physical field. Our performance analysis implies the characterization of a random matrix product, involving a multifold Vandermonde matrix with complex exponential entries. We therefore derive the LMMSE by computing the eta-transform of this matrix product, which can be evaluated either by implicit as well as by explicit expression, using the matrix asymptotic moments. Finally, we show how our results can be applied in some cases of practical interest. [C248]

"Track-Before-Detect for sensors with complex measurements"

Track before detect (TkBD) is a paradigm that combines the target detection and estimation processes that are usually sequentially applied to sensor data in a conventional system. Under TkBD the single frame detector is removed and the tracker is supplied with the whole sensor image. Detection decisions are then shifted to the output of the tracker which is able to use temporal correlation to improve the decision performance. A fundamental measure used by most TkBD approaches is the likelihood ratio of the sensor data and this is formed as the product over individual cell likelihoods under the assumption of spatially independent noise. However, that approach exploits only the envelope of the known sensor point spread function. This article presents an approach for determining the data likelihood ratio that also includes phase information. This alternative likelihood ratio formulation is shown to both improve the discrimination of targets from noise and reduce the computation overhead of the algorithm. [C249]

"Cyclotron protective device with increased frequency band"

The authors talk about the last achievements with designing the cyclotron protective device (CPD) having a recovery time not more then 20 to 30 ns. The combination of CPD with low noise amplifier (LNA) is named as cyclotron protected complex amplifier (CPCA). It is concluded that increasing the frequency band of 3 cm wavelength CPD in twice is very important stage of development for present-day radar systems. [C250]

"Segment Clustering Radar Signal Sorting"

Radar signal sorting is picking-up pulse serial of same radar emitter from dense complex pulse signal flow. The tolerance of radar signal sorting is analyzed in modern electronic warfare. The complex and dense pulses environment makes it become a vital factor to restrict the efficiency of sorting of the conventional multi-parameters signal sorting system. A segment clustering radar signal sorting method is presented based on support vector clustering (SVC) according to the idea of statistics learning theory. It prevents tolerance from affecting radar sorting. The accuracy of sorting and the sensitivity of algorithm on parameter variation is analyzed. The experimental results show that the sorting method presented is effective to overcome the tolerance of radar signal sorting. [C251]

"A new nonlinear filtering method for ballistic target tracking"

Tracking a ballistic re-entry target from radar observations is a highly complex problem in nonlinear filtering. The paper adopts a one-dimensional vertical motion model with unknown ballistic coefficient, we present a square-root quadrature Kalman filter (SRQKF) algorithm for this ballistic target tracking problem. The proposed algorithm is the square-root implementation of the quadrature Kalman filter (QKF). The quadrature Kalman filter is a recursive, nonlinear filtering algorithm developed in the Kalman filtering framework and computes the mean and covariance of all conditional densities using the Gauss-Hermite quadrature rule. The square-root quadrature Kalman filter propagates the mean and the square root of the covariance. It guarantees the symmetry and positive semi-definiteness of the covariance matrix, improved numerical stability and the numerical accuracy, but at the expense of increased computational complexity slightly. [C252]

"Estimation of crowd behavior using sensor networks and sensor fusion"

Commonly, surveillance operators are today monitoring a large number of CCTV screens, trying to solve the complex cognitive tasks of analyzing crowd behavior and detecting threats and other abnormal behavior. Information overload is a rule rather than an exception. Moreover, CCTV footage lacks important indicators

revealing certain threats, and can also in other respects be complemented by data from other sensors. This article presents an approach to automatically interpret sensor data and estimate behaviors of groups of people in order to provide the operator with relevant warnings. We use data from distributed heterogeneous sensors (visual cameras and a thermal infrared camera), and process the sensor data using detection algorithms. The extracted features are fed into a hidden Markov model in order to model normal behavior and detect deviations. We also discuss the use of radars for weapon detection. [C253]

"Multiple dictionaries-based radar target identification via a likelihood ratio test"

Target identification has been an active researching area in past decades. In this paper, we present an iteration procedure to optimize the size of the undercomplete dictionary when multiple undercomplete dictionaries are used to characterize the scattering signatures of a complex target. Furthermore, we extend the signature reconstruction and decision criterion with only single undercomplete dictionary to the case with multiple dictionaries for a more practical target identification application. The proposed approach is compared with the matching-score criterion-based approach and single dictionary-based approach using measured signatures of three aircraft models in an ultra wide-band chamber. Results show that the proposed approach can provide more promising identification accuracy due to a more effective representation to the complex scattering behaviors. [C254]

"Convoy detection processing by using the hybrid algorithm (GMCPHD/VS-IMMC-MHT) and Dynamic Bayesian Networks"

Convoys are military objects of interests in certain applications like battlefield surveillance, that is why it is important to detect and track them in the midst of civilian traffic as part of the situation assessment. Our purpose is a process in two steps. The first is an original tracking algorithm appropriate for ground moving target indicator (GMTI) data based on the hybridization of a labeled GMCPHD (Gaussian mixture cardinalized probability hypothesis density) and the VS-IMMC-MHT (variable structure-interacting multiple model with constraints-multiple hypothesis tracking): one is very efficient to estimate the number of targets and the other for the state estimates. Then, by using algorithm outputs and other data like video or SAR if they are available, vehicle aggregates are detected and their characteristic are introduced into a dynamic Bayesian network which processes the probability for an aggregate to be a convoy. Finally, the number of targets belonging to the convoy is evaluated. This process is tested on a complex simulated scenario, our tracking algorithm is compared to classical ones and used to compute the probability to have convoys. [C255]

"Unification of radar and sonar coverage modeling"

Radar and sonar are by tradition separate disciplines with different user communities. This situation is about to change as many navies are experimenting with reduced manning concepts. As a result, tomorrow's sensor operator is likely to monitor and control all available sensors on his own. In this situation operator overload is expected, especially due to less educated and less experienced personnel and the introduction of new and more complex sensor systems. A possible solution is a high level of automation in sensor management and the integration of tactical decision aids. To further assist the human operator, this work aims to unify sensor performance modeling for the complete sensor suite. The radar and sonar equations are compared and combined with a propagation model for complex environments. The analysis of a real-world scenario with both radar and sonar is shown to result in a unified visualization of predicted sensor coverage. [C256]

"Camera and imaging radar feature level sensorfusion for night vision pedestrian recognition"

This contribution presents a robust pedestrian detection system at night that fuses a camera sensor and a scanning radar sensor on feature level. Each sensor defines an overdetermined set of features to be selected and parameterized using the supervised training algorithm AdaBoost. This technique assures an optimal selection and weighting of the features from both sensors depending on their discriminative power for the classification task. In the radar plane a new complex signal filter has been derived which describes a local similarity measure of velocity differences. In order to achieve realtime capability multiple classifiers are combined using a cascade. [C257]

"SAR Image Compression Using Wavelet Packets"

A SAR (Synthetic Aperture Radar) system usually collects huge amount of data, and focusing of the raw data acquires complex range varying phase compensation techniques, which are generally performed off-board. The large amounts of data generated have to be stored on-board or be transmitted to a ground station via a dedicated data link. Therefore, some form of compression on the raw data provides an attractive option for SAR systems. In this paper we investigate the usage of WPT (Wavelet Packet Transform), which performs uniform

division of frequency spectrum, independently on real and imaginary parts of the complex SAR raw data along with scalar quantization for compressing SAR raw data. We propose another image coding algorithm which uses rate distortion optimized WPT. [C258]

"A multi-agent method for automatic building recognition based on the fusion of Lidar range and intensity data"

Lidar has proved to be a promising data source for various mapping and 3D modeling of buildings in urban areas. Therefore, many researchers have been trying to study and develop automatic building recognition algorithms based on Lidar data. But, according to the complicated relationships between buildings and other objects in urban areas, especially trees and vegetations, the performance of obtained results from most of these algorithms is still dependent to several assumptions and simplifications. In this paper a multi-agent methodology has been proposed for automatic building recognition based on the fusion of textural and spatial information extracted from Lidar range and intensity data. The evaluation of obtained results confirms the high capabilities of this proposed multi-agent algorithm to decrease the conflicts in the field of automatic building recognition in complex urban areas. [C259]

"FPGA-based Radar Signal Processing for Automotive Driver Assistance System"

Safety and comfort applications are addressed using driver assistance (DA) systems like adaptive cruise control (ACC) system using long range radar (LRR) or short range radar (SRR) or both. Novel waveforms and functionalities applied to next generation DA multi-sensor systems and their corresponding complex algorithms require advanced digital hardware supporting high computation rate and severe real-time constraints. In this paper, we present a flexible FPGA-based architecture for digital control and signal processing of a DA system. The considered DA system makes use of a new particular waveform to enhance capabilities of old generation ACC radar. Hardware/software partitioning has been explored in order to match the real-time requirement of the system. Development steps, from algorithm specification to on-board demonstration, are detailed. Promising results in terms of resources use and execution time are shown using a prototyping board with a single Virtex-II Pro device. [C260]

"Sum and difference pattern with common aperture tail"

For tracking and search design array antennas is very usually the optimization of the main beam sum pattern to sidelobe level ratio, SLL, while still maintaining high directivity of the main beam. For tracking systems, a difference pattern is needed as an auxiliary pattern with a boresight null coincident with the beam peak of the main (sum) pattern. The tracking drive system moves the antenna positioner until the signal in this difference channel reaches a minimum, thereby causing the main channel (sum) to point accurately at the radar target. Aperture distributions of sum good patterns, e. g. Taylor distributions, and difference patterns, e. g. Bayliss distributions, are different. Theoretically, two independent excitations could be applied to the search-and-track antenna in order to achieve good features in both patterns. However, this approach requires a feed network too complex to make a practical design feasible. [C261]

"An approach for robust mapping, detection, tracking and classification in dynamic environments"

Understanding its environment remains a difficult problem for a mobile robot. Several intricate problems (localization, mapping, detection, tracking, classification) have indeed to be solved concurrently. However, most perception algorithms solve these issues independently leading to limited performances in highly changing environments. We present in this paper an original approach where the mapping, the tracking, the detection and the classification problems are addressed concurrently and where the perceptual knowledge of the robot is described using four recursively estimated discrete probability mass functions. Our first experiments based on simulated and real range data show that our approach is able to cope with complex outdoor situations. [C262]

"Generation of a narrow linewidth mm-wave signal from two phase-locked DFB lasers that are mutually coupled via four wave mixing"

Wireless communication systems require compact sources for the generation of mm-wave signals, that must have high spectral purity (linewidth < 100 kHz, phase noise < 100 dBc @ 100 kHz offset), tuneability, low power consumption and low cost. Other important applications for mm-wave signals are: i) anti-collision car-borne radars (60 GHz); ii) local oscillators for astronomic investigations (100-900 GHz range); iii) THz applications (300-3000 GHz range). The optoelectronic approach based on photomixing is tuneable and scalable, and allows for the propagation along an optical fiber. The major limitation lies in the spectral purity of the generated RF signal that can be hardly reduced below 1 MHz. To achieve a better spectral purity, complex systems have been

proposed, that include a reference RF signal source and an opto-electronic feedback loop. [C263]

"Characterization of UWB antenna in time domain using the complex natural resonances"

In this paper, we have shown the possibilities to extract CNR (coefficient natural of resonances) of an UWB antenna with a signal processing in time domain (SEM method). Complementary analyses are in progress to enhance the first interesting results obtained on CNR's extracted from TLS-Prony processing. [C264]

"Radio channel simulations using multiple scattering center models"

A stochastic approach to model scattering effects of complex objects in comprehensive system simulation scenarios has been used in a simple and consistent way. In the given example the system simulation complexity is thereby reduced from appr. 100000 triangles per vehicle object down to 80 triangles plus additional bistatic RCS table look-ups. Consequently, detailed deterministic analyses of radio channel signal variations can be carried out for critical communication or sensing systems in an efficient and accurate way. Significant deviations can be observed, as expected, particularly at the shadow boundaries for grazing incidence. It should be mentioned that for larger scenarios and rather low number of observation points a system level ray tracing instead of the ray launching is expected to bring performance benefits. Nevertheless, a good approximation of the results obtained with the much more complex polygonal models has been proven. [C265]

"An optimization procedure for signature reconstruction of near-field targets"

In this paper, a target reconstruction procedure is proposed for simulating the near-field signatures of a complex target with high fidelity. The target model is composed of trihedral corner reflectors and different radar targets can be represented by combinations of trihedral corner reflectors without manufacture of either full-size or scaled target models. The near-field target is initially reconstructed based on the synthetic radar image. An optimization procedure is proposed to improve the performance of such target model. Simulation results show that the aspect-variant scattering characteristics of the target model maintain good agreements with that of the true target. [C266]

"Model-based statistical analysis of PolSAR data"

In this paper, we consider statistical analysis of PolSAR data in the framework of the multivariate product model. The complex scattering vector is here considered as a double stochastic circular Gaussian variable, in which the variance is linearly scaled by a common stochastic scaling factor z. The scaling factor is associated with texture. We discuss various parametric probability density functions for z, and indicate how model parameters can be estimated from data by a simple moment based method. Experimental analysis shows that for some surface covers, certain texture distributions fit better than others. Then, polarimetric covariance matrix data analysis is addressed in the framework of product models, and we propose a processing scheme which perform image segmentation using a stochastic EM approach. [C267]

"Exploitation of ALOS-PALSAR SAR full-polarimetry data to the mapping of an African region"

Due to their large scale of observation and their relatively high revisiting frequency, spaceborne SAR systems offer interesting possibilities for the systematic monitoring of land cover. Several techniques have been developed to analyze land cover areas from single-polarization spaceborne SAR data, based on the statistical properties of the reflectivity of such complex media and its spatial variations (texture). The reduced resolution of the data, compared to the airborne SAR case, is a particularly limiting factor. Polarization diversity offers an interesting and powerful alternative mean to characterize land cover areas. In this paper, we propose to use polarimetric SAR acquired by the ALOS sensor at L band, to monitor land cover of an African region. [C268]

"Method of persistent scatterer pairs (PSP) and high resolution SAR interferometry"

Synthetic aperture radar (SAR) interferometry is an effective technology for detection and monitoring of slow terrain movements with millimetric resolution. This information is extracted by means of complex techniques from the phase of the signal, which is wrapped modulo 2Г‚Вї and affected by noise and systematic terms. We have recently proposed a new method, named persistent scatterer pairs (PSP), aimed at overcoming some limitations of standard persistent scatter interferometry (PSI) techniques. The method is characterized in that it works only with pairs of nearby pixels both for selecting and analyzing the persistent scatterers (PS), thus being intrinsically not affected by artifacts slowly variable in space, like those depending on atmosphere or orbits. Moreover, the method does not require an initial selection of PS based on the radar backscattered amplitude. In this work, after resuming the main ideas of the PSP method, we show some results obtained in extensive applications with ERS/ENVISAT data, and the first results obtained with high resolution COSMO-SkyMed images. [C269]

"Multiple scatterers identification in complex scenarios with adaptive differential tomography"

In the last few years, the interest is increasing in the interferometric processing of multibaseline/multitemporal SAR data from complex urban or infrastructure areas. In order to locate and monitor a high number of ground structures with the lowest signal misinterpretation, the identification, i.e. the detection and height and deformation velocity estimation, of both single and multiple layover scatterers is an important step. This issue is addressed here by extensively experimenting the technique of adaptive differential tomography, a recent interferometric framework which allows to resolve multiple moving scatterers at different heights in the same SAR cell. To this aim, adaptive differential tomography is augmented with an automated information extraction algorithm. The technique has been applied to real C-band spaceborne data over an urban area. Corresponding results are discussed. [C270]

"Chirp scaling algorithm for parallel bistatic SAR data processing"

This paper discusses parallel bistatic synthetic aperture radar (SAR) processing using chirp scaling algorithm. The key step is to use an analytical form of the signal spectrum derived by the geometry-based bistatic formula (GBF) method. With the above formula, a chirp scaling (CS) algorithm is proposed for azimuth-shift-invariant bistatic SAR processing. The presented algorithm can well resolve the range variation of motion through range cell(MTRC) for bistatic SAR, and requires no interpolate; it requires only FFTs and complex multiplies, these attributes lead to efficient implementations of FFT-based signal processors and high speed parallel processors; it can be used for high resolution image formation. [C271]

"Simulation of 3D laser systems"

This paper deals with modeling of new optical non-conventional imaging with laser systems. In this paper, we present the simulation of the 3D ladar sensor including physics based modeling of laser backscattering from complex rough targets, reflectance modeling of porous occluders, development of 3D scenes and reconstruction algorithms for identification. We shall focus on tomography algorithms for reconstructing optical three-dimensional scenes. [C272]

"Sea surface simulation for SAR remote sensing based on the fractal model"

Based on the fractal ocean surface model, electromagnetic scattering model under Kirchhoff Approximation and the raw signal simulation procedure of dynamic scene based on time domain, the sea surface of the SAR remote sensing has been simulated. The images of the wave and complex fractal sea surface are in accordance with the hydrodynamic modulation, the tilt modulation and the velocity bunching modulation. The simulation has been developed in the Matlab programming language. [C273]

"Comparison of helicopter-borne thin sea ice thickness profiles with polarimetric signatures of dual-pol Terrasar-X data"

In this paper first results of a sensitivity study using dual polarimetric TerraSAR-X data for ice thickness estimation are presented. The sea ice thickness reference data set was measured, coincident to the SAR data take, by means of a helicopter-borne EM sounding device on April 28, 2008 in the Russian Arctic. For some of the signatures, namely the complex correlation coefficient, a relation to ice thickness could be found that is theoretically predicted for L-band SAR. The first results show, that the new generation of polarimetric space borne SAR sensors like TerraSAR-X may open a new opportunity for thin sea ice thickness monitoring from space. [C274]

"The January 2002 eruption of Nyiragongo volcano (DRC) captured by InSAR"

On 17thJanuary 2002, Nyiragongo erupted along an approximately 20 km long fracture network extending from the volcano to the city of Goma and its airport. The event was captured by InSAR data from the ERS-2 and RADARSAT-1 satellites acquired in three different geometries. These data show complex ground displacements, with several overlapping fringe patterns, associated to a combination of sources of magmatic and tectonics origins. A combination of 3D numerical modeling and inversions is used in order to interpret these displacements. Synthetic tests indicate that with one to three INSAR geometries, the best fit and mean models are within the confidence intervals whether the source of displacements is a single dike, a dike combined with a west dipping normal fault or a dike combined with an ellipsoid. Increasing the number of InSAR geometries makes the confidence intervals smaller and the inversions faster. At this stage of the study, only the area close to the eruptive fissures was analyzed assuming displacements were caused by a single dike. The best-fit dike model obtained with a simultaneous inversion of the three InSAR geometries is subvertical, and has a low

overpressure. Both characteristics are consistent with the rift context. [C275]

"SAR interferometry and Speckle tracking approach for glacier velocity estimation using ERS-1/2 and TerraSAR-X spotlight high resolution data"

Glacier retreat and advance is general phenomenon in Himalayan region due to change in climatic conditions. For quantifying the global warming effects on local scale glacier system monitoring and estimating its dynamic geophysical parameters viz. movement and volume change are important. In this study glacier movement estimation is attempted in north western Himalayan region using spaceborne InSAR technique, which is based on preserving the coherence between two acquisitions of the same scene. It is observed that ERS-1/2 tandem data give high correlation over Gangotri glacier and Siachen glacier and movement in LOS direction is deciphered. However, with the use of SAR Speckle tracking method two dimensional (Azimuth and range directions) velocities of glaciers can be obtained. In this study attempt has been made to measure 2-D velocity components of Gangotri glacier. New generation TerraSAR-X (TS-X) high resolution spotlight mode (HS), single look slant range complex (SSCs) data of 28thAugust, 2008, 08thSeptember, 2008, 19th September, 2008 and 30thSeptember, 2008 are exploited for this study. Interferogram, coherence image and intensity image are generated. It is observed that Interferometric SSC data of 28thAugust, 2008 and 08th September, 2008 give some fringes outside glacier area and complete decorrelation is shown on the Gangotri glacier due to high movement of glacier. [C276]

"SWIM: A state of the art multi-incidence beams Ku-band waves scatterometer to go beyond current radar systems"

The instrument SWIM (Surface Waves Investigation and Monitoring) on the CFOSAT program (Chinese French Oceanographic Satellite) is a state of the art radar for several reasons. At first, SWIM is the first ever space radar concept that is mainly dedicated to the measurement of ocean waves directional spectra and surface wind velocities through multi-azimuth multi-incidence observations. Orbiting on a 500 km sun-synchronous orbit, its multiple Ku-band (13, 575 GHz) beams illuminating from nadir to 10Г‚В° incidence and scanning the whole azimuth angles (0-360Г‚В°) provide with a 180 km wide swath and a quasi global coverage of the world between -80 and 80Г‚В°. Secondly, such a wide range of observations requiring high range resolution (about 20 m on the ground) have led to design an instrument whose architecture and technology goes beyond what has been done on altimeter and scatterometer systems. The global coverage and the reduction of telemetry budgets have required to perform onboard range compression. The variety of signals at different incidences, the impact of the complex moving geometry of observation and the required real-time signal processing have led to propose onboard complete digital range compression on backscattered 320 MHz bandwidth signals. Finally, multi-azimuth multi-incidence observations requirements have led to design a complex antenna subsystem that rotates at 6 rounds per minute while transmitting high power RF signals towards tunable directions. [C277]

"Mapping aurora activity with SAR-a case study"

Auroral physics is an exceedingly rich and complex subject. However, due to a lack of high resolution data of ionospheric activity during auroral events, not all phenomena in the high latitude ionosphere are fully understood. Recent research has proven that L-band SAR data is significantly affected by the ionosphere and can be used for mapping its activity. With this paper we will prove and unambiguously verify the potential of L-band SAR to capture auroral activity. We will present examples of aurora signatures mapped from ALOS PALSAR data and will verify the results from SAR with observations provided from ground based measurements. [C278]

"Time series of polarimetric and interferometric observations of TerraSAR-X data over rice fields in Spain"

The objective of this work is to investigate the coherent co-polarized behavior of rice plants during the growing stages and to explore their information content for rice monitoring at high frequencies recently available through new SAR satellite missions. Time series of dual-pol TerraSAR-X images have been acquired during the whole cultivation period over a rice site in Spain. Among different observations, the backscattering coefficients at HH and VV channels and the HH/VV ratio have confirmed to show a temporal variation that has a significant correlation with the development of the plants during the vegetative and reproductive phenological phases. In addition, the information content of the HHVV complex coherence and a dual polarimetric target decomposition is investigated and discussed. All the information layers investigated are contributing to the discrimination of rice fields from other crop types. Finally, interferograms computed with pairs of successive images (11 days separation) have been preliminary tested. [C279]

"Local, nonlinear adaptive co-registration of master and slave interferometric SAR complex image

data for high quality digital elevation map generation"

Interferometric synthetic aperture radar (InSAR) is a key technology in geoscience. In the generation of a digital elevation map (DEM), the elimination of singular points (SPs) is the most important process besides the phase unwrapping (PU). A SP means a point where the phase rotation is not zero in the interferogram obtained by InSAR. What yields the SPs? One reason is a big cliff actually existing in the observation region. Empirically, such cliff-generated SP pairs (positive and negative SPs) are located at a distance from each other. Contrarily, other SP pairs, which make up the majority of the SPs, emerge closely to each other. Such close pairs arise from the autointerference caused by the diffraction in electromagnetic-wave propagation including the local permittivity fluctuation effect related to moisture vapor density in the air and other effects. We call the former the global SPs, while we do the latter the local SPs. [C280]

"Polarimetric scattering feature estimation for accurate vegetation area classification"

This paper proposes an accuracy improvement of the vegetation area classification based on the POLSAR image analysis, when vegetation and man-made areas are both included in the radar target region. Here we introduce a simple compensate polarimetric marker, T13or T31, to accurately distinguish the unexpected scattering from the obliquely oriented man-made targets and the complex volume scattering generated from vegetation area. T13or T31is the (1, 3) or (3, 1) elements of the 3Γ́B—3 averaged coherency matrix ([T]), and has not been effectively utilized in the general scattering power decomposition scheme. By appropriately utilizing T13(T31), one can extract only the vegetation area from the mixed target region. It is verified from the detailed analysis that the proposed marker T13(T31) works well not only for Pi-SAR data but also for ALOS/PALSAR data. [C281]

"Techniques and examples for the 3D reconstruction of complex scattering situations using TerraSAR-X"

The German radar satellite TerraSAR-X was launched in June 2007. Since then, it is continuously providing high resolution space-borne radar data which are perfectly suitable for sophisticated interferometric applications. I.e. the mission concept and the SAR sensor support the coherent stacking of radar scenes which is the basis for advanced processing techniques e.g. Persistent Scatterer Interferometry (PSI) and SAR tomography. In particular, the short repeat cycle of eleven days and the highly reproducible scene repetition of the spotlight acquisitions support the stacking and consequently the time series analysis of the radar data. Furthermore, the sensor's orbital tube is precisely controlled to be in the order of 200 m which basically allows to utilize the baseline spread of the stacked acquisitions. However, this small spread is actually limiting the resolution in the SAR tomography. Interferometric applications could be demonstrated already in a very early stage of the TerraSAR-X mission. Because the resolution is 0.6 m in slant range and 1.1 m in azimuth in the high resolution spotlight mode the PSI and the SAR tomography processing results were impressive. Urban areas and single buildings could be mapped from space in three dimensions. Even the structural stress of single buildings caused by thermal dilation could be demonstrated. However, extended layover areas are caused by typical buildings and as a consequence complicated scattering situations need to be resolved. DLR's operational In-SAR processing system GENESIS had already been adapted to cope with the new sensor modes of TerraSAR-X and their new specific spectral characteristics. Now, the new image characteristics e.g. the extended layover areas and the long time coherent distributed scatterer need better to be supported. Subject is to optimally exploit the available information e.g. the radar reflectivity. Several algorithms of the processing system can take advantage of this, e.g. the scatterer-configuration detection. As a matter of fact, the scatterer configuration has now become a very important characteristic for each resolution cell. It influences e.g. the estimation data extraction, the estimation of the 3D location and basically the estimation precision. A typical resolution cell can be composed of a single dominant point scatterer surrounded by clutter, two or more dominant point scatterers in clutter and of distributed scatterers with a specific phase stability over time. The paper provides technical details and a processing example of a newly developed algorithm to retrieve the 3D location of point scatterers from the scene's intensity which finally also provides the information on the scatterer configuration in a resolution cell. [C282]

"Detection and analysis of urban areas using ALOS PALSAR polarimetric data"

Due to their large scale of observation and their relatively high revisiting frequency, spaceborne SAR systems offer interesting possibilities for the systematic monitoring of urban areas. Several techniques have been developed to analyze urban areas from single-polarization spaceborne SAR data, based on the statistical properties of the reflectivity of such complex media and its spatial variations (texture). The reduced resolution of the data, compared to the airborne SAR case, is a particularly limiting factor. Polarization diversity offers an interesting and powerful alternative mean to detect and characterize urban areas. In this paper, we propose to use po-larimetric SAR acquired by the ALOS sensor at L band, to monitor urban areas. The proposed technique uses three complementary approaches to discriminate urban structures using detectors adapted to the complex

polarimetric features of this medium, to isolate specific coherent responses from a Time-Frequency analysis of the coherent SAR signal, and finally to characterize built-up areas from the coherence properties of their Polarimetric and Interferometric SAR (POL-inSAR) response. [C283]

"Statistical characterization of the Sinclair matrix: Application to polarimetric image segmentation"

This paper focuses on the flexibility of a multidimensional model of probability density function (pdf) to describe distribution of complex data in polarimetric SAR images. This model is based on Copulas Theory for characterizing the dependence between the polarimetric channels (HH, VV, HV, VH). This corresponds to finding a model based on multidimensional copulas to describe the behavior of the target vector. The advantage in using copulas theory is to extend correlation concept to a wider dependence one, which may be non-linear, especially when processing high-resolution data. So, from this point of view, the model is more flexible than the classical Wishart distribution since no speckle filtering is required as preprocessing step to model accurately the pdfs. The other advantage of copulas is to split dependence concept and marginal distributions. Then, this multidimensional characterization may be linked to pdf which are not necessary of circular Gaussian law. So, specific parametric distribution may be choosen to fit each component (modulus and phase) of the Sinclair matrix. It yields a flexible model, for characterizing statistical behavior of the polarimetric SAR data, that may be derived to produce a segmentation algorithm. [C284]

"Fragment size detection within homogeneous material using Ground Penetrating Radar"

Ground Penetrating Radar (GPR) offers the ability to observe the internal structure of a pile of rocks. Large fragments within the pile may not be visible on the surface. Determining these large fragment sizes before collection can improve mine productivity. This research has examined the potential to identify objects where the background media and the object exhibit the same dielectric properties. Preliminary results are presented which show identification is possible using standard GPR equipment. [C285]

"Fast characterization of radiation patterns of conformal array antennas in the Presence of Excitation Errors"

A multilevel algorithm for the statistical characterization of the radiation patterns of beam steered conformal arrays is presented. The algorithm can be used to obtain average complex field patterns and power patterns in the presence of random amplitude and phase excitation errors. The computational scheme is based on a hierarchical decomposition of the array into smaller sub-arrays. At the finest level of decomposition, the radiation patterns of single element arrays are computed or measured over a sparse grid of directions. The subsequent computational sequence comprises interpolations and aggregations of sub-array contributions repeated until obtaining the radiation pattern of the array. The proposed algorithm attains a computational complexity substantially lower than that of the direct computation and thus can be employed for Monte Carlo type statistical simulations. [C286]

"Low cost moving target tracking and fire control"

Classical solutions for moving target tracking and fire control are complex and costly as they involve high performance radar, specific weapons and highly accurate seekers. The innovative solution described in this article uses a multiplatform configuration to simultaneously track target and weapon, thanks to a GMTI mode with a wide velocity waveform. The accuracy of the initial designation and the subsequent target+weapon update allow the use of a simpler weapons, drastically reducing the global mission cost. [C287]

"A GPU based real-time SAR simulation for complex scenes"

This paper presents a novel simulator which uses programmable graphics processing units (GPU) to generate Synthetic Aperture Radar (SAR) images. The conventional SAR simulations, based on mere mathematical computation, are usually time-consuming and not intuitionistic. In this paper, a new method which can simulate real-time SAR images even for complex scenes is developed. The simulator takes the advantage of computer graphics in three-dimensional display and combines it with SAR principle to yield the SAR images. This is implemented on graphics hardware, which offers 3D hardware acceleration and programmable GPU. [C288]

"A robust adaptive detector for steering phase uncertainties"

This paper deals with adaptive detection of a signal with unknown complex amplitude and whose steering vector presents angle uncertainties. The background environment is assumed homogeneous and Gaussian with unknown covariance matrix. At the design stage, we devise a robust receiver accounting for the aforementioned uncertainty. To this end, we prove that the maximization of the concentrated likelihood function over the phase

parameter shares an hidden convexity property. Specifically, exploiting some recent results concerning trigonometric polynomials, we formulate the apparently non-convex maximization over the phase as a Semidefinite Programming (SDP) convex optimization problem. At the analysis stage, we assess the performance of the new receiver in comparison with some classic detectors available in open literature. [C289]

"Classification of SHOALS 3000 bathymetric LiDAR signals using decision tree and ensemble techniques"

Coastal Management is a complex issue that is facing policy makers and scientists around the world. Monitoring the coast can be difficult given the vast stretch of water which needs to be covered. Ship-based surveys can take weeks to perform mapping of the coastal zone. LiDAR bathymetry is a tool which shortens the survey time at reduced survey cost. The objective of this paper is to describe the parameterization of the LiDAR waveform from the SHOALS 3000 LiDAR system and show how it can be successfully used for classification of bottom habitat. Decision tree techniques and ensemble methods are used for classification purposes. The Rotation Forest ensemble method provided the greatest overall classification accuracy of 91% averaged over all fractions of the training data. [C290]

"Design and Implementation of Digital Channelized Receiver in Multi-FPGA"

A method of parallel processing for digital channelized receiver to complex signal is proposed to solve the problem of shortage of resources in real-time signal processing. When complex signals go through poly-phase digital channelized receiver, in order to ensure there are non-blind spots and frequency aliasing, the maximum decimation factor per channel can only be half of the number of the channels. This directly increases the data that will be processed. In order to deal with this data in specific time, the processor needs more resources or higher processing speed. The paper takes full advantage of the decimate factor and analyses the law of the convolution in the non-blind spots digital channelized receiver. The filter bank structure is achieved by using two parallel computing modules. In this way, the digital channelized receiver can be achieved in several processors simultaneously. So, the resource problem is ameliorated by this parallel implementation. Experimental results proved that the proposed method performs well in distributing the processor's resources and improving the characteristic of ultra-wideband channelized receiver, especially complex signals involved. [C291]

"Study of effect of room window on through wall imaging in UWB range"

In through wall imaging (TWI), detection is possible due to dielectric contrasts between target and room environment. Complexity increases if room consists of furniture's and other objects beside desired target. Further detection of desired target becomes complex with the presence of window in back wall of room. Thus in this paper, effect of presence of window in back wall of room is investigated on detection and imaging. A detection technique is proposed in which signal processing technique is applied to extract the target information from clutter signal. A back projection imaging technique is applied to image the target. For this purpose, indigenously a TWI system based on step frequency continuous wave (SFCW) principle is developed in ultra wide band (UWB) range of frequency (i.e., 3.95 GHz to 5.85 GHz), plywood considered as wall and metallic plate is considered as target behind the plywood wall. The results are quite encouraging. [C292]

"Hilbert transform pitfalls and solutions for ultrasonic NDE applications"

Hilbert transform (HT) is a classical tool used to obtain complex analytical signal representation, which is useful for instantaneous frequency and envelop estimation of bandpass signals. However, noise has a significant adverse impact on the performance of HT. Furthermore, the narrowband signal condition in Bedrosian identity makes it problematic to analyze ultrasonic scattering signal using HT. In this investigation, two key issues related to Hilbert transform are addressed for enhanced instantaneous frequency (IF) estimation. First, in order to minimize the effect of the noise, ultrasonic signals are decomposed to multiple narrowbands and instantaneous frequencies within these bands are estimated. Second, a weighted estimated of IF based on envelop estimate of each narrowband is introduced. These methods are applied to various experimental ultrasonic data sets and utilized to examine microstructure scattering, effects of attenuation in large grained materials, and flaw detection in presence of high scattering noise. Simulation studies and experimental results support accuracy of the IF estimation. Enhanced IF estimation techniques provide tractable frequency estimation and makes it possible to quantify spectral shifts due to attenuation, scattering and dispersion effects. [C293]

"Polarimetric ice sounding at P-band: First results"

For polar ice sheets valuable stress and strain information can be deduced from the crystal orientation fabric (COF) and its prevailing c-axis alignment. Polarimetric radio echo sounding is a promising technique to measure the anisotropic electromagnetic propagation and reflection properties associated with the COF. In this paper,

dual-polarized P-band data acquired with the airborne POLARIS system near the ice divide of the Greenland ice sheet are analyzed. The internal layers in the uppermost few hundred meters of the ice sheet look the same at HH and VV polarizations, whereas the layering differs further down. Accordingly, the magnitude of the complex HH-VV correlation coefficient decreases with depth and, interestingly, the phase gives evidence of polarization dependent reflection and birefringence effects. [C294]

"Modeling the multidimensional & fiscal impacts of storm surge & sea level rise: A compelling view through a powerful interactive 4D data integration, analysis and visualization tool"

Nearly one third of the world's population live in coastal areas, and ten of the fifteen most populous cities in the world lie on a coast. Inhabitants of the Low Elevation Coastal Zone (LECZ)-defined as the contiguous area along the coast that is less than 10 meters above sea level-make up 10% of the world's population and 13% of the world's urban population. Sea level rise, coastal inundation and associated shoreline retreat have emerged as one of the primary threats to these populations and the resources located near the coastal fringe. To meet the needs of governments, planners and managers, researchers are continually faced with the challenge of integrating large volumes of complex environmental and spatial-temporal data. Typically the spatial and temporal components of data sets are underutilized because methods for effectively handling these data have not been available. To address these issues, Eonfusion, a 4-Dimensional software solution, is easily incorporated into the geospatial workflow to significantly enhance the ease with which we can now integrate and explore complex spatially and temporally variant data sets. This paper explores case studies along prominent coastal regions in which, as example, models are developed to predict the impact of rising sea levels on low-lying coastal areas focusing on: (1) Coastal Inundation (2) Coastal Vulnerability (3) Property Devaluation. The inundation is spatially modeled as a function of time and enables the visualization of sea level rise scenarios to assess the extent and impact. The coastal vulnerability mapping highlights the analytical power of Eonfusion, through the efficient integration of inundation and vulnerability models to demonstrate the universal application of the software to the field of climate change research. The third model fuses the cadastral layer and a simple property valuation model to complete the scenario, thus demonstrating a powerful pathway for the estimation and visualization of-the impact of these climate change events. The data for these case studies include: (1) Sea level rise scenarios from IPCC stage 4 (2) LID AR Elevation Data (3) Cadastral Parcels and Value Indicators (4) Storm Surge Information (5) Vulnerability Mapping. The processing steps required to integrate, analyze and visualize these models are: (1) Generation of 3D terrain model from LID AR data (2) Adjustments for any Height Data (AHD) discrepancies (3) Integrate IPCC sea level rises and storm surges into Sea level rise timeseries (4) Identification of sinks using Eonfusion API application (5) Calculate inundation levels and tipping points at which sinks get filled (6) Fuse Cadastre and value model with 3D surface-value decreases as % of title flooded (7) Airphoto drape (8) Set up visualization scene with integrated graph for all scenarios. The outcomes from this work include the identification of powerful pathways through the employment of new visualization and spatial-temporal analysis tools for: (1) Dynamic scenario based modeling for assessing cost and environmental impacts from climate change; (2) The provision of a mechanism enabling the visualization of the complex spatial and temporal patterns from a wide range of data derived empirically and from models. This enables key stakeholders to rapidly assess scenarios and their likely impacts (3) Modeling of this type could be used in a number of areas including fire, flood, tsunami, hurricanes, etc. [C295]

"Evaluating snow depth in Western China based on passive microwave remote sensing"

In order to evaluate the accuracy of snow water equivalent (SWE) inversion algorithm for passive microwave sensor Advanced Microwave Scanning Radiometer-Earth Observing System (AMSR-E) in Western China, we compared SWE got from AMSR-E daily SWE product with the ground measurements from 15 meteorological stations in Tibetan plateau. The results show AMSR-E overestimate SWE in this regions and the RMSE is 21mm Tibetan plateau. Through incorporating snow fraction factor, a new empirical algorithm estimate snow depth and SWE have been developed in Tibet. This new algorithm appeared higher accuracy than AMSR-E. Due to complex topography, shallow patchy snow and frozen grounds covered at the Tibetan Plateau, this technique didn't show good results. In future we will focus on how to evaluate and eliminate the effects of these factors quantitatively on SWE retrieval. [C296]

"Parametric versus non-parametric complex image analysis"

In this paper we compare parametric and non-parametric method for the analysis of complex valued high-resolution SAR data. Gauss-Markov Random Field (GMRF) model with a quadratic energy function as a parametric analysis parameterizes the spectogram of the signal, whereas nonlinear short time Fourier transform (STFT) method, the method based on time frequency analysis (TFA) as a non-parametric approach exploits the signal's non-stationarity in the time-frequency domain for information extraction. This comparative analysis helps to understand, characterize and analyze complex valued SAR data. [C297]

"Experiments in coherent change detection for synthetic aperture sonar"

Automatic Change Detection (ACD) compares new and stored terrain images for alerting to changes occurring over time. ACD techniques, long used in airborne radar applications, are just beginning to be applied to sidescan sonar. In Coherent Change Detection (CCD) the cross-correlation of multi-temporal complex data collected from coherent imaging sonars detects changes in the transduced amplitudes and phase of image pixels which, under the right conditions, can be used to detect new objects or disturbances on the seafloor. Synthetic aperture sonars (SAS) produce range-independent, fine resolution seafloor images. With centimetric resolution demonstrated out to hundreds of meters, these coherent systems can classify small manmade objects at long ranges, and should be suitable for CCD. This paper describes experiments testing CCD with data from synthetic aperture sonars mounted on autonomous undersea vehicles and actively navigated tow bodies. A noncoherent example carried out with data collected from an AUV-mounted SAS demonstrates the utility of correlation-based automatic change detection. CCD tests were carried out with repeat pass data collected using a SAS mounted on a dynamically controlled tow vehicle. While simple image pair co-registration procedures failed to provide sufficient coherence in the overall scene required for CCD, preliminary tests of image warping techniques used for airborne radar applications show promise of transitioning successfully into the SAS signal processing chain. [C298]

"ASTRAD platform: A future reference in radar simulation"

ASTRAD, which means Architecture and Simulation Tools for Radar Analysis and Design, is a simulation platform, providing services and allowing users to develop, use and exploit complex simulations. The concept of platform is a key point for reducing development time and cost, and focusing on core development. [C299]

"The effects of SAR data compression on coherent and non-coherent change detection"

The performance of coherent and non-coherent change detection algorithms is evaluated using complex SAR data that have been processed with various data compression algorithms. When BAQ compression is applied to raw (I,Q) SAR phase-history data, our previous studies show that to obtain reasonably good coherent change detection (CCD) performance, BAQ compression requires 4-bit quantization of the I and Q phase-history samples; since the original data were 8-bits, the resulting compression ratio (CR) achieved using BAQ was a factor of 2. This paper demonstrates a wavelet-based compressive sensing approach that gives CR = 3 with comparable CCD performance; we also demonstrate a wavelet-based SPIHT approach that gives CR = 4 with comparable CCD performance. [C300]

"Interferometric measurements using redundant phase centers of synthetic aperture sonars"

Interferometric sonars with multiple horizontal rows of elements have been used routinely to produce swath bathymetry. However, interferometric sonars are larger more complex, and consume more power than arrays with a single row of elements. Synthetic aperture sonar (SAS) systems often require the use of redundant phase centers (RPC), where the aft sonar element positions overlap in space with the forward element positions of the previous ping. Considering that a vehicle carrying a SAS array would likely have non-zero pitch, the use of RPC provides sonar data from receivers at the same along-track position with some vertical displacement. This data is similar to that of interferometric systems with the exception that the distance between receiver pairs can vary with vehicle motion and the received signals are not collected concurrently. This paper evaluates the possibility that an interferometric capability could be achieved using RPC data collected from a SAS system consisting of a single horizontal row of elements. An error analysis was conducted to determine the effect of errors in relative receiver position on swath bathymetry. Results show that errors in receiver vertical displacement result in similar percent errors in elevation. Therefore, errors in swath bathymetry can be reduced by designing the array to increase vertical displacement between RPC pairs. Results also show that increasing vertical displacement between RPC pairs can also reduce the impact of data phase measurement errors on swath bathymetry. Swath bathymetry measurements are very sensitive to errors in across-track displacements, but the predictable nature and scale of the error may indicate that accurate across-track displacements could be calculated from phase measurements. Swath bathymetry images produced from data acquired by an existing SAS consisting of a single horizontal row of elements are shown and illustrate viability of the technique depending on the required resolution of the syst- em. [C301]

"Next-generation advances in cognitive processing using spiking neural networks for biochemical sensing, radar and rapid HDL"

This invited plenary paper introduces a novel spiking neural network methodology, and applies it to an odorant learning, medical and radar detection applications. Rapid HDL is introduced as a 15 minute rapid prototyping

approach, where real-time implementations will be demoed on FPGAs. The spike-time dependent plasticity can support coding schemes that are based on spatio-temporal spike patterns. Spiking (or pulsed) neural networks (SNNs) are models which explicitly take into account the timing of inputs. The network input and output are usually represented as series of spikes (delta function or more complex shapes). Plasticity SNNs have an advantage of being able to recurrently process information. Spike-time dependent plasticity can enhance signal transmission by selectively strengthening synaptic connections that transmit precisely timed spikes at the expense of those synapses that transmit poorly timed spikes. [C302]

"Regularization of Complex SAR Images Using Markov Random Fields"

This paper presents despeckling and information extraction using non-quadratic regularization. The novelty of this paper is that instead of the Gaussian prior model a Gauss-Markov random field model is chosen, because it can efficiently model textures in the images. The iterative procedure consists of noise-free image and texture parameter. The experimental results show that the proposed method satisfactorily removes noise form synthetic and real SAR images and is comparable with the state of the art methods using objective measurements on synthetic SAR images. [C303]

"Nonlinear Modeling and Optimal Controller Design for Radar Servo System"

Radar servo system is a complex system with nonlinearity and coupling. In this paper, the nonlinear mathematical model of radar servo system is established according to the model of executive motor and the load characteristics of radar antenna. Based on the model, an optimal controller for radar servo system is designed by the theory of feedback linearization and linear quadratic regulator (LQR). The feedback linearization approach is employed to realize the linearization and decoupling of the nonlinear model, and LQR is used to design the optimal controller to ensure that the speed tracking error is optimal. The experimental results show that, compared with the traditional feedforward control and feedback control, the designed optimal controller enhances the speed tracking accuracy of radar servo system, while suppressing the load disturbance more effectively. [C304]

"Use of large curvilinear synthetic aperture for 3-D target imaging"

Parametric imaging methods for the curvilinear synthetic aperture radar (SAR) are always used the extracted three-dimensional (3-D) target feature (amplitude and 3-D position) to reconstruct the 3-D target image. Their efficient implementations, however, are only suitable for small synthetic aperture case. In this paper, a model is presented for describing the scatterer's echo received by large synthetic aperture, and based on this model, an efficient parametric method is proposed for imaging the 3-D target. The proposed method removes the coupling between the range and cross-range, which is introduced by range migration. With the decoupled data, the proposed method can replace the high dimensional search with a series of lower dimensional searches, which results in the feature estimates being extracted efficiently. The simulation results show that the method proposed in this paper can achieve the objective of the complex 3-D imaging, and the feature estimates can be reach the corresponding CRBs at low signal-to-noise ratio. [C305]

"Radar signal feature extraction based on wavelet ridge and high order spectra analysis"

In this paper, a novel feature extraction method for radar emitter signals is introduced. The modern radar signal waveforms are used for experiment simulation such as the linear frequency modulation, FSK and PSK-coded. The wavelet ridges and higher-order statistics are used to extract signal features. These features extracted by proposed methods are discriminative and suitable for radar emitter classification, especially for specific emitter identification (SEI). Then these discriminative and low dimensional features achieved are fed to a fuzzy support vector machine classifier for different radar emitter signals. In simulation, the classifier attains over 80% overall average correct classification rate. Experimental results show that the proposed methodology is efficient for different complex radar signals detection and classification in modern electronic warfare environment. [C306]

"Comparison of several methods for high speed detection target with narrow bandwidth"

A new method dealing with high speed target (HST) detection in pulse-Doppler (PD) radar is proposed. By utilizing Keystone Transform (KT) and linear range walk rectification, the range walk can be removed completely. The method is also compared with the Hough Transform (HT) and Complex Radon Transform (CRT). The simulated data validates the method and the analysis. [C307]

"A multilevel interferometric SAR simulator"

A novel simulator is presented for interferometric synthetic aperture radar (InSAR), which contains three

simulation levels: the raw signal level (RSL), the SLC image level (SIL) and the interferometric phase level (IPL). In this simulator, a new model of complex backscattering coefficients for the extended scene with low complexity is presented and validated. Furthermore the implementation details of the multilevel simulator are discussed. For the raw signal level, a new model with higher computation efficiency to generate the radar echo is proposed. For the image level, an efficient approach to create single-look image pair is presented. For the interferometric phase level, a reasonable noise model related to geometric decorrelation is also proposed. Finally some meaningful results by the novel simulator are presented. These results demonstrate not only the validity of the proposed simulator but also the conformability of the three simulation levels. [C308]

"Intelligent Load Balancing Strategies for Complex Distributed Simulation Applications"

With the rapid development of computer simulation technology, the Radar simulation applications scale up increasingly. More and more Radar simulation applications adopt distributed structure to improve system performance and availability. Hence, how to enhance the robustness and efficiency of these complex distributed simulation systems is a hot point. We should balance the load for the applications to enhance the resource' s utility and increase the throughput. To overcome the problem, one effective way is to make use of load balancing. At the same time, load balancing middleware provides better scalability, response time and throughput. However, we must pay attention to the fact that the computing of the load should be adaptive and predicative to avoid the affection of the peak load. To the complex simulation applications, the peak means the system may suffer extremely high load for a short period while keeping stable load for a long time and some hosts of the system may be overloaded and the response time may be decreased for this kind of fluctuate. Therefore, to utilize the services effectively especially when the workloads fluctuate frequently, we should make the system react to the load fluctuate gradually and predictably. So we have proposed and implemented machine learning based load prediction and fuzzy logic based replica management for adaptive and flexible load balancing mechanism within the framework of distributed middleware. [C309]

"Micro-Doppler analysis and imaging of air-planes with rotating parts"

In ISAR imaging of air-planes with rotating parts, the micro-Doppler phenomenon induced by the rotors will generate side-bands about the rigid body image. This paper derives the imaging model and analyzes the micro-Doppler of rotors. Then, a method for micro-Doppler separation based on low chirp rate matching is proposed. Meanwhile, an algorithm for scaling the 2D imaging of rigid body is presented, based on the complex-valued back-projection algorithm. Similarly, ISAR imaging of the rotating rotors can be obtained through the same algorithm. Finally, images from the rigid body and the rotating rotors are merged together to obtain a full image of the air-plane. The validity of the proposed algorithms has been proved by simulations. [C310]

"A digital down conversion of WB radar based on intersection of spectrum"

A new wideband digital down conversion (WB-DDC) method based on intersection of frequency spectrum is proposed. In this method, the input wideband signal is split into several subbands by analysis filter bank and each of these subbands with explicit meanings can be processed independently. The outputs of useful subbands are combined by synthesis filter bank to get the complex baseband signal. That means subband operation becomes possible and great flexible comparing with the traditional structure. Moreover, the new method is computationally more efficient than the traditional method. The methods of designing filter bank and the perfect reconstruction condition are analyzed. The influence of the prototype filter to reconstruction is indicated by simulation. The simulation results show that the presented method is of good performance. [C311]

"FH/MPS hybrid radar waveform"

A novel waveform design is proposed in order to fulfil several requirements and avoid many disadvantages encountered in some of known waveforms. The proposed waveform is a hybrid complex form that is named as the frequency-hopped/minimum peak-to-sidelobe (FH/MPS) waveform. Many computer simulations using MATLAB were made so as to investigate the FH/MPS radar waveform. Very significant results are obtained, regarding ambiguity in range and velocity measurements and improvement of the signal-to-noise ratio for a different number of codes. [C312]

"Single channel pulse train radar signal separation using algebraic method"

In the complex radio environment, single sensor may receive a number of mixed time-frequency overlapping radar signals. Considering the pulse train form of these signals, this paper achieves separation of fixed pulse repetition interval signals using their periodicities, and proposes the separation method of variational pulse repetition interval signals using their algebraic properties. Both approaches are based on the linear equations construction and solution without requirement of intra-pulse information of the source signals, and applicable

under the situation that the source signals are time-frequency overlapping. The simulation results confirm the validity of their performance. [C313]

"RCS calculation of complex targets shielded with plasma based on visual GRECO method"

Based on the assumption that plasma medium is cold, unmagnetized, collisional and inhomogeneous, a radar cross section (RCS) calculation model for complex targets shielded with plasma is presented. In high frequency region, the plasma that defilading a target can be treated as layered media. In each layer, the plasma is equivalent to a uniform dielectric. Physics optics (PO), ray-tracing method and Wentzel-Kramer-Brillouin (WKB) method are applied to calculate the backscattering field, which is implemented by visual graphical electromagnetic computing (GRECO) platform. Numerical results illustrate that shielding the targets with plasma is a valid way to reduce the RCS of targets. This conclusion has a broad prospect for plasma stealth and anti stealth. [C314]

"The FDTD Modeling of GPR for Tunnel Inspection"

Ground-penetrating radar is an important tool non-destructive testing for buildings and transportation systems. However, ground-penetrating radar signals is extremely complex and is easily influenced by many factors, which lead the interpretation of radar data to be very complex and often with a certain error. The accurately interpretation of radar data need workers have some special experience, such experience is often get through the acquisition of a large number of data and their predecessor's scholarly papers. Based on the finite-difference timedomain method, the forward modeling of GPR signal provides the reference for the interpretation of ground penetrating radar data in tunnel lining inspection, so that the reliability of detection can be improved. [C315]

"A novel method for ISAR imaging of ship target"

High resolution ISAR (inverse synthetic aperture radar) imaging and recognition of ship target is very important for many applications. Although the principle of ISAR imaging of ship target on the sea is the same as that of flying target in the sky, the former usually has more complex motion (fluctuation with the oceanic waves) than the latter, which makes the motion compensation very difficult. However, the change of phase chirp rate caused by the complex motion of ships will deteriorate the azimuth focusing quality. In this paper, we first model the complex motion of ship target with cubic phase terms (parameterized on chirp rate and its change rate), then a new ISAR imaging method, referred to as TCD-echirpClean, is proposed, which estimates the chirp rate and the change rate of chirp rate of all scatters in the time-chirp distribution plane. Both numerical and experimental results are provided to demonstrate the performance of the proposed method. [C316]

"The signal to noise ratio analysis of ground forward scattering radar"

In this paper, based on the complex signal model of ground forward scattering radar (FSR), the analytical signal energy formula is derived step by step, and moreover the close form of signal to noise ratio (SNR) is obtained, therefore the improvement factor of optimal processing can be also directly obtained. Finally according to the signal model and SNR formula, the simulate results show the correctness of the SNR analysis of ground FSR, it also indicates the huge potential application of ground FSR. [C317]

"Ballistic missile micro-Doppler parameter estimation based on multi-section signals"

Spin motion of the ballistic missile (BM) with empennages caused micro-Doppler modulations in radar returns, which was quite an important characteristic in BM radar target recognition systems. Early-warning radar (EWR) sometimes had to observe targets in time segmented due to the demands of multi-object-tracking and multi-tasking. While there were many difficulties to extract feature parameters from the non-coherent multi-section signals. The paper modelled the multi-section radar signals of the spinning BM firstly. According to the characteristics of the multi-section signals, the method of Radon-pseudo-STFT was proposed to estimate the radial acceleration using the multi-section signals. After the acceleration compensation, the micro-Doppler modulation period was extracted based on the method of complex envelops unbiased autocorrelation. [C318]

"Performance analysis and design of radar signal waveforms in modern electronic warfare environment"

In this paper, the modern radar signal waveforms are introduced. For improving the detection capability and reducing the probability of interception, the more complex signal waveforms are applied in the modern radar system. Some basic principles are provided in the design of the LPI signal waveforms. Some novel waveforms with complex modulation are introduced. The WVD-Hough transform are used to analysis the performance of novel radar signals. Experimental results show that the waveforms with combined modulation are efficient for

radar anti-reconnaissance design in modern electronic warfare environment. [C319]

"The application of power density spectrum estimation on synthetic aperture radiometer"

Aperture synthetic is a technique for overcoming the limitation that a large antenna aperture places on passive microwave remote sensing form space. This is an interferometric technique in which pairs of small antennas are used together with signal processing to achieve the solution of a single large aperture antenna. In this technique, the product of the signal from each pair of antennas is measured using a correlation radiometer. The complex product is recorded for pairs of antennas at many different spacings. The spacing is called a baseline and both the magnitude and orientation of the distance between the antennas is important. Once the place and the number of antennas are determined, the complex products are determined. In this paper, we get more complex products by the method of power density spectrum estimation to improve the temperature sensitive. [C320]

"Modeling surface-flow characteristics in glaciated landscapes"

Geographic Information Systems (GIS) hydrologic modeling techniques are used to better understand the surface-flow characteristics in the Prairie Pothole Region (PPR) of North America. This research uses an airborne Interferometric Synthetic Aperture Radar (IFSAR)-derived digital terrain model (DTM) as a base for developing a hydrologically-correct DEM and derivative products. The IFSAR DTM is assessed for accuracy and ability to resolve wetland features. A wetland mask is developed to selectively fill the DTM and from it products such as wetland catchments and drainage linkages are derived and interpreted. Study sites in the PPR are two surveyed and closely monitored wetland complexes, Crystal Springs and Orchid Meadows in Deuel County, South Dakota, USA. [C321]

"Parametrization of integrated hydrological model of Nam Co lake catchment on Tibetan Plateau using synergy of SAR and optical data"

Understanding of exchange processes over Tibetan Plateau including hydrological cycle is becoming increasingly important since their influence on the formation of the Asian monsoon system is known. Tibetan Plateau is source area for main Asian rivers that are of crucial importance for downstream communities of China, India, Bangladesh, Pakistan and SE Asia. Accurate and up-to date information of the characteristics and the current trend of these changes, provided by modern satellite systems like TerraSAR-X, are thus needed. The study area is delimited by the watershed of Nam Co basin on Tibetan Plateau in Tibet Autonomous Region of China approximately 100 km NNW from Lhasa. The no-outlet basin of the lake offers an excellent example of landscape unit characteristic for Tibetan Plateau where all exchange processes between land and atmosphere can be studied. Hydrologic modeling of Nam Co basin will be supported by complex interpretation of TerraSAR-X data that will provide whole set of hydrologic parameters. The TerraSAR data will be processed in synergy with other available microwave and optical remote sensing data sets. Basic extracted variables will be thus transformed into meaningful hydrological parameters. Data evaluation will take into account various aspects of landscape qualities with respect to water cycle. Variability of lake level, seasonal changes of soil moisture, influence of wetlands, lake icing and snow melt will be estimated. The synergetic approach to interpretation of TerraSAR-X data will benefit from major advantages of the high spatial resolution, the fast repetition cycle and the full-polarimetric capabilities in combination with high resolution optical data (RapidEye, QuickBird, Kompsat-2, ASTER. Landsat etc.) and digital elevation models. [C322]

"Enhancing complex interferograms by anisotropic diffusion"

In this paper a new algorithm for interferometric phase restoration is presented. Firstly, a continuous framework for anisotropic phase diffusion is stated. A tensorial based metric allows directional control. The periodic continuous structure of the phase representation is accounted for. Secondly, this framework is adapted for interferometric phase filtering. Progressive re-estimation of directionality avoids directional bias. Isotropy and anisotropy are adaptively combined with a constant overall diffusion rhythm, so that the degree of regularization is the same regardless of the underlying topography. Robust estimation minimizes the spread of outliers. Results on both synthetic and TerraSAR-X data are provided. [C323]

"Landmines recognition system using thermovision techniques"

Sub-surface and buried landmines, with the surrounding environment constitute a complex system with variable characteristics. Infrared thermography techniques are attractive candidates for this kind of applications. They can be used from a considerable standoff distance to provide information on several mine properties, and they can also rapidly survey large areas. This paper presents a robust method for landmine detection and recognition. It uses the mean-shift algorithm to segment the acquired infrared image. The segmented image retains pixels associated with mines together with background clutters. To determine which pixels represent the mines, a

second phase of segmentation is applied to the output of the mean-shift algorithm by using a self-organizing maps (SOM) algorithm. Depending on the resulted cluster intensity variations, the chips extracted from the segmented image are processed to extract mine signatures. After that, the extracted signatures are scanned horizontally, vertically, and diagonally to build a cluster intensity variation profile. This profile is statistically compared with the known mine signature profiles v. The proposed system is applied on series of time variant mid-wave infrared images (MWIR), and the test result show that the system can effectively recognize the mines with low false alarm rate. [C324]

"Precise optical scanning for multiuse"

Many approaches for remote measurement techniques for object surfaces and approaches for 3D object recognition have been proposed; but often they still require complex and expensive equipment. Not least due to the rapidly increasing number of efficient 3d hard- and software system components, alternative low cost solutions are in great demand. We propose such a low-cost system for 3d data acquisition and fast surface registration by digitized points Cartesian coordinates matrix keeping. There are presented experimental research and computer simulation of various natural factors which can affects the normal functioning of the passive optical scanning aperture under proposition. [C325]

"High range resolution directional borehole radar for 3-D fracture delineation"

Directional borehole radar was developed for detection of three-dimensional (3-D) target localization in single-hole radar measurement. Phase differences among four dipole elements of receiving circular array uniquely determine an azimuth direction of a reflected wave. Receiving voltages of dipole elements are measured by optical electric field sensors whose high electrical isolation feature enables data acquisition of highly correlated signal between the channels. Besides, a switching unit to control resonant frequency of dipole elements was newly developed to reduce mutual coupling between the dipole elements. Laboratory experiments have demonstrated that approximately 30% frequency bandwidth enlargement is achieved by the switching operation without been affected by the mutual coupling in air. The directional borehole radar system was tested in a field test site in Kamaishi-Mine in Japan. All the boreholes available in this test site is filled with water and past borehole radar surveys conducted in this test site revealed presence of complex fracture system. Cross-hole and single-hole borehole radar measurement were conducted to clarify the performance of the resonant switching control and also to detect 3-D geometrical structure of fractures in this test site. 3-D analysis of data acquired by the directional borehole radar in a single-hole measurement clarified azimuth orientation fractures up to a range distance of 15 m with a range resolution less than 1 m. High reliability of the result was inferred from the fact that individual fracture pattern in a reflection profile showed a consistent color along the depth and also high repeatability of the result was obtained by repeating measurements. [C326]

"A first validation experiment for a Multi-Chromatic Analysis (MCA) of SAR data starting from SLC images"

The Multi-Chromatic Analysis uses interferometric pairs of SAR images processed at range sub-bands and explores the phase trend of each pixel as a function of the different central carrier frequencies to perform absolute topographic measurements. The previous work on the subject has started demonstrating the practical feasibility of the technique by using a set of SAR data collected by the airborne AES-1 radar-interferometer and by focusing the sensor raw data. The present work verifies the reliability of MCA procedures starting from SLC images, tests the robustness of MCA methods with respect to the total processed bandwidth and, provides first indications on the use of TerraSAR-X satellite data. [C327]

"Edge-preserving classification of high-resolution remote-sensing images by Markovian data fusion"

Very high spatial resolution (HR) data provide plenty of detailed information about the ground on a regular basis for applications such as urban planning, precision farming, or damage assessment after environmental disasters. The complex nature of HR observations, especially when acquired over urban/artificial environments, makes the accurate discrimination of distinct thematic classes a difficult task. In the present paper, a novel technique is proposed for supervised classification of multispectral HR images, based on the key-idea to fuse through a Markov random field (MRF) the information conveyed by user-defined thematic classes, subclasses related to the spectral responses of different ground materials, and spatial edges. The method is validated by experiments on IKONOS images. [C328]

"SBAS-InSAR analysis of surface deformation at Mauna Loa and Kilauea volcanoes in Hawaii"

We investigate the deformation of Mauna Loa and Kllauea volcanoes, Hawai'i, by exploiting the advanced differential Synthetic Aperture Radar Interferometry (InSAR) technique referred to as the Small BAseline Subset (SBAS) algorithm. In particular, we present time series of line-of-sight (LOS) displacements derived from SAR data acquired by the ASAR instrument, on board the ENVISAT satellite, from the ascending (track 93) and descending (track 429) orbits between 2003 and 2008. For each coherent pixel of the radar images we compute time-dependent surface displacements as well as the average LOS deformation rate. Our results quantify, in space and time, the complex deformation of Mauna Loa and Kllauea volcanoes. The derived InSAR measurements are compared to continuous GPS data to asses the quality of the SBAS-InSAR products. [C329]

"A revised radiometric normalisation standard for SAR"

Improved geometric accuracy in SAR sensors implies that more complex models of the Earth may be used not only to geometrically rectify imagery, but also to more robustly calibrate their radiometry. Current beta, sigma, and gamma nought SAR radiometry conventions all assume a simple Г‚Вїflat as KansasГ‚Вї Earth ellipsoid model. We complement these simple models with improved radiometric calibration that accounts for local terrain variations. In the era of ERS-1 and RADARSAT-1, image geolocation accuracy was in the order of multiple samples, and tiepoint-free establishment of the relationship between radar and map geometries was not possible. Newer sensors such as ASAR, PALSAR, and TerraSAR-X all support accurate geolocation based on product annotations alone. We show that high geolocation accuracy, combined with availability of high-resolution accurate elevation models, enables a more robust radiometric calibration standard for modern SAR sensors that is based on gamma nought normalised using an Earth terrain-model. [C330]

"SAR raw signal simulation based on GPU parallel computation"

In this paper we present a raw signal simulator based on GPU parallel computation for synthetic aperture radar. We describe a mathematical model of SAR simulation based on FFT in detail and implement it through GPU parallel computation. GPU has a better performance in complex calculation than CPU. It supports parallel computation and raises the speed of algorithms. At the last part of this paper, a simulation comparison is given. The result shows that the simulator base on GPU parallel computation improves the efficiency of algorithm. It is very useful when the algorithm consumes large amount of CPU time. [C331]

"A web application with visual SAR processor for education"

In this paper, a web application with a visual SAR processor is proposed in consideration of educational use and computer system environment. A system structure of the web application employs Ajax technology and object oriented software components. The main window of a client computer consists of view area, scene selection tab, tool panel, vertical and horizontal scroll bars. The processor can generate intermediate complex and map-projected images from raw SAR data using the range-Doppler method. An example of the educational use is demonstrated by compositing orthorectified images generated from a pair of ALOS PALSAR data observed by ascending and descending orbits. [C332]

"Model based design flow for implementing an anti-collision radar detection system"

We have presented a novel design methodology to model complex intensive data-parallel applications. The modeling is carried out using the UML graphical language and the MARTE standard. Afterwards, automatic code generation can be carried out via MDE tools and technologies. Finally the code can be synthesized and implemented on a target FPGA. We have presented an example of this process, by building a correlation based delay estimator for a anti-collision radar system. We presented some results, and we have got very promising results. In perspective to our works we plane to made optimisations to optimization on the MDE tools and compare the performances of the generated code vs a hand made one. [C333]

"Integrated full-waveform analysis of ground penetrating radar and electromagnetic induction data for non-invasive reconstruction of multilayered media"

We present a new integrated method for full-waveform modeling of zero-offset, off-ground ground penetrating radar (GPR) and electromagnetic induction (EMI) in multilayered media. For both GPR and EMI systems, a vector network analyser (VNA) is used as transmitter and receiver. The antennas and their interactions with the investigated medium are modeled in the frequency domain by means of a linear system of complex transfer functions. The air-subsurface is represented by a 3-D multilayered medium, for which Maxwell's equations are exactly solved. These approaches have been validated in laboratory conditions, demonstrating the high accuracy of the GPR and EMI models. The results show great promise for non-invasive reconstruction of multilayered media using GPR and EMI. [C334]

"Classifying urban landscape in aerial LiDAR using 3D shape analysis"

The classification of urban landscape in aerial lidar point clouds is useful in 3D modeling and object recognition applications in urban environments. In this paper, we introduce a multi-category classification system for identifying water, ground, roof, and trees in airborne lidar. The system is organized as a cascade of binary classifiers, each of which performs unsupervised region growing followed by supervised, segment-wise classification. Categories with the most discriminating features, such as water and ground, are identified first and are used as context for identifying more complex categories, such as trees. We use 3D shape analysis and region growing to identify Г‚ВїplanarГ‚Вї and Г‚ВїscatterГ‚Вї regions that likely correspond to ground/roof and trees respectively. We demonstrate results on two urban datasets, the larger of which contains 200 million lidar returns over 7km2. We show that our ground, roof, and tree classifiers, when trained on one dataset, perform well on the other dataset. [C335]

"Undue influence: Mitigating range-intensity coupling in AMCW 'flash' lidar using scene texture"

We present a new algorithm for mitigating range-intensity coupling caused by scattered light in full-field amplitude modulated continuous wave lidar systems using scene texture. Full-field Lidar works using the time-of-flight principle to measure the range to thousands of points in a scene simultaneously. Mixed pixel are erroneous range measurements caused by pixels integrating light from more than one object at a time. Conventional optics suffer from internal reflections and light scattering which can result in every pixel being mixed with scattered light. This causes erroneous range measurements and range-intensity coupling. By measuring how range changes with intensity over local regions it is possible to determine the phase and intensity of the scattered light without the complex calibration inherent in deconvolution based restoration. The new method is shown to produce a substantial improvement in range image quality. An additional range from texture method is demonstrated which is resistant to scattered light. Variations of the algorithms are tested with and without segmentation-the variant without segmentation is faster, but causes erroneous ranges around the edges of objects which are not present in the segmented algorithm. [C336]

"Situation assessment via multi-target identification and classification in radar sensor networks"

DoD has defined three levels of data fusion for network centric warfare (NCW). Level 1 data fusion combines data from single or multiple sensors and sources to provide the best estimate of objects and events in the battlespace. Level 2 data fusion focuses on situation assessment. Level 3 data fusion is threat assessment. To facilitate situation assessment, we investigate the problem of jointly classifying and identifying multiple targets in radar sensor networks where the maximum number of categories and the maximum number of targets in each category are obtained a priori based on statistical data. However, the actual number of targets in each category and the actual number of target categories being present at any given time are assumed unknown. It is assumed that a given target belongs to one category and one identification number. The target signals are modeled as zero-mean complex Gaussian processes. We propose a joint multi-target identification and classification (JMIC) algorithm for radar surveillance using cognitive radars. The existing target categories are first classified and then the targets in each category are accordingly identified. Simulation results are presented to evaluate the feasibility and effectiveness of the proposed JMIC algorithm in a query surveillance region. [C337]

"Modeling of a radar signal for scan pattern"

As electronic warfare (EW) environment has rapidly changed to be more complex, ambiguity in detecting and identifying enemies' radars also has increased in electronic warfare support (ES) systems. To overcome this critical problem by the limitation of the conventional detection and identification method based on the inter-pulse modulation characteristic such as pulse repetition interval (PRI) and frequency modulation type, a new approach introducing scan patterns of radars has been presented. The conventional researches, however, have mostly dealt with a simple scan pattern type like a circular scan. This is due to the difficulty in gathering various radar signals, even though they are essentially needed to identify lots of radar systems. Therefore it is required a solution which secures the various radar signals to trigger and advance related researches. To satisfy this need, we propose a novel radar-signal model which can generate radar signals including various scan patterns. By analyzing and considering the relationship between a shift of radar boresight by the scan pattern and parameters determining power variation, we establish the proposed model. To make the model more practical, some distortions such as noise, missing pulses, and spurious pulses are added. The validity of radar signals generated from the model is verified by analyzing their results where various radar signals of a typical radar scan pattern type are produced varying with operational parameters. [C338]

"A Kernel Density Window Clustering Algorithm for Radar Pulses"

As radar signal environments become denser and more complex, the capability of high-speed and accurate signal analysis is required for ES (electronic warfare support) system to identify individual radar signals at real-time. In this paper, we propose the novel clustering algorithm of radar pulses to alleviate the load of signal analysis process and support reliable analysis. The proposed algorithm uses KDE (kernel density estimator) and its CDF (cumulative distribution function) to compose clusters considering the distribution characteristics of pulses. Simulation results show the good performance of the proposed clustering algorithm in clustering and classifying the emitters. [C339]

"An efficient conflict-free parallel memory access scheme for dual-butterfly constant geometry radix-2 FFT processor"

In this paper, a parallel access scheme for dual-butterfly constant geometry radix-2 Fast Fourier Transform (FFT) algorithm is proposed. According to the constant geometry, the proposed method in this paper utilizes the Least Significant Bit (LSB) and the Most Significant Bit (MSB) of the data counter to decrease the computational complexity of the address generation for reads and writes. It allows simultaneous access to the 4 operands needed for the dual parallel butterfly calculations, so it only costs (N/4)*log2(N) clock periods for calculating a N complex point radix-2 FFT or IFFT in hardware implementation. For every stage has the same architecture, it also enhances the implement flexibility of the FFT algorithm. [C340]

"Microwave Fourier-holography approach improvement via minimum duration amplitude multifrequency data extrapolation"

The problem of restoration improvement of complex multifrequency reflection coefficient data of layered dielectric structure from scalar amplitude data measurements is considered. It is proposed to use extrapolated amplitude multifrequency data in the framework of developed Fourier-holography approach, making it easier to extract informative segment of data, which corresponds to structure, in the time domain. Extrapolation is carried through special nonquadratic regularization procedure based on method of minimum of duration. Results of numerical simulations and experimental data processing are given. [C341]

"A Radar Signal Sorting Method Based on Immune Evolutionary Artificial Neural Network"

The sorting and feature extraction of radar signal are important precondition of the recognition and location to the radars in reconnaissance areas, and they are also an important piece of content in radar countermeasure reconnaissance information analysis. Radar signal sorting is to separate the pulse signals of each radar from the complex signal pulse data received by radar countermeasure scout, and serve as the base of subsequent feature extraction and signal recognition. For the environment of electromagnetism signal has become complicated day by day, so the conventional methods for signal sorting cannot satisfy the requirement of modern warfare. In order to settle this problem better, the sorting of radar signals by artificial neural network (ANN) based on immune evolutionary algorithms is realized in this paper. The ANN based on immune evolutionary algorithms uses global search optimizing means, overcomes the intrinsic shortcomings of conventional methods, and improves the convergence speed and performance of the network greatly. Computer simulation proves that the correct sorting rate of the immune evolutionary ANN is high when special radar signals is inputted. [C342]

"A Bayesian classification of pedestrians in urban areas: The importance of the data preprocessing"

We have previously proposed a Bayesian framework to fuse at feature level information from a lidar and video camera in order to classify pedestrians. After studying the influence of each stage of the computation on the system performance, it appears that object segmentation and sensor models are essential for good results. In this paper, we propose some improvements on these steps. Instead of using only the lidar for segmentation, image candidates help to discard the lidar detected objects occluded due to the perspective projection. This leads to a drastic reduction of the number of objects to classify. As a result, the false positive rate decreases and the system is sped up. New sensor models, required in the Bayesian classifier, are also introduced. These distributions come from training processes with databases obtained using our experimental setup. Receiver operating characteristic curves (ROCs) show the ldquooptimalrdquo performances expected while using these distributions in the Bayesian classifier. The evaluation of the proposed object segmentation algorithm on cluttered environments indicates that using only the lidar-based detector increases the number of objects requiring classification by 70%. Experiments, performed on real data in complex urban areas, confirm the effectiveness of the proposed approach. [C343]

"Robust non-parametric statistics method for joint angle-Doppler estimation in non-Gaussian

clutter"

In this paper, a new method is proposed for the problem of joint angle and Doppler estimation in non-Gaussian clutter which is modeled as the complex symmetric alpha stable (SalphaS) process. The proposed method normalizes each space-time snapshot vector by its infinity-norm, so that the second-order statistics-based superresolution estimators can become applicable to the non-Gaussian heavy-tailed clutter environments. Unlike the well-known fractional lower-order moment (FLOM)-based methods, the proposed method does not require any priori knowledge of the non-Gaussian clutterpsilas statistics, and hence, it is ldquoblindrdquo. Numerical results show that the proposed method outperforms the FLOM-based algorithms in the presence of non-Gaussian clutter. [C344]

"A novel supervised classification scheme based on Adaboost for Polarimetric SAR"

In this paper, a novel scheme for supervised classification problem of Polarimetric SAR images is proposed, which is based on Adaboost. Compared to traditional classifiers such as complex Wishart distribution based maximum likelihood classifier or Neural Network based classifier, the proposed method is more robust and flexible. Different features or parameters extracted from Polarimetric SAR data could be adopted into the scheme and a quantitative analysis on the significance of each parameter for classification could be achieved. Experiment results demonstrated the effectiveness of the proposed scheme. [C345]

"Radar emitter signal classification based on mutual information and fuzzy support vector machines"

In this paper, a novel method based on mutual information and fuzzy support vector machines for recognizing radar emitter signals is introduced. The radar signal waveforms are the linear frequency modulation (LFM), frequency-coded signals, BPSK and QPSK. The wavelet ridges and higher-order statistics are used to extract signal features. Mutual information measures is used to reduce the redundant components from the feature vectors set. Then these discriminative and low dimensional features achieved are fed to a fuzzy support vector machine classifier for multi-class patter recognition. In simulation, the classifier attains over 78% overall average correct classification rate. Experimental results show that the proposed methodology is efficient for different complex radar signals detection and classification. [C346]

"High-resolution imaging using a narrowband MIMO radar system"

This paper presents a system model and method for the two-dimensional (2-D) imaging application via a narrowband multiple-input multiple-output (MIMO) radar system with two perpendicular linear arrays. The proposed method utilities the spatial parallel procedure sampling the scattered echoes during a single snapshot illumination, instead of the spatial sequential one sampling the scattered echoes during multiple snapshot illuminations in inverse synthetic aperture radar (ISAR) imaging. Consequently, the complex motion compensation in ISAR imaging can be avoided. Furthermore, in our array configuration, multiple narrowband shared-spectrum waveforms coded with orthogonal polyphase sequences are employed to illuminate a target. The mainlobe of the compressed echoes from the different filter band for all scatterers could be located in the same range bin, and thus, complex range alignment in classical ISAR imaging is not necessary. Numerical simulations based on synthetic data are provided for testing our proposed method. [C347]

"Performance analysis of Independent Component Analysis to separate mixtures of complex sinusoidal signals"

ICA (independent component analysis) has a remarkable capability of separating mixtures of stochastic random signals. However, we often face problems of separating mixtures of deterministic signals, especially sinusoidal signals, in some applications such as radar systems and communication systems. One may ask if ICA is effective for deterministic signals. In this paper, we analyze basic performance of separating mixtures of complex sinusoidal signals for ICA which utilizes the forth cumulant as a criterion of independency of signals. We theoretically show the ICA can separate mixtures of deterministic sinusoidal signals. Then, we conduct computer simulations and radio experiments with a linear array antenna to confirm the theoretical result. We will show that the ICA is successful to separate mixtures of sinusoidal signals with frequencies close to less than FFT resolution and at DOAs (direction of arrival) close to less than Rayleigh criterion. [C348]

"SAR polar format implementation with MATLAB"

Transform coding based on the Karhunen-Loeve transform (KLT), the discrete cosine transform (DCT), and the discrete wavelet transform (DWT) is well-understood for optical images. Transform coding applied to synthetic aperture radar (SAR) data, however, has not been well-studied. This paper compares the results of compressing

SAR images when it is available in Cartesian and polar formats. We compare the compression results based on six performance criteria-mean-squared error, mean absolute error, peak signal-to-noise ratio, energy compaction, transform gain, and compression ratio.In both the formats the phase information of the compressed data is preserved to a great extent. A block adaptive Max quantizer is used with 1-5 bit quantization of the components. The quality of the reconstructed data is compared in terms of compression ratio and quality parameters: signal to noise ratio (SNR), standard deviation of the phase (PSD), and mean phase error (MPE). The parameters are calculated for SAR raw data, complex data and 8-bit gray scale image. Finally, original(Fig.4) and reconstructed gray scale images(Fig. 5) are presented. [C349]

"Robust approach to skin location estimation for radar-based breast imaging systems"

Increasingly complex breast models are being used to test emerging microwave imaging modalities. With the increased complexity, waveforms received from skin reflections may consist of contributions from multiple locations, resulting in signatures not examined with simpler models. For example, antennas placed near the chest wall or at significant distances from the breast have been found to receive multiple skin reflections. With these received signals, simple methods used to estimate skin location, such as peak detection, do not provide reliable results. In this paper, we apply a deconvolution technique to find the impulse response with respect to a known reflected signal. Results demonstrate that this method provides more reliable estimates of skin location and shows the ability to estimate two skin locations from a waveform exhibiting two dominant skin reflections. [C350]

"Efficient method of TOA estimation for through wall imaging by UWB radar"

Precise Time Of Arrival (TOA) estimation is a basic step of standard migration methods for object imaging from SAR measurements. In this paper, an effective computation method of the TOA for through wall model of object recognition is presented. The conventional method that uses constant velocity model produces errors in object shape and position estimations. Computation of the TOA (corresponding to true flight distance) for three layer model requires the complex minimization algorithm. Proposed method transforms three layer (air-wall-air) model to equivalent two layer (air-wall) model with lower computation complexity. It uses iterative solution of well defined minimization problem. Moreover, conveniently selected initial conditions of iteration process can further decrease computational complexity of the method. The proposed method provides more precise TOA estimation than conventional one and is less complex than three layer methods. Therefore, it is suitable for implementation on realtime hardware. The method performance is demonstrated by processing of real 2-dimensional SAR data acquired by through wall M-sequence UWB radar system. [C351]

"Implementation of GSC based subarray adaptive LMS algorithm using Xilinx FPGA"

Large scale fully adaptive systems are difficult to implement on FPGA because of low latency, high speed data transfer, and computational requirements. A solution is proposed in previous correspondence where randomly sampled adaptive systems are employed to distribute complex problem into blocks of simple subarray modules. In this contribution we analyze generalized sidelobe canceller (GSC) based LMS subarray adaptive algorithm for FPGA implementation in complex domain. A complex adaptive algorithm requires twice as much device area as compared to real adaptive systems. GSC based LMS adaptive algorithms are evaluated using varying number of data sizes and antenna elements. A twelve channel adaptive beamformer with 18 bit resolution fits into almost one fourth of a Xilinx Virtex4 XC4VSX55 device. This means one Virtex4 device can accommodate both the sum and difference subarray channels for estimating target azimuthal and elevation polarization. [C352]

"Performance improvement plastic landmine visualization system by employing local correlation method"

We have been studying ground-penetrating radars to visualize antipersonnel plastic landmines by treating amplitude and phase data of electromagnetic reflection and scattering by using a complex self-organizing map (CSOM). In this paper, we propose a new method, namely local correlation method, to extract feature quantity for higher performance. [C353]

"Photonic microwave matched filters for chirped microwave pulse compression"

In this paper, a technique to design and implement a photonic microwave matched filter for chirped microwave pulse compression is presented. To realize matched filtering, the filter should have a spectral response that is matched to that of the input pulse, which is implemented in this paper using a photonic system that consists of an optical single-sideband (SSB) modulator and a fiber Bragg grating (FBG). The FBG is designed to have a spectral response which is transferred to the spectral response of the microwave filter via SSB modulation and heterodyne detection at a high-speed photodetector. A theoretical investigation on the microwave filter design

and the chirped microwave pulse compression is developed. Theoretical analysis on the implementation of three different forms of microwave matched filters, including a classical complex matched filter (CMF), a phase-only filter (POF) and a modified inverse filter (MIF), is presented. A comparison between the filters against the performance measures for a linearly chirped microwave signal compression is provided. [C354]

"Frequency estimation of a radar pulse train with an unknown binary phase-coded sequence"

In this paper, we address the problem of estimating the frequency of a binary phase-coded pulse train in additive noise. We propose two frequency estimators which assume no prior knowledge of the underlying phase-coded sequence used in the pulse train. These estimators are modified versions of the weighted phase average (WPA) estimator and the maximum likelihood (ML) estimator that have been developed previously for frequency estimation of the single complex sinusoidal signals. [C355]

"A direct algebraic method of instantaneous wave source localization"

We deal with the problem of direction and distance estimate of emission sources in 3-D space. We first introduce a partial differential equation (PDE) what we call the location constraint PDE (LC-PDE), which provides a necessary and sufficient description of wavefield generated by a source at direction n and distance R. To remove differentials, we integrate the LC-PDE in a finite rectangular area with complex sinusoidal weight functions. By using a well-known class of window function to eliminate the integral boundary terms, we show an exact finite set of algebraic equations can be obtained including n, R as the unknown variables and small number of 2-D discrete Fourier transform (DFT) components of wavefield as the measurements. Owing to frequency domain separation by DFT, it can be applied to multiple sources with sufficient angle difference. We examine this method with numerical simulation assuming noisy measurements and multiple source conditions. [C356]

"HAF-based spectral analysis of first-order sea clutter in bistatic shipborne surface wave radar"

Doppler frequency shifts of sea echoes in bistatic shipborne surface wave radar (BS-SWR) are simultaneously modulated by the velocity components projected from the motion of both platforms, and therefore the Doppler spectrum is much more complex than its counterparts in monostatic mode. In this paper, based on the dynamic geometric relationship among bistatic platforms and first-order sea clutter interferences, we claim that there exist dynamic Doppler-broadening components due to the unavoidably different motion of bistatic platforms. Then based on the built signal model of sea echoes only containing the first-order components, we analyze the time-varying characteristic via the high-order ambiguity function (HAF) method in both first- and second-order spectrum. By simulation results, finally, not only the above analysis is demonstrated, but also the difference are shown before and after attenuating the first-order sea clutter via an existing time-space cascaded filtering algorithm in both Doppler and acceleration domain, respectively. [C357]

"Advanced microwave material developments for electronically steerable phased array radars"

Due to the complex nature of electronically steerable phased arrays, higher operating frequencies, increased density requirements, and wider operating temperatures, there has been increased focus on technology development with thinner microwave laminate substrates to create a multi-layer boards that are phase stable with temperature and compatible with embedded resistors utilized for Wilkinson Power Dividers. These laminates can range from 0.003" to 0.010" in thickness with frequencies well into the Ka Band. This paper explores technical advances and technical considerations placed on these materials as they are required for these advanced systems. This paper also discusses the processing limitations placed on existing materials and technical developments to overcome these deficiencies. [C358]

"Development of a high resolution MMW radar employing an antenna with combined frequency and mechanical scanning"

Electronically steerable antennas are expensive, whilst mechanically scanned antennas are of complex construction and hence are prone to failure. Based on the leaky-wave frequency-scanning principle, the spinning grating antenna (SGA) provides beam steering without the need of hinges. Whilst pulsed or stepped frequency waveforms may be implemented with this antenna, a frequency modulated continuous wave (FMCW) waveform allows close range operation at high speed, the possibility of excellent range-resolution, and low-cost signal processing. However, to implement FMCW with the SGA, the inherent scan-angle variation with frequency must first be overcome. Following on from an effort to develop a highly accurate radar system employing closed-loop linearisation to achieve 4 GHz of bandwidth centred at 94 GHz, this paper focuses on simultaneously achieving high angular resolution over a 20 degree scan range with good results. [C359]

"Evaluation of WiFi beacon transmissions for wireless based passive radar"

Wireless transmissions are a potentially powerful and widely available source of transmissions for passive radar detection. In this work we have carried out a detailed study on the use of IEEE 802.11 (WiFi) transmissions in a passive radar system. The WiFi transmission sequence has been found to be complex and dependent on the user environment but is dominated by direct sequence spread spectrum (DSSS) and orthogonal frequency division multiplexing (OFDM) signals. An ambiguity function analysis of the DSSS based WiFi beacon signal has been carried out followed by field measurements using a wireless based passive radar system. Range and Doppler characterization of this system is reported and compared with the theoretical predictions. Detection of moving human targets has been achieved for the first time using 802.11 transmissions. This work shows that this technique has considerable promise for a low cost and widely deployable detection and tracking system. [C360]

"The operation and performance of a multi-frequency HF Surfacewave Radar"

The challenge to achieve robust operational performance for a HFSWR in a complex environment requires the combination of an effective operator interface with automated radar control processes. The development of a radar system that simultaneously transmits and processes signals on multiple frequency channels provides the basic detection capability that is necessary to counter severe natural and man-made electrical interference in the HF band. Mission based radar control profiles can be defined for specific combinations of environmental conditions and targets of interest. The radar operator is able to select from these profiles allowing automated radar control functions to manage the real time aspects of the radar including the optimal selection of frequencies using a wideband Frequency Monitoring System. This paper details the operational aspects of this production standard HF Surfacewave radar and provides examples of air and surface track performance and characterisation of target RCS variation with aspect angle and frequency. These examples are taken from data recordings for selected durations of the radar operating at its test site. [C361]

"Moving target emulators for ultra wide band signals: Electrically modulated fragmented surfaces"

MTI radar systems and signal processing algorithms may be made more efficient if a wide range of perfect and background distorted Doppler signatures could be made available to test system hardware and algorithms. This paper addresses emulators of moving vehicle Doppler signatures. Measured Doppler spectra of tracked and wheeled vehicles are used to guide the development of moving target emulators made from ldquoswitchablerdquo reflectivity panels. The geometry of the panels are electrically percolating surfaces The percolating patterns provide 10:1 bandwidths and thus satisfy UWB criteria for frequency response and they use minimal modulating elements. A potential problem is the number of modulating elements on a panel that are required to synthesize the complex Doppler waveform measured on a ground vehicle. [C362]

"Using genetic algorithms for radar waveform selection"

Genetic algorithms have proven to be useful tools in optimizing complex problems with large solution spaces. Radar waveform selection is a challenging problem that may benefit from the use of genetic algorithms. Furthermore, advances in the areas of waveform diversity, multistatic radars and knowledge-aided radars are making waveform selection even more challenging. As a design tool we used genetic algorithms to perform waveform selection utilizing the autocorrelation and ambiguity functions in the fitness evaluation. Monostatic, bistatic and multistatic notional examples are presented and early results indicate that genetic algorithms can provide a useful and effective tool in waveform selection for a variety of radar configurations. [C363]

"Synthetic Aperture Radar raw data encoding using Compressed Sensing"

Synthetic aperture radar (SAR) is active and coherent microwave high resolution imaging system, which has the capability to image in all weather and day-night conditions. SAR transmits chirp signals and the received echoes are sampled into In-phase (I) and Quadrature (Q) components, generally referred to as raw SAR data. Raw data compression is an essential future requirement for high resolution space borne SAR sensor in order to reduce the volume of data that is stored onboard and later transmitted to ground station. Due to the low computational resources available onboard satellite a simple encoding algorithm based on compressed sensing framework to compress SAR raw data with real wavelets is proposed in this paper. The decoding of the data on ground is then based on convex optimization through projections on convex sets (POCS) or uses greedy algorithms such as orthogonal matching pursuit (OMP). The option of converting the complex SAR signal to real data by shifting the frequency spectrum by half bandwidth and then using real wavelets as a sparsifying transform to compress the SAR signal is studied and compared with using the wavelets with the complex signal in the CS framework. [C364]

"Real-time signal processing system for high resolution CWLFM millimeter-wave radars"

An FPGA-based real-time signal processing unit has been developed to perform Doppler processing in a high resolution CWLFM (continuous wave linear frequency modulated) millimeter-wave radar demonstrator. The article focuses on the strategies followed in order to achieve the required throughput as well as on the measures taken to guarantee coherency. Doppler processing is accomplished to output Range-Doppler radar images and transfer them to a PC application for display. Two different experimental setups have been used to verify the correct operation of the processing flow. The system has been designed so as to allow for future addition of complex target detection-classification schemes. [C365]

"Forest height inversion based on polarimetric SAR interferometry"

To extract the forest height accurately and quickly based on polarimetric SAR interferometry, a forest height inversion method is proposed, based on the polarimetric interferometric model (PolIn-model). A credit (linearity measurement) of height inversion is introduced. For each pixel with high credit, the complex volume coherence gammavis estimated by the ESPRIT algorithm, and then the forest height is estimated by a pre-calculated look-up table according to the PolIn-model. Otherwise, the forest height is estimated by the ESPRIT algorithm directly. The experimental results demonstrate that the proposed linearity measurement is more effective compared to the traditional way and the location of the volume coherence is in accordance with the PolIn-model. The time consumption by the proposed method is decreased to 25% of that by the PolIn-model based method. [C366]

"Double-IF quadrature demodulation of super-heterodyne radar receiver"

In radar, sonar and communication applications, and especially in all-digital receivers and software radio systems, baseband in-phase and quadrature (denoted by I and Q) components are usually needed. In a super-heterodyne radar receiver, the conventional method to obtain quadrature components of signals is to multiply the original signal with a complex exponential. In this paper, the fundamental principles of obtain digital quadrature components of the super-heterodyne radar receiver are introduced. Double-IF quadrature demodulation topology is synthesized and fully analyzed in this paper. [C367]

"Application of adaptive kernel time-frequency distribution in ISAR imaging with complex motion target"

The ISAR image will be blurred using the traditional range-Doppler algorithm for imaging maneuvering targets. Time frequency analysis is an effective method for solving this problem. On the basis of analyzing the radar echopsilas Doppler frequency time-varying characteristic with complex maneuvering in detail, a new adaptive kernel time frequency distribution (AKTFD) which is suitable for complex maneuvering targetpsilas ISAR imaging is introduced. The new algorithm for estimation the kernel functionpsilas parameters is also proposed in this paper. Simulation result based on simulated data and real data shows the validity of proposed algorithm. [C368]

"Interferometric phase improvement in multi-look case"

In this paper, an intensity optimization based method is proposed to improve the interferometric phase in the multi-look case by polarimetric information fusion. In general, the lower the intensity is, the less reliable is the phase. The reliability of phases can be improved by maximizing the intensity for the multi-look case. For each pixel, an optimal unitary complex vector is found to maximize the lesser intensity of the interferometric pair. The Cloudepsilas coherence optimization method is used for comparison. Using the data collected by SIR-C/X-SAR, the authors demonstrate the effectiveness and the robustness of the proposed approach. [C369]

"Challenges in developing Sense & Avoid capability for Unmanned Aircraft Systems"

Unmanned aircraft systems will require a sense & avoid function to protect against collisions with other aircraft as well as various other hazards. Architectural alternatives in the distributions of functionality between aircraft and a ground control station make the development of requirements and standards more complex. [C370]

"High resolution through-the-wall radar imaging using extended target model"

Through-the-wall radar imaging attempts to image complex scenes within enclosed structures. While most of the high-resolution imaging techniques assume point targets, indoor imaging requires dealing with single or multiple walls which are extended targets in nature and violate the point-target assumption. In order to provide high quality imaging, we need to consider point targets and extended targets separately. In this paper, we model extended targets and apply signal subspace methods for target localization. By combining two separate images,

one with point target model and the other with extended target model, both types of targets can be identifiable. Imaging results are shown with both synthesized and experimental data. [C371]

"Modulus constraints in adaptive radar waveform design"

Within the taxonomy of adaptive waveform generation methodologies is the family of arbitrary waveform design algorithms, which are capable of designing both the modulus and phase of a complex-valued waveform in response to changes in the operational environment of the sensor. Algorithms of this kind have been the subject of renewed research interest as a consequence of the relatively recent advances in linear RF power amplifiers, arbitrary waveform generators, and computational capability. In this paper, we use hardware considerations to argue that constraints on the maximum waveform modulus will generally supersede the total energy constraint commonly found in the literature. In order to illustrate the deleterious effects on system performance that can arise when these modulus constraints are not accounted for, we subjected recently published waveform design algorithms to maximum modulus limitations in simulation, and we present the results here. We also propose a novel arbitrary waveform design algorithm that accounts for both maximum modulus constraints and constraints on the waveformpsilas autocorrelation function. Simulation results that demonstrate the efficacy of this algorithm are presented. [C372]

"Lidar simulation using graphics hardware acceleration"

Modern enhanced and synthetic vision systems (EVS/SVS) often make use of the fusion of multi-sensor data. Thus there is a demand for simulated sensor data in order to test and evaluate those systems at an early stage. We describe an approach for simulating Lidar sensors based on using modern computer graphics hardware making heavy use of recent technologies like vertex and fragment shaders. This approach has been successfully used for simulating millimeter wave radar sensors before. It is shown that a multi sensor simulation suite integrating such different sensors like millimeter wave radar, Lidar or infrared can be realized using principally similar software techniques thus allowing for a unified comprehensive simulator. This approach allows us to use a single consistent data base for multi sensor fusion. Recent graphics hardware offers the possibility of carrying out a variety of tasks in the graphical processing unit (GPU) as opposed to the traditional approach of doing most computations in the computerpsilas CPU. Using vertex and fragment shaders makes these tasks particularly easy. We present a vertex shader solution written in GLSL, the OpenGL shading language. The program computes all necessary view transformations and shading information necessary for Lidar simulation in one pass. This allows high frame rates for real time simulations of even complex flight scenes. [C373]

"mmw active phased array seeker project for Hit To Kill engagement"

The fulfilment of hit to kill performance in air defence scenarios against highly manoeuvring targets can be obtained by using a millimeter wavelength seeker with a dedicated ldquohit to killrdquo guidance. The use of a phased array configuration allows to have the benefits of the electronic scanning. The features of this technology permits to counteract complex threats. So it could be an interesting choice for the systems that have to meet asymmetric threats (aircraft, cruise missiles, TBM,...). [C374]

"Realizing complex autonomous driving maneuvers the approach taken by team CarOLO at the DARPA urban challenge"

The 2007 DARPA Urban Challenge has been a great opportunity to demonstrate the abilities of the Technische Universitat Braunschweig to develop an autonomous vehicle named Caroline and to show its capabilities in urban-like environments. Team CarOLO was among 11 of 89 teams who qualified for the final DARPA Urban Challenge early in the competition. This paper describes the approaches taken by team CarOLO for the realization of complex autonomous driving maneuvers. Compared to previous activities in autonomous driving this is the first venture to require fully autonomous vehicle guidance in an urban environment: all previous projects have focused on navigating deserts and highways. Completely new concepts are required to make vehicle guidance in urban environments possible. An efficient and flexible interface as well as the control structure of Carolinepsilas system is shown that was applied in the DARPA Urban Challenge. [C375]

"Detection of buried objects using GPR change detection in polarimetric Huynen spaces"

Change detection is a useful method for detecting new events in a scene such as the placement of mines, and/or the movement of people, vehicles and structures. The basis of the approach is to examine an area via radar several times. Once, before there were targets planted there, and the other (or others) after. The change detection algorithm will notice if there are any changes after the first view was made. False alarm, that is a critical issue in this approach, can be reduced in a number of ways: exploiting additional information such as phase and polarization, and 2) exploiting critical attributes by computing changes in focused sub-spaces. In this

paper we present anew approach for polarimetric change detection, whereby the target is represented not in terms of the complex scattering elements but in terms of phenomenologically-based Huynen parameters. Each element of the Huynen parameter set conveys useful physical and geometrical attributes about the scatterers thus augmenting the potential for significant false alarm mitigation. Results of the application of this approach on fully polarimetric signatures of simulated buried targets are provided. These results indicate that Huynen parameters are more effective for change detection than the scattering matrix elements in generating higher unambiguous autocorrelation peaks and less prominent cross-correlation peaks. [C376]

"A Novel Complex Valued Blind Signal Extraction Method for Adaptive Interference Suppression in Civil Aviation Air-to-Ground Communication"

Complex valued blind signal processing is a frequently arising problem in signal processing, and it is an effective method to the resolve linear convolutional mixing problem. In this paper, based on the circularity of the signal, we proposed a new complex valued blind signal extraction method to realize the interference suppression in civil aviation air-to-ground communication. The new method can reduce the computational burden effectively and has good processing effect. Simulation results are presented to demonstrate the performance of the proposed method. [C377]

"Signal processing for through wall moving target tracking by M-sequence UWB radar"

In this paper, through wall moving target tracking by UWB radar is described as a complex process with all required phases of radar signal processing. For particular phases of that process, i.e. for raw radar data preprocessing, background subtraction, detection, trace estimation, localization and tracking itself, the phase significance and its corresponding representative methods are outlined. The complete process is illustrated by the results of processing of real data acquired by M-sequence UWB radar. [C378]

"A Vision-Based System For Automatic Detection and Extraction Of Road Networks"

In this paper we present a novel vision-based system for automatic detection and extraction of complex road networks from various sensor resources such as aerial photographs, satellite images, and LiDAR. Uniquely, the proposed system is an integrated solution that merges the power of perceptual grouping theory (Gabor filtering, tensor voting) and optimized segmentation techniques (global optimization using graph-cuts) into a unified framework to address the challenging problems of geospatial feature detection and classification. Firstly, the local precision of the Gabor filters is combined with the global context of the tensor voting to produce accurate classification of the geospatial features. In addition, the tensorial representation used for the encoding of the data eliminates the need for any thresholds, therefore removing any data dependencies. Secondly, a novel orientation-based segmentation is presented which incorporates the classification of the perceptual grouping, and results in segmentations with better defined boundaries and continuous linear segments. Finally, a set of Gaussian-based filters are applied to automatically extract centerline information (magnitude, width and orientation). This information is then used for creating road segments and then transforming them to their polygonal representations. [C379]

"Binary Phase-Coded Sequence Recognition Based on EMD"

Identifying the phase-coded sequence of the binary phase-coded radar signal is a difficultly issue in the radar countermeasures. In this paper, a new approach of abstracting waveform features of the radar signal and identifying the phase-coded sequences is proposed, based on experimental model decomposition. The proposed approach can successfully identify complex phase-coded signal. Moreover, the presented approach can be applied as an integral part of radar signal recognition algorithm to prevent the electronic support measure (ESM) system from taking actions against false radar signal recognition and consequently avoid the waste of the available resources. Computer simulation results have shown that the proposed approach can successfully identify phase-coded sequences, and the recognition accuracy is greater than or equal to 89% when the signal-to-noise ratio is as low as 8 dB. [C380]

"Superresolution via extrapolation with constraints on signal duration"

Method of signal extrapolation in frequency domain for improvement of resolution in time domain is proposed. The main idea of this method is use of concept of duration of signal through formulation of non-energy constraints, when there is a priori information about finiteness of signal support in time domain. Unlike traditional extrapolation techniques no strict model of extrapolated data is required, as well as no exact information about signal support in Fourier conjugate domain must be provided. Developed approach is investigated through numerical simulations and applied for processing of multifrequency data of complex reflection coefficient of

dielectric layered structure. [C381]

"Point scatterers target identification using frequency domain signal processing"

The coherent short pulse radar provides high resolution image of the target. A model of this image is composed in the superposition form by complex envelope of signals returned from point-scatterers. In accordance with their positions and reflection coefficients the values of complex envelope are distributed over radar image coordinate plane. Radar image model is based on known radar pulse envelope and pattern of the antenna. The parameters of the target point scatterers are processed in the frequency domain using one dimensional data extracted from the complex discrete Fourier transformed image. Matrix pencil algorithm is used for the parametrical target identification. This approach is characterized by the ambiguity of the point scatterers positioning in the coordinate plane. Rotation of the image axes is used to provide a disambiguation. [C382]

"Segmentation of Spectrum Map for HFSWR Based on Feature Extraction"

When targets fall in different types of clutter and noise background in High Frequency Surface Wave Radar (HFSWR), uniform detection algorithms always result in poor detection and tracking performances. To solve the problem, two methods are proposed in this paper by extracting the background features according to the probability distribution and the image characteristic of the spectrum map. The first method uses Parzen window for estimating probability density function and Kullback-Leibler convergence for evaluating the difference between the Azimuth-Range-Doppler cells in spectrum map which can be used to distinguish the homogenous detection background from the non-homogenous. The second method is proposed based on the image edge feature in multi-scale space. The real data results about HFSWR show that the proposed methods can not only identify noise/clutter but also help choose appropriate detection/tracking algorithms to improve performances in such complex environments. [C383]

"Estimation of canopy attenuation for active/passive microwave soil moisture retrieval algorithms"

This paper discusses the importance of the proper characterization of scattering and attenuation in trees needed for accurate retrieval of soil moisture in the presence of trees. Emphasis is placed on determining an accurate estimation of the propagation properties of a vegetation canopy using the complex frequency correlation function (FCF). A new technique for determining the canopy attenuation that uses the measured stepped frequency radar backscatter response is proposed. It makes use of the details found in a transient solution where the canopy (volume scattering) and the tree-ground (double interaction) effects appear at different times. The proposed technique is based on separating the backscattering sources within a forest canopy in the time response. The technique has been used with L band data collected over deciduous trees to verify that the algorithm results match the simulated data. [C384]

"Analytical, numerical, and experimental methods for through-the-wall radar imaging"

In this paper a physics-based approach for image formation of targets behind complex wall structures is presented. Analytical and numerical techniques are used for the development of forward scattering models which are then exploited in construction of matched filters for ultra-wideband synthetic aperture radars operating over a wide rang of incidence angles. Special scattering models for different wall types including cinder block and reinforced concrete walls are presented using efficient numerical and approximate analytical techniques. These allow for construction of SAR images as well as development of a refocusing algorithm. An experimental ultra-wideband radar is set up in the laboratory environment for the evaluation of the models presented. Also, a radar measurement configuration is proposed that allows for elimination of direct reflection from the walls. [C385]

"Multi-location wideband through-the-wall beamforming"

Significant multipath propagation and heavy clutter in indoor environments renders through-the-wall radar imaging a difficult and complex proposition. It is highly desirable to properly interpret the radar images and determine the contents of the indoor scene with a high level of confidence. Data collected from multiple positions around a structure can be used to improve imaging visibility into the indoor scene, thereby enhancing indoor target detection and localization. In this paper, we consider multi-location radar imaging. Image fusion techniques for combining radar images acquired from multiple locations along two sides of an enclosed structure are presented. Supporting results, based on real-data, are also provided. [C386]

"A new DEM reconstruction method based on an accurate flattening algorithm in interferometric SAR"

This paper presents a new approach to reconstruct digital elevation model (DEM) without compensating the flat

earth phase back to the unwrapped interferometry in the interferometric synthetic aperture radar (InSAR). The new approach is based on an accurate flattening algorithm called model-spectrum algorithm which combines the advantages of classic algorithms. The experimental results show that the new algorithm has a better performance than the conventional ones. Based on this novel algorithm, DEM reconstruction can be implemented by a quasi-linear scaling after phase unwrapping. There is no need to add the flat earth phase back to the flattened interferogram, which avoids complex geometrical conversion as what is done in the conventional algorithms. [C387]

"Radar clutter mitigation via space-time wavefront adaptive sensing"

Space-time adaptive processing (STAP) in complex radar propagation and inhomogeneous clutter environments is often precluded because neither the target wavefront is sufficiently known nor is signal-free training data available. In recent work, wavefront adaptive sensing (WAS) was proposed to overcome these challenges by combining minimum variance (MV) adaptive processing and blind source separation (BSS) for distributed sources. In this paper, WAS is compared with conventional BSS and MV processing both analytically and via simulation. In an over- the-horizon radar (OTHR) spread-Doppler clutter environment, WAS is shown to avoid MV signal cancellation at high SNR and poor BSS threshold performance at low SNR. [C388]

"An Interacting Multiple Model Tracking Algorithm Based on Rigid-Body Model of Target"

Rigid-Body Model (RBM) is a more precise method for motion description of airborne maneuvering target compared with traditional Particle Point Model (PPM). It includes a pose-angle vector in the target state variable vector to model target motion more exactly, which has the potential to improve the tracking performance. Traditional RBMs are usually too complex to be accomplished in practical application. Therefore, a simplified application-oriented RBM is proposed in this paper by analyzing the motion characters of maneuvering targets. It is then used in the Interacting Multiple Model (IMM) algorithm, where the fuzzy association measure between the pose-angle measurement of a target and the current motion mode is calculated, and the association result is used to fuse with the model probability. Numerical simulation results show that the proposed method could effectively improve the tracking performance of IMM because of the enhancement of identification ability of motion model, and nearly bring no additional computational burden. [C389]

"Barankin Bound for Bearing Estimation with Bias Correction"

Array-based bearing estimation is commonly used in many sonar/radar applications. Typical performance of a practical implementation displays a threshold behavior, that is, below certain signal-to-noise ratio (SNR) the estimation mean- square error increases dramatically. The error increase is known to be largely attributed to sidelobe ambiguities in signal field correlation along with estimation bias at low SNR, and some performance bounds are exploited to capture the ambiguities and predict the threshold SNR. Research in the past often ignores the bias-related contribution due to evaluation difficulty. Recently a complete Cramer-Rao bound (CRB) has been derived to include both the Fisher information and the bias contribution using a first-order approximation of the MLE bias. The revised CRB has shown some threshold behavior, however it is still far less tight compared to the simulations, first because it cannot capture the sidelobe ambiguities; second because the expression of the first-order bias given in a referred paper was later found incorrect in terms of the sample size order. This paper further develops the concept of local performance bounds with bias correction in two aspects. First a closed-form expression of the MLE first-order bias is derived for a complex multivariate Gaussian data model. Second, the Barankin bound is derived and evaluated for the bearing estimation problem, which is optimized through a set of test points in the parameter space to capture the sidelobe ambiguities. The simulations show that the resulted bound is much tighter than the CRB. Together with the bias correction, the bound is also able to close the gap from the large-error global bounds yet with much less computations. [C390]

"Velocity measurement of the automobile based on the wavelet de-noising and STFT"

This paper mainly deals with the velocity measurement of automotive millimeter wave radar. The echo from the noisy traffic environment often makes it difficult for the traditional frequency spectrum analysis and the complex time-frequency processing methods to accurately and briefly represent the automotive velocity. A new method based on the wavelet de-noising and the short-time Fourier transform is proposed here to extract desired signal from interference and give a new time-frequency spectrum of the Doppler frequency, and calculate the moving velocity effectively. Higher signal to clutter ratio and higher resolution in the time-frequency distribution are obtained via the computer simulation and the actual gathered signal processing, and the velocity is also measured effectively. The method may widely apply to the velocity measurement of the moving goals of projectiles, ships and so on. [C391]

"Modeling and Interpretation of Multifunction Radars with Stochastic Grammar"

Multifunction radars (MFRs) are sophisticated sensors with complex dynamical modes that are widely used in surveillance and tracking. Because of their agility, a new solution to the interpretation of radar signal is critical to aircraft survivability and successful mission completion. In this paper, we introduce a knowledge-based statistical signal processing technique that allows syntactic representation of domain expert knowledge. In particular, we model MFRs as systems that "speak" a language that can be characterized by a Markov modulated stochastic context free grammar (SCFG). We demonstrate that SCFG, modulated by a Markov chain, serves as an adequate knowledge representation of MFRs' dynamics. We then deal with the statistical signal interpretation, the threat evaluation, of the MFR signal. Two statistical estimation algorithms for MFR signal are derived-a maximum likelihood sequence estimator to estimate the system state, and a maximum likelihood parameter estimator to infer the system parameter values. Based on the interpreted radar signal, the interaction dynamics between the MFR and the target is studied and the control of the aircraft's maneuvering models is implemented. [C392]

"A Comparative Study of Speckle Filtering In Polarimetric Radar SAR Images"

Speckle appearing in polarimetric synthetic aperture radar (SAR) images is generated by coherent processing of radar signals. It hampers perception and extraction of fine details in the image. That is why speckle reducing is necessary before images analysis because Speckle filtering of polarimetric synthetic aperture radar (POLSAR) image has a great impact on the accuracy of terrain and land-use classification and scene interpretation. In this communication, we studied and tested several linear and non linear methods (Boxcar, Lee, Novak, Russell and Saad filters) to remove speckle in polarimetric SAR images. The single look complex (SLC) images to be filtered were acquired on the P band in airborne polarimetric mode. The evaluation of each filter is based on the following principal criteria: i) Its capacity to smooth the homogeneous areas, ii) Its aptitude to preserve contours, and iii) its capacity to preserve polarimetric information [C393]

"Solving video-association problem with explicit evaluation of hypothesis using EDAs"

In this work the data association problem in visual tracking is formulated as a combinatorial hypotheses search with a heuristic evaluation function taking into account structural and specific information such as distance, shape, colour, etc. In order to guarantee real time performance, the search process has a time limit to explore alternative solutions. This time defines the upper bound of the number of evaluations depending on the efficiency of the search algorithm. Estimation distribution algorithms (EDA) is proposed as an efficient evolutionary computation technique to search in this hypothesis space. Then, an exhaustive comparison of the performance of alternative algorithms is carried out considering complex representative situations in real video sets. [C394]

"Ground Moving Target Tracking with context information and a refined sensor model"

For the detection of targets moving on ground, airborne ground moving target indicator (GMTI) radar is well-suited. In the tracking process, complex target dynamics, particularly stop and go maneuvers, and target masking due to Doppler blindness, often lead to track losses. By means of a refined sensor model it is possible to detect and handle such diverse target states. In addition, the generation of precise and continuous tracks from GMTI radar plots often is a demanding task due to terrain and technical obscuration and clutter. The exploitation of topographic background information such as road maps and terrain data is therefore highly desirable for the enhancement of track quality and track continuity. In the present paper these two aspects have been merged. The significant gain in track quality and track continuity is demonstrated in a number of simulation scenarios involving Doppler blindness and terrain obscuration. [C395]

"Point scatterers target identification using frequency domain signal processing"

The coherent ultra short pulse radar provides high resolution image of the target. A model of this image is composed in the superposition form by complex envelope of signals returned from point scatterers. In accordance with their positions and reflection coefficients the values of complex envelope are distributed over radar image coordinate plane. Radar image model is based on the known radar pulse envelope and a pattern of the antenna. The parameters of the target point scatterers are processed in the frequency domain using one dimensional data extracted from the complex discrete Fourier transform of the radar image. The Matrix pencil algorithm is used for the parametrical target identification. This approach is characterized by the ambiguity of the point scatterers positioning in the coordinate plane. Rotation of the image axes is used to provide a disambiguation. [C396]

"A new scattering matrix of multiport antenna array"

This paper deals with the mathematical model and properties of a new scattering matrix of given antenna array normalized to complex multiport impedance matrix of generators. The introduced scattering matrix is described a matching problem for a connection of array with multiport beamformer. The scattering parameters are based on eigenvalues and eigenvectors of the antenna multiport matrices. As shown there are an infinite number of the scattering matrices for given antenna array and multiport beamformer. The extremum properties of the Rayleigh ratio for the power maximization for multiport networks are used. The particular array and excitation network (signal divider) and results of computer frequency characteristic simulations are described. [C397]

"Estimation of the parameters of complex exponentials under radar land clutter and single snapshot observation using Modified Forward Backward Linear Prediction"

Estimation of the frequencies, amplitudes and phases of complex exponentials that model the targets present in radar data under additive white Gaussian noise and land clutter, is investigated stating Maximum Likelihood (ML) and employing spectrum estimation techniques. Use of Tufts & Kumaresanpsilas Modified Forward Backward Linear Prediction (M-FBLP) [D.W. Tufts and R. Kumaresan, 1982] in the defined problem, to the best of our knowledge, seems unpublished. The essential part of the work is that line spectra estimation techniques model the clutter process also as a complex exponential. To estimate the amplitudes and phases given the frequency estimates, two methods are employed and compared. Cramer-Rao bounds are also provided. It has been concluded that for the selected SNR range, M-FBLP shows better performance compared to others. In addition, it is stated that the optimum linear time invariant filter that can be placed before the M-FBLP deteriorates the operation. [C398]

"An adaptive ground penetrating radar imaging system based on complex-valued self-organizing map-recent progress and experiments in Cambodia -"

This paper reports recent progress in an adaptive ground penetrating radar imaging system based on a complex-valued neural network (CVNN), i.e., a complex-valued self-organizing map (CSOM). In the CSOM processing, we deal with feature vectors that represent complex-amplitude texture in space and frequency domains. We developed a switched walled linearly tapered slot antenna (walled-LTSA) array for the front-end. A higher resolution results in a better classification quality. To realize a high resolution in range and azimuth directions, we utilize a wide frequency bandwidth in frequency stepping operation, and a special switching scheme for the walled LTSA. We conducted experiments in Cambodia. In this paper, we report successful plastic landmine visualization, not only for targets buried in normal sand but also for those in wet laterite soil at the Siem Reap test site. Adaptive coherent radar imaging is one of the most potential application fields of the CVNNs. [C399]

"A unified Car-IT Communication-Architecture: Network switch design guidelines"

Rising communication needs in transportation systems due to meshed control circuits and complex sensor technology like lidar, radar and cameras lead to increasing wiring harness and system complexity. To solve this, we made an approach for a unified car-IT communication-architecture based on IEEE 802.3 switched Ethernet for use in the vehicular environment. In this paper, we present the requirements for and realization of the core-network components to enable deterministic communication and the corresponding real-time calculus for system verification. [C400]

"Complex signal demodulation and random body movement cancellation techniques for non-contact vital sign detection"

A complex signal demodulation technique is proposed to eliminate the null detection point problem in non-contact vital sign detection. This technique is robust against DC offset in direct conversion system. Based on the complex signal demodulation, a random body movement cancellation technique is developed to cancel out strong noise caused by random body movement in non-contact vital sign monitoring. Multiple transceivers and antennas with polarization and frequency multiplexing are used to detect signals from different body orientations. The noise due to random body movement is cancelled out based on different patterns of the desired and undesired signals. Experiments by highly compact 5-6 GHz portable radar systems have been performed to verify these two techniques. [C401]

"Blind source separation of human body motion using direct conversion Doppler radar"

Direct conversion Doppler radar can provide remote non-invasive monitoring of cardio-pulmonary activity of human subjects. However, real world life signs monitoring requires real-time processing of data over long monitoring periods, during which it is unlikely that the subject can be expected to suppress other body motion.

Measurement of cardiopulmonary motion of a human subject with extraneous subject movement in the field of view of a Doppler radar system is a complex problem. The use of multiple antennas and blind source separation signal processing techniques is a logical approach for monitoring humans in real world conditions. Described here is the successful separation of cardiopulmonary motion and hand motion for a single subject. [C402]

"Distribution of the diagonal of a 3 Ч 3 complex non-central Wishart matrix"

This paper derives the joint density of the diagonal elements of a 3 times 3 complex non-central Wishart matrix. This distribution arises in a number of applications including synthetic aperture radar, extra-solar planet detection, and multi-antenna wireless communications. The density expression is in the form of an infinite series representation which converges rapidly and is easy to compute. [C403]

"Clustering of fully polarimetric SAR data using finite Gp 0 mixture model and SEM Algorithm"

This paper presents a novel method for clustering multilook polarimetric SAR images by combining the stochastic expectation-maximization (SEM) algorithm with the mixture of Gp0distributions, using the method of moments for parameter estimation. The pixel values of multilook SAR data are complex covariance matrices, and they are described by mixtures of gp0laws. This distribution can describe different type of targets; like urban areas, forest and pasture. The proposed clustering technique can be applied to unsupervised classification and segmentation process. Experiments with real image data provide good results. [C404]

"Locally adaptive threshold SAR image denoising in complex wavelet packet domain"

A novel SAR image denoising scheme based on the quad-tree complex wavelet packets transform (QCWPT) was presented to achieve the tradeoff between details retainment and noise removal. A new threshold method was used in the proposed scheme, and the QCWPT detail coefficients were shrunk via calculating the locally adaptive shrinkage factors with reference to the QCWPT coefficients within the neighborhood window. Experimental results show that the proposed denoising algorithm is possible to achieve an excellent balance between suppresse speckle noise effectively and preserve as many image details and edges as possible. [C405]

"Multi-component LFM radar emitter signal detection based on LWD"

Based on local wave decomposition (LWD), a novel approach for detecting the multi-component linear frequency modulated (LFM) radar emitter signal is proposed in this paper. Every complex radar signal is decomposed into its intrinsic mode components, meanwhile the signal local characteristics are dynamically depicted by instantaneous frequencies. The presented approach can successfully abstract the local frequency features and envelop features of every component of the multi-component LFM radar signal, and estimate the numbers and frequency offsets of component signal of the complex radar signal. Theoretical analysis and experimental results indicate that the proposed approach is effective to analyze and detect the multi-component LFM radar emitter signal. [C406]

"Localization of backscatter transponders based on a synthetic aperture secondary radar imaging approach"

In this paper, we introduce the novel synthetic aperture secondary (SAS) radar positioning technique for the localization of a vehicle. The SAS technique is based on a frequency-modulated continuous wave (FMCW) secondary radar concept where the interrogating radar signal is reflected coherently by a backscatter transponder. It will be shown that SAS positioning is a very efficient way to combine the data of wireless positioning systems with the data from assisting sensors. Our novel SAS local positioning technique outperforms the usual integrated or hybrid navigation approaches based on multilateration notably. A 5.8-GHz wireless local positioning system has been built to test our SAS concept. The synthetic aperture is set up by a moving vehicle. Aperture points are determined with the use of gyroscope and tachymeter sensor data. A newly developed SAS reconstruction algorithm estimates the most likely transponder positions. Based on these estimations, the vehicle determines its position with an accuracy of approximately 5 cm even in complex multipath environments. [C407]

"Road tracking by Parallel Angular Texture Signature"

Road tracking is a promising technique to increase the efficiency of road mapping. In this paper, a new semi-automatic road tracker, parallel angular texture signature (PATS) is presented. The tracker is object-oriented in some sense, because it makes best use of the texture signature of road primitives on high-resolution remotely sensed imagery. Our tracker uses parabola to model the road trajectory and predict the position of next road centreline point. It employs parallel angular texture signature (PATS) to get the moving direction of current road centreline point, and it will move on one predefined step along the direction to reach a new position, and then it

uses curvature change to verify the newly added road point. We also build compactness of Angular Texture Signature polygon to check whether the parallel angular texture signature (PATS) is suitable for tracking. Extensive experiments demonstrate that the proposed tracker reliably extracts ribbon roads from high resolution optical imagery even in very complex scenes. [C408]

"Ship detection over single-look complex SAR images"

Synthetic aperture radar (SAR) ship detection is an important application in the context of environment and security monitoring. Ship detection techniques are generally based on statistically significant contrast between the ship and the local ocean background. Typically, high resolution (few tenths of meters) SAR images need to be considered. Such images are heavily affected by the presence of the speckle, and, for this reason, many ship detection algorithms employ constant false alarm rate (CFAR) algorithms. In this study, a different approach is proposed. The speckle is not mitigated but considered as a source of information. The ship is considered as a dominant scatterer responsible for a strong and coherent backscatter signal. Hence, the different behavior of the speckle statistics in presence of a dominant scatterer exploited. A new simple and very effective filtering technique, which is able to process high resolution SAR images, has been conceived an implemented. Experiments, accomplished over C-band Single Look Complex ERS 1/2 SAR images, show the effectiveness of this new approach for ship detection. [C409]

"Study on visualization simulation of complex electromagnetic environment for tactics application"

This paper presents a kind of visualization model for electromagnetic signals according to battle actualities and tactics needs. In modern battles, complex electromagnetic environment is difficult to control as its invisibility and variety. According with the requirement of tactics application, the proposed model provides a new way to simulate electromagnetic environment for acquiring information dominance. The key techniques are introduced in detail, such as electromagnetic signal modeling, electromagnetic situation evolution and combat scheme simulation. The general framework of the visualization system are designed and realized for naval combat application. The implementation of the techniques and the system greatly enhance naval officerspsila commanding ability in electromagnetic campaigns. [C410]

"Radar imaging through cinder block walls and other periodic structures"

Through-wall radar imaging is a challenging area of research due to the complex multi-layer and inhomogeneous structure of building walls. The wall distorts and attenuates the radar signal in a way that is not easy to predict, except in the most simple of cases. In this paper a general periodic model is developed and applied to the imaging algorithm. Periodic dielectric wall models for microwave transmission and reflection have been investigated by several researchers [1-5]. Floquet mode theory [6] is used to find the discrete plane wave directions that are uniquely determined by the period. Below a certain frequency there are no propagating Floquet modes, so only the specularly transmitted and reflected plane waves are present. In this case it is often possible to use an equivalent 3-layer homogeneous model as described in [4]. This makes it much easier to use a ray tracing code such as the NEC-Basic Scattering Code (NEC-BSC) [7] because the Fresnel plane wave reflection and transmission coefficients may be applied directly. Here we compare the 3-layer model with a volume periodic moment method solution. The goal is to generate model-based images using both approaches to see the effect of the periodicity on the image. [C411]

"Low SNR radar signal detection using the continuous wavelet transform (CWT) and a Morlet wavelet"

A continuous wavelet transform (CWT) system for low SNR radar target detection is proposed in this paper. The radar transmission signal is a pulsed complex exponential. The proposed method automatically determines the optimal scale parameter for CWT analysis by finding the peak in the return signal CWT power computed across translations. The contributions of this paper are an algorithm for determining the optimal scale range for integration of CWT data, a denoising algorithm based on analysis in a small neighborhood around the optimal scale, and analysis of computational and memory requirements. Results are analyzed for simulated radar targets corrupted by white Gaussian noise and compared to a more traditional matched filter (MF). Theoretical and simulation results show that the average CWT and MF process gain (PG) is 23.4 dB and 21.2 dB, respectively, with no Doppler shift, where the theoretical CWT PG is 24.1 dB. For Doppler shifted signals, the mean PG was 23.53 and 13.84 dB for CWT and MF, respectively. The proposed method achieves 3 to 10 dB on average higher PG than the MF method. [C412]

"Doppler Parameter Estimation for Single-Channel SAR Moving Target based on a Novel Model in Complex Image Domain"

In order to characterize the signal of moving target in complex image domain (CID) of synthetic aperture radar (SAR), this paper deduces the model of moving target based on Range-Doppler imaging algorithm and stationary phase principle (SPP). In CID, the target approximately modeled as a linear frequency modulated signal (LFM), which has a great improvement in signal-clutter ratio (SCR), and distributes as mis-located segment in the 2D image. The center and slope of the segment is determined by the Doppler center and Doppler ambiguity integer. Meanwhile, the spreading length is jointly determined by the azimuth velocity and Doppler ambiguity integer. Furthermore, this paper derives the Cramer-Rao Bound (CRB) of parameter estimation in CID. At last, numeric experiments is made to approve the conclusion. [C413]

"Surface deformation retrieval of Yongcheng City(China) based on small baseline DInSAR technique"

In this paper, we apply small baseline DInSAR technique for the generation of surface deformation maps of the investigated area based on complex network. The technique estimates the linear deformation velocity in wide areas, not only in urban areas but also in suburban areas. The results presented in this study are obtained using 6 SAR data acquired by ENVISAT ASAR during 2004-2006. We compare the results with precise leveling data, which validate our results. [C414]

"Second-Order Motion Compensation in Bistatic Airborne SAR based on the Windowed Fourier-Transformation"

A crucial problem in most airborne Synthetic Aperture Radar (SAR) systems is the compensation of motion errors to prevent the image degradation. If these errors are not compensated, some undesired effects will appear, such as loss of geometric resolution and radiometric accuracy, reduction of image contrast, azimuth ambiguities and strong phase distortions. For the bistatic airborne SAR systems, the motion errors become more complex since two separate trajectory deviations contribute to these errors. This paper proposes an approach that will compensate the bistatic motion errors in the frequency domain. [C415]

"Sahelian-Grassland Parameter Estimation from Backscattered Radar Response"

In recent years a special emphasis has been placed on the retrieval of physical parameters from polarimetric radar at microwave frequencies in many research programs. In this paper, we adapted a technique based on an empirical model and a genetic algorithm, and verify its applicability for a complex class of vegetation within a wide temporal interval. This complex class of vegetation is Sahelian grassland which is mainly composed of annual grass and shrubs. The proposed retrieval algorithm is conformed of 3 main steps: (1) Identification of sensitive parameters, (2) Development of the empirical model, and (3) Implementation of a genetic algorithm for the inverse process. For this class of vegetation the sensitive parameters are: the soil moisture content ms, the grass density D, and the grass moisture content mv. When applying the retrieval algorithm to simulated radar responses, a great agreement (an error of 6% when estimating the soil moisture content, 13% for the grass density, and 18% for the grass moisture content in the adult-plant stage) is observed between input parameters and estimated ones. [C416]

"Image Registration of TerraSAR-X Data using Different Information Measures"

Image registration is known as an important part of generating Digital Elevation Models (DEM) with Interferometric SAR (InSAR) processing and is one of the critical preprocessing steps in remote sensing. It is used in the formation of 3-D models based on 2-D images taken at different view points as well as for mosaicking applications. The paper gives an overview of the information measures which can be used for automatic generation of reference points und finding the correspondences in the second image. The approach is validated with simulated and real image pairs originate from the TerraSAR-X satellite. Additionally to the classic correlation based methods, we will employ, compare and combine theoretical methods, based on information theory, such as mutual information, alignability in conjunction with automated bin size determination to achieve optimally. Considering the co-registration of single look complex SAR data, where correlation approaches are standard, the exploitation of similarity measures and transformation, based on information theory, is rather novel. Comparing these novel approaches with standard references with respect to quality and quantitative measures, will broaden the scientific understanding, and, furthermore, provide new insights concerning co-registration techniques for interferometric applications. [C417]

"Two-Dimensional Flow Patterns Observed at Threemile Slough Using Two RiverSondes"

Two-dimensional river flow patterns were measured using a pair of RiverSondes in an experiment at Threemile Slough in the Sacramento-San Joaquin River Delta system of central California during October 2007. An earlier

experiment at Walnut Grove in April 2007, on the migration path of juvenile fish, revealed complex flow patterns during periods of tidally-induced flow reversals, but data there were limited by low winds. Consequently, a follow-on experiment was conducted at Threemile Slough where wind conditions and surface turbulence historically have resulted in abundant data from a single RiverSonde. The experiment at Threemile Slough included ADCP near-surface velocity measurements from unmanned survey vessels. Quantitative comparisons between the RiverSondes and the ADCPs showed mean differences of 0.007 cm/s in the cross-channel component and 0.5 cm/s in the along-channel component, and RMS differences of 7.9 cm/s in the cross-channel component and 13.5 cm/s in the along-channel component after obvious outliers were removed. Interpolation and integration of the velocity vectors revealed complex trajectories of simulated particles during times of flow reversal and smooth trajectories during the remainder of the tidal cycle. [C418]

"The H/A/Alpha Polarimetric Decomposition Theorem and Complex Wishart Distribution for Snow Cover Monitoring"

This study discusses the capability of full polarimetric L-band ALOS PALSAR data for snow classification. In this study, Polarimetric decomposition and the complex Wishart classifier are applied on ALOS-PALSAR data. Optical (ALOS-AVNIR) data within six days difference was used for visual interpretation of snow and non-snow classes. Application of Entropy-Anistropy-Alpha-Wishart classifier for training samples gives better classification results. To reduce speckle effects and to improve classification results, the refined Lee filter was applied on the covariance matrix several times, each time increasing the size of the moving window. Over all classification accuracy were observed 75.61%, 91.46%, 94.91%, 96.19%, 97.16% and 98.37% using different window sizes 1times1 (without filtered image), 3times3, 5times5, 7times7, 9times9 and 11times11 respectively for refined lee speckle filter. It is observed that classification accuracy increases as size of the filter window increases for speckle reduction. Polarization signatures of various features have also been generated using polarization synthesis techniques and signatures are represented in 3-D plot. [C419]

"A Critical Analysis to Generate Change Detection Map using SAR Interferometry for Land Subsidence Monitoring of New Orleans City of USA"

Present paper aims to critically analyze and study the SAR interferometric RADARSAT-1 data for land subsidence monitoring system for New Orleans USA, using Differential SAR Interferometry (D-InSAR) approach. In Louisiana, areas along the coast are sinking as much as one inch a year, and New Orleans is among the worst affected area due to land subsidence. For mapping subsidence, 84 complex data sets from April 15, 2002 to March 15, 2007 were available. Out of this, we have chosen six sets of suitable differential interferometric pairs with approximately one year of temporal span and six interferometric pairs to provide DEM generation for the above differential pairs. In this paper, change detection due to surface deformation is identified using D-InSAR methodology and is compared with classical change detection approach using MRD (mean ratio detector). Results show that subsidence was widespread throughout New Orleans, with maximum subsidence near MRGO canal in period of March 01, 2005 to April 1, 2006. [C420]

"A BPM Two-Scale Contrast Model"

This paper describes a new two-scale polarimetric contrast model based on the Boundary Perturbation Model (BPM). The damping of the short gravity-capillary surface waves by small slicks is modelled by the Marangoni damping coefficient. The surface slick is supposed to modify both the short wave part of the sea surface spectrum intensity and the wind input. The model has been validated over SIR-C/X-SAR Multi Look Complex (MLC) L- and C-band Synthetic Aperture Radar (SAR) data. [C421]

"TerraSAR-X: Complex Image Inversion for Feature Extraction"

In this paper we present two algorithms for information extraction from Single Look Complex (SLC) Synthetic Aperture Radar (SAR) images. The first algorithm is based on Tikhonov regularization with Total Variation (TV) and a Point-Based Feature (PBF) term. Based on the equivalence of Tikhonov and the Bayesian estimate, the second algorithm is a Maximum A Posteriori (MAP) estimation with a complex-valued Gauss-Markov Random Field (GMRF) in addition to the TV prior. The first algorithm produces a despeckled image preserving fine details and texture. The second algorithm gives a denoised image and in addition the estimated feature parameter vector thetas. [C422]

"An Adaptive Technique based on Similarity Measures for Change Detection in Very High Resolution SAR Images"

This paper presents a novel adaptive technique for change detection in very high geometrical resolution (VHR)

Synthetic Aperture Radar (SAR) images that exploits information theoretical similarity measures for modeling the temporal evolution of probability density functions (pdfs). Image statistics for characterizing pdfs are adaptively estimated on a local basis by exploiting the spatial-context information of pixels on small homogeneous regions shared by multitemporal images (i.e., multitemporal "parcels"). The joint analysis of different orders statistics makes the method robust and suitable to the detection of both step changes of the backscattering and texture changes. The use of parcels allows one to model both complex objects in the investigated scene and borders of the changed areas and change details. Experimental results confirm the effectiveness of the proposed approach. [C423]

"Texture Analysis and its Application for Single-Band SAR Thematic Information Extraction"

In this paper single-band and single-polarization Radarsat-1 SAR image is used to evaluate image classification with textural analysis. Firstly, the statistic information of sample were analyzed using semivariogram to determine the optimum parameters for textural extraction; Then four textures such as Homogeneity, Mean, Angle Second Moment and Entropy had been calculated based on GLCM, and the image data were processed using Support Vector Machine classification. The results show that the water and settlement areas are extracted accurately with accuracy 99.34% and 82.54%, and the SVM method has better extension ability for SAR image classification; Assisting with textural information, the image classification based on SVM has a obvious enhancement to original SAR, especially for some complex objects such as settlement areas(about increasing accuracy 18%). [C424]

"Singular Unit Restoration Based on Complex-Valued Markov Random Field Model for Insar Interferograms"

The complex-valued Markov random field (CMRF) model is a powerful basis in complex-amplitude image processing. In this paper, we propose a method to reduce singular points (SPs) included in interferograms based on the CMRF model by focusing on the local pixel-value correlation. We deal with the SP-forming four pixels as a set, namely the singular unit (SU), in the CMRF-based compensation of data values distorted in electromagnetic-wave propagation with interference. We find that the method reduces the SP number with less processing distortion. [C425]

"Multi-Doppler Measurements of Atmospheric Rotors and Turbulent Mountain Waves"

Radar measurements of reflectivity and Doppler velocity for selected cases of rotors and turbulence associated with mountain waves from 2006 T-REX and NASA06 field campaigns are analyzed. The data were collected with the Wyoming Cloud Radar (WCR, http://atmos .uwvo .edu/wcr) on board the University of Wyoming King Air research aircraft (UWKA, https://atmos.uwvo.edu/n2uw'). The retrieval of single- Doppler vertical velocity at 30 m resolution above and below the aircraft and two-dimensional (2-D), high-resolution (on the order of 40x40 m) Dual-Doppler, vertical velocity fields below the aircraft are discussed. The results demonstrate complex dynamics occurring within mountain cap and roll/rotor clouds. Turbulent dynamics and small-scale vortices, without the presence of a larger-scale organized vortex, appear to be more prevalent below mountain wave crests at low levels. The analysis of radar data from consecutive passes during mountain wave events also suggests that while the terrain-induced waves exhibit both stationary and non-stationary behavior, there is a significant evolution in the turbulent dynamics under mountain wave crests and individual features/vortices have a variable life span (on the order of minutes to tens of minutes). The reflectivity fields reveal a disorganized and turbulent structure of the scatterers in the roll clouds. When scatterers are present below the roll cloud (e.g., due to precipitation) their distribution is highly non-uniform. Our radar data does not resolve the 3rddimension (across these flight tracks) and thus some 2-D assumptions are made. The three-dimensionality of the terrain may influence the mountain wave structure and dynamics, but our assumptions are reasonable for flow structures generated by long mountain ranges. [C426]

"Reflectivity and DEM Estimation from Multi-baseline Complex SAR Signals"

Multi-baseline interferometric Synthetic Aperture Radar (In-SAR) systems are used to obtain increased accuracy Digital Elevation Model (DEM) of the observed ground scene. The techniques which are commonly used exploit only the interferometric phase information, and are based on Maximum Likelihood (ML) estimation. Due to the difficulty of express the multi-baseline likelihood function in closed form, they adopt the statistical independence approximation of the interferometric phases. In this paper we present a method exploiting both amplitude and phase of the interferometric images, and allowing to express the multi-baseline likelihood function in closed form. It has also the advantage of correctly performing multi-baseline speckle reduction on the image intensity. [C427]

"Polarimetric BISAR Image Simulation and Analysis"

Employing three-dimensional mapping and projection algorithm (MPA), imaging simulation of bistatic SAR

(BISAR) observation over complex scenario is developed. Based on the explicit expression of point target response of stripmap BISAR imaging, raw data is efficiently generated from the scattering map pre-calculated by MPA. Some examples of BISAR image simulation are studied. Polarimetric characteristics of BISAR image are then discussed. A transform of unified bistatic polar bases for BISAR image is proposed. Analysis of simulated images shows that the redefined parameters by the unified bistatic polar bases transform well describe different scattering mechanisms in BISAR imaging. It provides a primary tool for BISAR image interpretation and terrain classification. [C428]

"InSAR Monitoring of Landslides in Canada"

In this study we used differential and CTM InSAR techniques to monitor landslide slides at different geological sites in Canada. Our results show that InSAR measurements are providing new information on the deformation behaviour of complex landslide processes. [C429]

"Bayesian Estimation of Altimeter Echo Parameters"

This paper studies a Bayesian algorithm for estimating the parameters associated to Brown's model. The joint posterior distribution of the unknown parameter vector (amplitude, epoch and significant wave height) associated with this model is derived. This posterior is too complex to obtain closed form expressions of the minimum mean square error and the maximum aposterioriestimators. We propose to sample according to this distribution using an hybrid Metropolis within Gibbs algorithm. The simulated samples are then used to estimate the unknown parameters of Brown's model. The proposed strategy provides better estimations than the standard maximum likelihood estimator at the price of an increased computational cost. [C430]

"Improving PWF Method of Despeckle in Polarimetric SAR Image by Fusion Based on Nonsubsampled Contourlet Transform"

A novel and efficient improving PWF method of speckle reduction in polarimetric SAR image by fusion based on nonsubsampled contourlet transform is proposed. First, the three complex elements (HH, HV, and VV) of the polarimetric scattering matrix were decorrelated to form a new elements matrix. Then we show that the sub-band decompositions of the three elements using nonsubsampled contourlet transform, and fusion factor is applied to the decomposed directional high-frequency coefficients to create new sub-band coefficients. Finally, we process and reconstruct multi-resolution contourlet coefficients according to the PWF method. Experimental results show that compared with PWF de-speckling algorithm, the proposed algorithm can achieve an excellent balance between suppresses speckle effectively and preserves image details, and the significant information of original image like textures and contour details is well maintained. [C431]

"Frames and a vector-valued ambiguity function"

The setting is that of vector-valued codes of length N. The background for this setting is our construction of new complex valued constant amplitude zero autocorrelation codes (off dc)-CAZACs, which serve as coefficients for phase coded waveforms with prescribed ambiguity function behavior. Vector-valued CAZACs are relevant in light of vector sensor and MIMO technologies. The goal is to define the discrete vector-valued ambiguity function. Our notion of frame multiplication allows us to make this definition. The theory and relevance of such ambiguity functions is developed, including computation of code from received discrete vector-valued ambiguity function data. [C432]

"Networked Multi-target Detection Using Electromagnetic Modeling and Neural Network"

Multi-target detection is crucial in modern warfare. It is challenging to distinguish radar returns of multiple, separate targets from those of multiple reflection points on a single target. Methods developed so far use straightforward discrimination, which is computationally complex. In this paper, we propose ideas to detect multi-targets by using electromagnetic modeling and neural networks (NNs). Preliminary result for missile identification through NN is presented for indicating the efficiency of NN for multi-target detection. [C433]

"A serial MAC architecture for FPGA implementation of a complex adaptive beamformer"

Large scale adaptive beamformers for monopulse radars are difficult to implement on distributed FPGA arrays due to their computational complexity and/or data bandwidth requirements between FPGA processors. In monopulse target estimation, a 2D antenna array of 64 elements is employed for horizontal and vertical polarizations. For such a system sum and difference beamformers are required to estimate the target directional coordinates. In a previous communication we proposed a sparse subarray structure to reduce the computational burden. In extension to this work now we look at the problem of large amount of multipliers required for adaptive

subarray systems. For eight channel fully reconfigurable subarray system, an estimated 568 multipliers are required for two polarizations. In order to reduce this requirement we propose a serial MAC architecture where four parallel multipliers are employed serially using one multiplier. In this case one fourth reduction is achieved and adaptive system can be accommodated on single FPGA device. A complex subarray adaptive beamformer is implemented using the serial MAC structure on a Xilinx device. Device occupation of the proposed adaptive system is four times better than that of parallel adaptive system. [C434]

"A terrain elevation error model for stereometric SAR systems engineering"

A stereometric SAR model for the terrain elevation error is derived which is applicable to general imaging geometries. Range and azimuth stereo sensitivity coefficients are defined which facilitate analysis of wide angle crossed track, as well as parallel track geometries. The geometries are described in terms of a local ground reference point and unit vectors defining the associated slant plane image pairs. Complex-valued image pair correlation is studied for the case of crossed track geometries, including variations with the terrain gradient relative to the slant plane. The associated Prati shift vector and shape of the region of spectral overlap (frequency response support intersection), which characterize the correlation, are also discussed. [C435]

"Some features of signal model for fire reconnaissance radar"

It is necessary to improve the effectiveness of fire reconnaissance radar because of allows modern armed. Due to processor achievements the complex signal processing algorithms would be used in radar. One of them, using the projector matrix filter is depicted in the paper. [C436]

"Autonomy based modeling for the simulation of ocean remote sensing"

This article presents the simulation structure for the MODENA project [1] and illustrates what should become an original dynamical model for the reflectivity map of the sea surface. From our point of view, MODENA challenges to find accurate models for simulating dynamically interaction between sea state, sonar, radar and ship, while keeping physical coherency during the whole observation scenario (several tens of minutes), including human participation in this virtual reality system. To deal with such a complexity, as it is impossible and inappropriate to compute dynamically hydrodynamic, electromagnetic and acoustic equations on an accurate grid of points or mesh, MODENA simulation structure aims to use an autonomy based approach: the model of each phenomenon (wave, breaking, group, ship, wind, stream, transmitter, receiver...) involved in the simulation is seen as an autonomous entity, including an autonomy of time, space and scale. These models are combined and animated using enaction-based multi-agents simulation. In such simulation, computer activity is optimised at places where and when interaction occurs within revelant scale, according to choosen models. Furthermore, to add new phenomena or to modify existing models do not make previous work obsolete, as one has only to characterise interactions of new phenomena with previously defined models. This modeling approach facilitates interaction between research teams involved in the MODENA project, as the whole simulation results from the set of autonomized models developed by each team in parallel. Such a virtual laboratory should help for example to better distinguish the signal of breaking from the signal of small boats, in the dynamical signature of sea-states. [C437]

"Complex point target models for multistatic radar"

A mathematical and statistical model for complex point targets is proposed that may be applicable to statistical inference problems in multistatic or MIMO radar systems. Such targets are not resolved in space, but exhibit varying complex reflectivity across different bistatic view angles. The complex reflectivity can be modeled as a complex stochastic process whose index set is the set of all bistatic view angles, and the parameters of this stochastic process follow from an analysis of a target model comprising a number of ideal point scatterers randomly located within some radius of the target's center of mass. Six different models are proposed, with different assumed distributions on the locations of the point scatterers within the target. [C438]

"Intrapulse analysis of radar signal by the use of Hough transform"

ELINT/ESM type of electronic intelligence in the primary layer uses parameters measurements of intercepted radar signals. Nowadays modern radar uses more and more complex waveforms. Some waveforms are developed intentionally to make their intercept almost impossible. The main distinctive features of modern radar signal are hidden in its time-frequency structure. In the near past the problem of radar signal feature extraction was considered in time or frequency domain separately, because radar waveforms were relatively simple. Today, however, the signals should be observed simultaneously in both domains. Time-frequency distribution concept offers a new approach in radar signals classification/identification. The paper presents some results of Hough transform application to intra-pulse modulation analysis of radar signals. Linear frequency modulation within the

pulse was considered. [C439]

"Segmentation of Polarimetric SAR Data based on the Fisher Distribution for Texture Modeling"

The Polarimetric Synthetic Aperture Radar (PolSAR) covariance matrix is generally modeled by a complex Wishart distribution. For textured scenes, the product model is used and the texture component is often modeled by a Gamma distribution. In this paper, authors propose to use the Fisher distribution for texture modeling. From a Fisher distributed texture component, we derive the distribution of the complex covariance matrix and we propose to implement the KummerU distribution in a hierarchical segmentation and a hierarchical clustering algorithm. Segmentation and classification results are shown on synthetic images and on ESAR L-band PolSAR data over the Oberpfaffenhofen test-site. [C440]

"Automatic registration of inter-band and inter-sensor images using robust complex wavelet feature representations"

A robust method for registering inter-band and inter-sensor remote sensing images has been designed and implemented. The proposed method introduces noise-resilient and contrast invariant control point detection and control point matching schemes based on robust complex wavelet feature representations. Furthermore, an iterative refinement scheme is introduced for achieving improved control point pair localization and mapping function estimation between the images being registered. The registration accuracy of the proposed method was demonstrated on the registration of multi-spectral optical and synthetic aperture radar (SAR) images. The proposed method achieves better registration accuracy when compared with the state-of-the-art MSSD and ARRSI registration algorithms. [C441]

"Analysis of SAR Images in the Framework of Scale Mixture of Gaussian Models"

In this paper we present the normal variance-mean mixture model as a framework for analyzing SAR data. The complex envelope of the echo signal is considered as a double stochastic circular Gaussian variable, in which both the variance and the mean are linearly scaled by a stochastic scaling factor Z. We then derive the generalized K amplitude model, and indicate how its parameters can be estimated from data. Some preliminary results show that this model represents the amplitude of SAR data well. [C442]

"Phase Unwrapping using 2D-Kalman Filter-Potential and Limitations"

In the SAR community there are many methods offered for solving the problem of unwrapping the phase obtained from a noisy interferometric SAR (InSAR) image [2-5]. Generally a Kalman filter is a powerful tool to obtain accurate model based estimates out of different sources of information. All the given information is fused in a efficient way and also the noise is cancelled optimally. Because of this a Kalman filter based data fusion approach to unwrap and simultaneously filter the phases of interferometric SAR images is developed. The data fusion concept exploits phase information, extracted from the complex interferogram rather than from the phase image and fuses that information with phase slope information extracted from the power spectral density of the interferogram. The paper explains a Kalman filter method for phase unwrapping purposes and discusses the pros and cons of this approach. [C443]

"Application of Complex Wavelets in radar signal processing"

The present paper discusses the complex wavelet based signal processing techniques for the meteor detection. Firstly the signal containing meteor is processed with the wavelet based noise level estimation technique, which will improve SNR of the signal and improves the probability of detection of weak meteors. Secondly, complex wavelets (constructing filter banks based on Hilbert transform concept) that allow detecting certain parameters related to different Doppler frequency components. When the parameters exceed a certain threshold, it indicates that the meteor is detected. Meteor detection function (MDF) is defined using the above stated techniques. MDF gives the meteor count, Time of occurrence, meteor scan number. MDF is a unique function and it is very useful in astronomical studies. The advantages of this method are directly derived from the limitations of the existing methods. A great improvement in the characteristics of the meteor events is observed when processed with complex wavelet based signal processing techniques. Experimental results showed an increase in the detection of meteor events compared to the traditional method-which uses the spectrum (frequency domain) data. No need of intense observation on the data for threshold setting, the effect of dasianoisepsila and dasiainterferencepsila is also reduced to a great extent. [C444]

"Road-surface abstraction using ladar sensing"

Propose a road-surface abstraction algorithm which suitable for structured and semi-structured road

environments. Algorithm uses fuzzy cluster method which based on maximum entropy theory to cluster ladar points that belong to a scan line. After fitting clustered data linearly, one can abstract straight lines that belong to road-surface by their location and slope angle. We can acquire a current referenced horizontal by comparing several continuous ladar scan lines and then the algorithm abstracts obstacles on road-surface area. Experiments show our algorithm works well in spite of the road-boundary's shape is regular or not, and free from the impact of complex texture or irregular illumination of the road. [C445]

"Research on water quality assessment method based on multi-class support vector machines"

It has been a more complex problem for water quality assessment. And its aim is to well and truly evaluate its degree of pollution for bodies of water, which will be easy to provide some principled projects and criterions for water resource's protection and their integration application. So, it has been widely applied into water quality assessment. SVM and directed acyclic graph support vector machine (DAGSVM) are paid much attention in this paper. A water quality assessment method based on DAGSVM is put forward. The test results show that the method proposed in this paper has an excellent performance on correct ratio. Besides, a wireless water quality monitoring system is designed and developed. The system can realize the acquisition of the water parameters, and the acquisition information timely and low cost transmission by GPRS (general packet radio service, GPRS). The developed system can store and display the water quality parameters from the monitoring spots in real time. Combining the wireless communication technology with the monitoring technology, the designed and developed system can greatly improve the real-time and continuity for the water quality's monitoring and assessment. [C446]

"Time-frequency-phase coherence-general framework for signal analysis in passive context"

The characterization of a natural environment (underwater, for example) and the identification of radar/communication signals in SIGINT (signal intelligence) are just two typical examples of applications requiring signal analysis in a passive configuration. In the first case, even if the characterization is based on the analysis of received signals in an active configuration, the unknown deformations of the transmitted signal transform the signal processing problem in a passive context one. Concerning the second case, the passive behavior of the signal intelligence field is a well-known problem in the electronic warfare problem.In this paper we propose a general signal analysis framework in passive context. We show that, in spite of the differences between some possible passive applications (underwater channel characterization and SIGINT) a unified signal analysis framework can defined. This definition starts from the general observation that real life signals received in a passive configuration are non-stationary. Their analysis in the time-frequency domain is well adapted so that it offers appropriated structures which are good candidates for the information post-processing. In a passive context, the definition of an appropriate time-frequency representation space is a complex problem, mainly related to the lack of a priori information about the processed signal. One general solution is proposed in this paper and it is based on the time-frequency-phase coherence. Conceptually, while the received signals are unknown (a model is difficult to be assumed), a general remark is the coherent shapes of their time-frequency structures. This coherence could be materialized by fundamental physical parameter of every signal-amplitude, time, frequency and initial phase. Indeed, the signal analysis framework is defined through three blocks: detection of regions of interest, segmentation and separation, analytical characterization. This architecture is mainly based on joint u--se of time, frequency and local phase analysis. More precisely, the phase information will be locally analysed, using generalized instantaneous moments, on the time-frequency regions previously selected thanks to the time-frequency grouping algorithm. This architecture constitutes an efficient scheme to solve the constraints brought by this type of signals with a complex time-frequency behavior and by the human operator to reduce his tasks in the decision process. Examples from underwater behavior (underwater mammals vocalizations) and electronic warfare will prove the efficiency of the proposed approach. [C447]

"Improving path planning and mapping based on stereo vision and lidar"

2D laser range finders have been widely used in mobile robot navigation. However, their use is limited to simple environments containing objects of regular geometry and shapes. Stereo vision, instead, provides 3D structural data of complex objects. In this paper, measurements from a stereo vision camera system and a 2D laser range finder are fused to dynamically plan and navigate a mobile robot in cluttered and complex environments. A robust estimator is used to detect obstacles and ground plane in 3D world model in front of the robot based on disparity information from stereo vision system. Based on this 3D world model, 2D cost map is generated. A separate 2D cost map is also generated by 2D laser range finder. Then we use a grid-based occupancy map approach to fuse the complementary information provided by the 2D laser range finder and stereo vision system. Since the two sensors may detect different parts of an object, two different fusion strategies are addressed here. The final occupancy grid map is simultaneously used for obstacle avoidance and path planning. Experimental results obtained form a Point Grey's Bumblebee stereo camera and a SICK LDOEM laser range finder mounted

on a Packbot robot are provided to demonstrate the effectiveness of the proposed lidar and stereo vision fusion strategy for mobile robot navigation. [C448]

"Non-Parameter Correlation Analysis in Polarimetric Signature and its Application to Change Detection in Polarimetric SAR"

Gonradsen et al. developed a change detection method with multilook fully polarimetric Synthetic Aperture Radar (SAR) data. The method is based on complex Wishart distribution supposition limits the applicable scope of test statistic, especially when only polarimetric diversity (the texture and speckle statistics depend on polarization) and not radiometric diversity. On the other hand, the polarization signature has the capability of representation of the polarimetric diversity. A new test statistic for equality of two polarization signature is proposed in this paper. Without statistical distribution hypothesis, it can give the associated asymptotic probability measure as the Conradsen's method just by non-parameter correlation analysis. Some experiments have been done in this paper with ALOS-PALSAR data by two different algorithms. It has been shown that the new method is effective. [C449]

"The Research on Vehicle Flow Detection in Complex Scenes"

Vehicle flow detection plays an important role in ITS. In the process of vehicle flow detection, the vehicle is contiguous with another and the same vehicle counted repeatedly are common problems, especially the problem of changing lanes, which is very difficult to solve. This paper uses the method that combines background difference and virtual-loop sensor to detect vehicle flow, which based on the fast adaptive background updating method, and it introduces a new method of multi-lane sharing one detecting region. Experiment results show that this method can update the background exactly along with the variance of illumination; it also can solve vehicle orientation and vehicle changing lane problems. In real traffic scenes, it can detect vehicle flow accurately and meet the real-time processing demand. [C450]

"Scattering Center Estimation of UWB Radar Target with Improved MP Method"

Successful target discrimination using the ultra wideband (UWB) radar hinges on an accurate understanding of the scattering behavior of complex radar targets. In the present study, a mathematical model of the UWB radar target is developed based on the analysis of its impulse response. Then an improved matrix pencil (MP) method with adaptive selection of the frequency sampling interval is proposed to extract the target scattering centers. Simulation experiments show that with the present method, the estimated scattering centers of the given UWB radar target are accurate and reliable even at the low signal noise ratio of 6 dB. [C451]

"A Video-Based Real-Time Vehicle Counting System Using Adaptive Background Method"

This paper presents a video-based solution for real time vehicle detection and counting system, using a surveillance camera mounted on a relatively high place to acquire the traffic video stream.The two main methods applied in this system are: the adaptive background estimation and the Gaussian shadow elimination. The former allows a robust moving detection especially in complex scenes. The latter is based on color space HSV, which is able to deal with different size and intensity shadows. After these two operations, it obtains an image with moving vehicle extracted, and then operation counting is effected by a method called virtual detector. [C452]

"Image Auto Coregistration and Interferogram Estimation Using Matrix Fitting"

In this paper, we proposed a novel method based on matrix fitting to estimate the synthetic aperture radar interferometry (InSAR) or synthetic aperture sonar interferometry (InSAS) interferometric phase. In this method, we formulate generalized steering vector at first. And then, taking advantage of the coherence information of neighboring pixel pairs, covariance matrix of complex data vector is estimated. At last, we formulate a global optimum cost function of the covariance matrix, by which the exact interferometric phase can be estimated when the cost function get its minimum. The method can provide accurate estimate of the terrain interferometric phase (interferogram) even if the coregistration error is more than one pixel. The real data of InSAR results show the robust and high efficiency of this method. [C453]

"Modeling and simulation of radar echo signal of aircraft targets with GRECO"

In this paper, the complex RCS at several frequency in a certain bandwidth of the given target is simulated by GRECO method, which is based on the physical optics (PO) method and physical theory of diffraction (PTD) method, and the HRRP of the target is calculated with these wideband responses. By convoluting transmission pulse of the given radar and the HRRP of the target, the echo signal of the given target with the given radar can be obtained. The proposed technique is validated, and simulation results for an aircraft model is given. [C454]

"Preliminary results of lava flow mapping using remote sensing in Piton de la Fournaise, La Rйunion island"

The use of remote sensing is more and more incontrovertible in volcanic monitoring, especially in INSAR and thermal studies. A comprehensive database of high-resolution multispectral and multitemporal optical satellite imagery exists for Piton de la Fournaise, the active volcano on La Reunion Island. This database, however, remains relatively underexploited in volcanological studies of Piton de la Fournaise. Using a large image data set including SPOT 5 and 4, ASTER and aerial photography, we performed cartography of recent lava flows. Different methods were applied for each sensor in order to extract and map lava flow contours and surface morphology. These methods include photo interpretation as well as fusion of thermal band and optical images. In addition we performed several tests with specific software combining object and spectral based techniques. Subsequently, a simple statistical comparison between different perimeters and areas mapped allowed us to determine a precision ratio. Results show that difficulties in extracting contours arise when the study area is a complex lava flow field where the different lava flows overlap, or have a similar textural and radiometric characteristics. [C455]

"Volcanic Deformation Mapping using PSInSARTM: Piton de la Fournaise, Stromboli and Vulcano test sites for the Globvolcano project"

This presentation focuses on the results of the application of the Permanent Scatterers Technique (PSInSARГ,Вї, an advanced InSAR technique capable of measuring millimetre scale displacements of individual radar targets on the ground) as a method for measuring deformation in volcanic area within the Globvolcano project. In this project, T.R.E. takes part as a service provider for the Deformation Mapping products. Three cases of PSInSARГ,Вї application are presented: Piton de la Fournaise (Reunion Island), Stromboli and Volcano (Eolie, Italy). More than 200 ENVISAT ASAR scenes have been processed to estimate the velocity field of the volcanoes surface, as a consequence of the magmatic camera evolution; time series of displacement have been extracted and, whenever possible, ascending and descending geometry dataset have been jointly exploited in order to produce vertical and easting displacement maps. The test cases presented will give the opportunity to describe the enhancement applied to the PSInSARГ,Вї processing chain, required to make the algorithm capable to cope with the complex volcanic deformation dynamics (abrupt changes, non-linear motion) and to allow their representation through a web interface for a quick browsing of the results provided to the users. [C456]

"Scattering center estimation of UWB radar target with improved MP method"

Successful target discrimination using the ultra wideband (UWB) radar hinges on an accurate understanding of the scattering behavior of complex radar targets. In the present study, a mathematical model of the UWB radar target is developed based on the analysis of its impulse response. Then an improved matrix pencil (MP) method with adaptive selection of the frequency sampling interval is employed to extract the target scattering centers. Simulation experiments show that with the proposed method, the estimated scattering centers of the given UWB radar target are accurate and reliable even at the low signal noise ratio of 6 dB. [C457]

"Embedded Sensor Fusion System for Unmanned Vehicle Navigation"

This paper presents the hardware design as well as the implemented sensor fusion algorithms used for navigation purposes in unmanned systems. A design concept is illustrated that has advantages when limited space and changing demands of different unmanned systems are of particular interest. The embedded system demonstrated in this work consists of a Field Programmable gate array (FPGA) board in conjunction with a digital signal processor (DSP) board. By exploiting the individual properties of FPGAs and DSPs, a highly efficient system can be achieved, which is able to process more computationally complex sensor fusion algorithms like iterative sigma point Kalman filters in real time as well as more complex sensor signal processing algorithms used for pulse radar target detection. To validate the system's performance, experimental results are presented by using an unmanned aerial vehicle (UAV). [C458]

"Estimation of rotation in ISAR imaging based on local sharpness measure"

The geometry of inverse synthetic aperture radar (ISAR) imaging suggests in principle a tomographic approach to the reconstruction of a 2D projection of an object illuminated by a radar signal. In theory this is straight forward, but the computational load of such reconstructions have in stead led to the use of fast Fourier transforms (FFTs) on a Cartesian grid. Using FFTs directly in ISAR imaging requires a small rotational motion to avoid blurring and defocusing. Alternatively, interpolation and polar reformatting can be applied prior to the reconstruction step. Also, time-frequency methods have been proposed to reduce the effects of blurring and defocusing of the reconstructed ISAR images. By applying tomographic reconstruction, the polar reformatting is

the last stage of the ISAR imaging process, meaning that phase problems involved in interpolating complex data points are reduced. The objectives of this paper are; 1) To propose a method for estimating the rotational motion of an object based on maximizing the sharpness of a small region of the reconstructed image, and 2) To describe an efficient implementation of a tomographic ISAR image reconstruction in the case of non uniform rotation. [C459]

"Radar target recognition method with MUSIC algorithm: Application to aircraft targets with measured scattered data"

This paper demonstrates the usefulness of an ultra wideband target recognition method in the case of realistic and complicated target geometries at resonance region. The method utilizes the MUSIC algorithm to extract the natural resonance-related scattering features of targets. The resulting features give the power distribution maps of targets. These maps are called as fused MUSIC spectrum matrices and used as the main target recognition feature in the method. The fusion process is needed to reduce the aspect dependency of target features, which increases the accuracy rate of the classifier. In this paper, the method is applied to classify three small-scale aircraft targets. It is demonstrated that the method provides high accurate classification rates although the target geometries are highly complex, the measured scattered data is incomplete and only a few different reference aspects are used in recognition design process. [C460]

"Rank-deficient APES filter for complex spectral estimation"

In this paper, a new spectral estimation method, which is based on the rank-deficient sample covariance matrix, is proposed. The new method applies the amplitude and phase estimation (APES) filter and the Capon weight simultaneously on the data matrix to obtain the complex amplitude estimate of the spectral line of interest. Because the sample covariance matrix is singular, a rank-deficient version of the APES filter is derived. For obtaining the unique filter, an additional constraint is under considered, which minimizes the noise gain of the design filter. Also considering only fewer snapshots available, the traditional Fourier weight can not sufficiently suppressed the components of the interference plus noise. By minimizing the norm of the weighted snapshot, the Capon weight is selected as the optimal weight. The simulation results demonstrate that the new method has excellent estimation performance for estimating the spectrum in case of sample covariance matrix singular. [C461]

"Radar signature analysis using information theory"

The ability to make radar signature databases portable for use within similar sensor systems is critical to the affordability of airborne signature exploitation systems. The capability to hybridize measured and synthetic signature database components will maximize the impact of the investment required to build complex radar signature databases. Modal mutual information is developed as a measure of similarity to compare measured field data to modeled synthetic data. The approach is demonstrated using synthetic signature sets comprised of both ldquosimilar targetsrdquo and ldquodissimilar targetsrdquo. [C462]

"Radar detection using Siegel distance between autoregressive processes, application to HF and X-band radar"

In this paper, we present an original generalization of the CFAR technique . The technique of CFAR consists in testing two alternative assumptions ldquopresence of targetrdquo versus ldquoabsence of targetrdquo in a distance-azimuth cell called ldquocell under testrdquo. In the case where the noise is Gaussian and additive, one can show that the CFAR is equivalent to withdraw from the signal under test the average of the surrounding signal and to divide the whole by the standard deviation of the surrounding signal. The presence of a target is then decided if the resulting quantity is higher than a given threshold determinated in order to maintain false alarm ratio constant. In our article, the treated data are the In Phase-Quadrature data obtained in each distance-azimuth cell. Those are interesting because their Fourier transform makes one possible to acquire the Doppler spectrum. These data are vectorial and more exactly are regarded as the realization of circular and centered complex Gaussian vectors. In order to generalize the technique of the CFAR, we take into account the works of C. R. Rao in information geometry and the works of T. Ando and D. Petz in order to define the distance between distributions as well as the concept of average. We will decide the presence of a target if the distance from the sample under test to the mean of the surrounding samples is higher than a certain threshold. [C463]

"Adaptive waveform diversity for cross-channel interference mitigation"

In this paper we investigate the impact of the presence of an interfering radar on the target direction of arrival (DOA) estimation performed by the reference radar. The DOA estimator is a modified version of the pseudo-

monopulse technique that, using adaptive waveform diversity in transmission, can mitigate the dependence of the estimation accuracy on the interfering signal. The importance of using proper coding in multi-user radar system is highlighted with reference to a simple scenario of two radars and the root-mean square error (RMSE) of the estimator is numerically evaluated in different operational conditions. [C464]

"An Efficient Extraction of On-Road Object and Lane Information Using Representation Method"

Robust and reliable lane detection is an important issue for driver assistance systems and self-guided systems. Input images acquired from a camera on moving vehicle need to be processed for lane and vehicular traffic detection. We propose an algorithm that uses a chain code detector for detecting lanes and detects vehicles using the horizontal lines formed by the vehicles at the edge of the images. In the first step, a vanishing point is obtained from both sides of the lane, which are obtained from the chain code analysis using the canny edge operator. In the second step, the driveways are decided by combining the vanishing point and the lane information on both sides of the moving vehicle. We define the lane properties and the limiting conditions for reliable lane detection. The robustness of proposed algorithm has been verified from experimental results of complex background images. [C465]

"Use of a weather radar for quantification of migrating birds"

Bird quantification through the analysis of radar echoes must deal with several problematic issues. Among other aspects, the complex characteristics of the received signal due to the radar cross section of a bird in flight, limit methods based on a straight conversion of radar reflectivity into bird density. In this paper we propose a bird count algorithm envisaged for processing radar maps collected during the conical scan mode of operation, that bypasses this problem. [C466]

"Tracking of the multi-dimensional parameters of a target signal using particle filtering"

In this contribution, a low-complexity particle filter (PF) is proposed to track the parameters of the signal reflected by a target illuminated with a digital-video-broadcast terrestrial (DVB-T) signal. The tracked parameters are the delay (time of arrival), the azimuth and elevation of arrival, the Doppler frequency, the complex amplitude of the target signal, as well as the rates of change of all but the last parameter. The proposed PF tracks these parameters based on samples of the target signal by assuming that the temporal behaviour of these parameters is governed by a multi-dimensional linear state-space model. The algorithm has an additional resampling step specifically designed to cope with the highly concentrated multi-dimensional posterior probability density function of the parameters. This step allows for tracking the parameters of the target signal with only a few particles, e.g. 50, leading to low computational complexity. Simulation results show that the PF outperforms the maximum-likelihood estimator applied to individual samples of the target signal in terms of higher accuracy and robustness. Under certain conditions usually met in reality the proposed PF can be used to track the parameters of the signals contributed by individual targets in multi-target scenarios. [C467]

"Hierarchical Methods for Landmine Detection with Wideband Electro-Magnetic Induction and Ground Penetrating Radar Multi-Sensor Systems"

A variety of algorithms are presented and employed in a hierarchical fashion to discriminate both anti-tank (AT) and anti-personnel (AP) landmines using data collected from wideband electromagnetic induction (WEMI) and ground penetrating radar (GPR) sensors mounted on a robotic platform. The two new algorithms for WEMI are based on the In-phase vs. Quadrature plot (the Argand diagram) of the complex measurement obtained at a single spatial location. The angle prototype match method uses the sequence of angles as a feature vector. Prototypes are constructed from these feature vectors and used to assign mine confidence to a test sample. The angle model based KNN method uses a two parameter model; where the parameters are fit to the In-phase and Quadrature data. For the GPR data, the Linear Prediction Processing and Spectral Features are calculated. All four features from WEMI and GPR are used in a Hierarchical Mixture of Experts model to increase the landmine detection rate. The EM algorithm is used to estimate the parameters of the hierarchical mixture. Instead of a two way mine/non-mine decision, the HME structure is trained to make a five way decision which aids in the detection of the low metal anti personnel mines. [C468]

"On the Use of Dual-Polarized SAR Data for Oil Spill Observation"

In this paper a novel approach for oil spill observation, based on partially polarimetric Synthetic Aperture Radar (SAR) data, is proposed. A model which relates the co-polarized phase difference (CPD) to the sea surface scattering mechanism with and without slicks is developed. Experiments accomplished over multi-look complex (MLC) C-Band SAR data, show that the CPD approach is useful both to observe oil spills and to distinguish between oil spills and biogenic slicks. [C469]

"Change Detection for Traffic Monitoring in Terrasar-X Imagery"

In this paper the changes occurring in two images acquired at two different time moments are analyzed. In particular the interest is in the changes of filling grade of car-parks or even detecting stopped vehicles on the congested or jammed roads. As input to the change detection processor can serve two repeat-pass single channel images acquired by any airborne or space borne SAR satellite sensor. Each channel is focused, calibrated and processed to a single look slant range complex SAR image. The proposed change detection approach is based on the combination of various techniques: co-registration of two SAR images by interferometric SAR processor, removal of the flat Earth phase, channel balancing, calculating of a coherent or incoherent difference of two images and finally image post-processing and analysis. First experiments on TerraSAR-X imagery show promising results. [C470]

"Estimation of Surface Velocity from Infrared Image Using the Global Optimal Solution to an Inverse Model"

We address the problem of obtaining ocean surface velocities from sequences of thermal (AVHRR) space-borne images by inverting the heat conservation equation (including sources of surface heat fluxes and vertical entrainment). We demonstrate the utility of the technique by deriving surface velocities from actual AVHRR images from one day. Typical formulations of this tracer inversion problem yield too few equations at each pixel, which is often remedied by imposing additional constraints (e.g., horizontal divergence, vorticity, and energy). In contrast, we propose an alternate strategy to convert the under-determined equation set to an over- determined one. We divide the image scene into many sub-arrays, and define velocities and sources within each sub-array using bilinear expressions in terms of the corner points (called knots). In turn, all velocities and sources on the knots can be determined by seeking an optimum solution to these linear equations over the large-scale, which we call the Global Optimal Solution (QOS). We test the accuracy of the GOS by contaminating the model output with up to 10% white noise, but find that filtering the data with a Gaussian convolution filter yields velocities nearly indistinguishable from those without the added noise. Application of the technique to a sequence of five NOAA AVHRR images yields a velocity field, which we compare with that from a Coastal Ocean Dynamics Radar (CODAR) array. We find that the GOS velocities generally agree more closely with those from the CODAR than they do with those from the MCC. Specifically, the root mean square error obtained by differencing GOS and CODAR velocities is smaller than that from the similar calculation with MCC velocities. The magnitude of the complex correlation between GOS and CODAR is larger than that between MCC and CODAR. The phase of the complex correlation indicates that both MCC and GOS on average yield velocity vectors biased in the clockwise direction relative to the COD--AR vectors for the period examined. [C471]

"Detection of Ionospheric Structures with L-Band Synthetic Aperture Radars"

Numerical simulations of low-latitude ionospheric instabilities show the formation of plasma density structures can be detected by synthetic aperture radar (SAR) radio signals. At L-band, the phase front distortions produced by propagation through plasma "bubbles" should provide measurable changes in both the complex-amplitude and polarization waves from orbiting satellite radars. The diffraction pattern from scattered ground SAR signals can be detected by orbiting receivers. Based on reciprocity, ground radars at Kwajalein Atoll are being used to determine the feasibility of space-based detection of ionospheric density structures. This new measurement technique can provide a global data base of ionospheric data for space-weather models that predict the effects of the ionosphere on radio systems. [C472]

"Towards Complex-Valued Neural Algorithms for Forest Parameters Estimation from Polinsar Data"

We discuss the development and application of a Complex-Valued Neural Network (CVNN) algorithm for retrieving forest biomass from polarimetric interferometric SAR data. After discussing some features of the net and of the training procedures, we analyze the performance of the algorithm in inverting combinations of simulated radar backscattering at different polarization states. The CVNN performance is compared with that of other retrieval algorithms. [C473]

"SAR Remote Sensing Data for Subsurface Targets Detection and Lop Nur Lake Evolution and Extinction Study"

This paper presents the observation from SAR images of the dried Lop Nur Lake in Xinjiang of west China. Lop Nur Lake is one of the driest places in the world and finally lost its last drop of water in 1972. It is well known for its "human ear shape" feature in optical remote sensing images. Likewise, the "ear" feature is shown in synthetic aperture radar (SAR) images, and is even larger because of the penetration effect. The universal existence of

lacustrine deposit with high water content and salinity are undetectable by previous remote sensing images in Lop Nur Lake. We have made some laboratory experiments about subsurface soils and developed an improved dielectric model for moist saline soil at microwave bands. A field trip was conducted from October 25 to November 8, 2006 to validate the image interpretation results. As an important indicator for environment degradation and climate change study in arid region, Lop Nur does need long-term and overall research to answer many scientific questions. [C474]

"A New Method for Identification and Analysis of Persistent Scatterers in Series of SAR Images"

Synthetic aperture radar (SAR) interferometry is a powerful technology for measuring slow terrain movements. The extraction of this information is a complex task, because the phase of the signal is measured only modulo 2pi and is affected by noise and systematic terms. The persistent scatterer (PS) approach brought important advances in the solution of this problem. In this work, we present a new method, named persistent scatterer pairs (PSP) method, for the identification and the analysis of PS in series of full resolution SAR images. The problems coming from orbital and atmosphere phase artifacts are effectively overcome by exploiting their spatial correlation, without using model based interpolations or fits, which can be advantageous when the atmospheric artifacts or the displacement to be retrieved are not very well described by the models used in the standard PS approach. Moreover, the proposed method does not need a preprocessing to calibrate the data and is insensitive to the density of PS candidates, it is able to identify PS in natural terrains and PS characterized by non linear movements, is computationally efficient and highly parallelizable. The results obtained on real ERS SAR data confirm the validity of the proposed approach. [C475]

"A Public Database of Simulated Multidimensional SAR Data for Techniques Validation"

This paper presents a new benchmark for techniques validation based on a multidimensional database of simulated data. By exploiting a SAR simulator of complex targets, series of numerical simulations may be run for specific sets of observation conditions and the results made public. Targets are in principle focused on urban structures, despite any other type of man-made targets may be considered. User interaction has allowed to fix the range of values for some design parameters according to the experience gained with real data. Multi-baseline polarimetric SAR interferometry and SAR tomography are the techniques for which this benchmark has been initially conceived, despite other research areas may also benefit, as multi-temporal or multi-frequency analysis. With the resulting amount of images, an adequate testing set can become available for multidimensional methods, which validation with real imagery is difficult. [C476]

"Study on State Prediction Method for Electronic System"

There are various fault modes in many electronic systems and it is very difficult to predict these complex signals which show the fault symptom. The relations between state features and states of two electrical systems are mainly studied and the paper proposes a hybrid method which takes full advantage of individual models to predict state of electronic system: Firstly through using the correlation of state feature ,the embedding dimension is calculated to reconstruct the phase space of state feature; Secondly, according to the character of state feature ARMA-GM(1,1) model is used to predict its linear part and LSSVM with parameters optimized by PSO algorithm is applied to predict its residual part, thus the final predicted values can be gained through adding the two parts of predicted values. Two experiment results show that the forecasting performance of the proposed method is superior to other methods and offers a potential for electronic system condition prognosis. [C477]

"Multi-sensor data fusion in automotive applications"

The application of environment sensor systems in modern-often called ldquointelligentrdquo-cars is regarded as a promising instrument for increasing road traffic safety. Based on a context perception enabled by well-known technologies such as radar, laser or video, these cars are able to detect threats on the road, anticipate emerging dangerous driving situations and take proactive actions for collision avoidance. Besides the combination of sensors towards an automotive multi-sensor system, complex signal processing and sensor data fusion strategies are of remarkable importance for the availability and robustness of the overall system. In this paper, we consider data fusion approaches on near-raw sensor data (low-level) and on pre-processed measuring points (high-level). We model sensor phenomena, road traffic scenarios, data fusion paradigms and signal processing algorithms and investigate the impact of combining sensor data on different levels of abstraction on the performance of the multi-sensor system by means of discrete event simulation. [C478]

"Remote sensing analysis of ongoing deformation in Hazara Kashmir Syntaxis in Northern Pakistan"

Hazara Kashmir Syntaxis (HKS) is a complex tec-tonic feature in North Western Himalayan Fold and Thrust

Belt. Himalayan Frontal thrust starts from the core of the Syntaxis while other faults like Kotil thrust, Riasi thrust and Tanda fault runs along NS directed Jehlum Fault. Seismicity is distributed along all the parts of the Syntaxis i.e. in the core and along the outer loop but decreases southward. The Kangra (1905) and Kashmir Earthquake (2005) are major outputs of the ongoing deformation process and thus gave motivation for this study. This study focuses Kunhar, Kishanganga, Jehlum and Poonch River and their automatically extracted tributaries. The drainage pattern of these rivers is controlled by different tectonic and climatologically changes in the region. Digital elevation models (DEMs) are used for drainage network extraction as it provides elevation information for the land surface throughout the catchment of the area. Drainage network has been extracted from Shuttle radar digital elevation data (SRTM-DEM). Rivers are sensitive to changes in tectonic deformation, adjusting over different periods of time depending on the physical properties of the host rocks, climatic effects and tectonic activity. Thus, the drainage system of a region records the evolution of tectonic deformation. The stream profile analysis of these four rivers provides information about absolute uplift condition in the region. This analysis provides us with different indices and they can later provide us several maps which, integrated in a GIS, allows a better interpretation of the results. We apply fractal analysis to these four rivers and try to study the rigidity of the areas from where they are passing. This is later confirmed with the steepness and concavity indices of the areas to identify the spatial distribution of the different rock types. We can separate various tectonic units and their deformation using knickpoints, concavity and steepness indices and their fractal behavior. [C479]

"Surface deformation analysis of the Mauna Loa and Kīlauea volcanoes, Hawai'i, based on InSAR displacement time series"

We investigate the deformation of Mauna Loa and Kilauea volcanoes, Hawai`i, by exploiting the advanced differential Synthetic Aperture Radar Interferometry (InSAR) technique referred to as the Small BAseline Subset (SBAS) algorithm. In particular, we present time series of line-of-sight (LOS) displacements derived from SAR data acquired by the ASAR instrument, on board the ENVISAT satellite, from the ascending (track 93) and descending (track 429) orbits between 2003 and 2008. For each coherent pixel of the radar images we compute time-dependent surface displacements as well as the average LOS deformation rate. Our results quantify, in space and time, the complex deformation of Mauna Loa and Kilauea volcanoes. The derived InSAR measurements are compared to continuous GPS data to asses the quality of the SBAS-InSAR products. [C480]

"Object recognition based on estimation of ultrawideband reflected pulse complex spectra"

A recognition method based on investigation of the complex spectra of ultrawideband pulses reflected from radar objects is suggested. An algorithm for complex spectrum estimation is described and a criterion according to which object identification is made is presented. Results of the algorithm approbation are given. [C481]

"Combined thermal-LIDAR imagery for urban mapping"

The use of high resolution thermal imagery to represent the urban thermal landscape provides an excellent method of visualising temperature fields and relating them to real world objects. The mapping of these temperature fields provides data for further analysis and is a powerful mechanism for communicating complex ideas to the general public. Aerial thermal mapping also provides a means of locating areas of heat loss by identifying locations of higher than ambient air temperature. Traditionally, imagery has been displayed in two dimesions; this fails to realistically represent urban landscapes. This paper presents a method of obtaining high resolution thermal imagery from an aerial platform and combining it with existing elevation data for the purposes of mapping the thermal landscape of Christchurch City in 2.5 dimensions. Analysis carried out on the subsequent 2 and 2.5 dimensional maps reveals the complexity of the temperature fields in the urban environment and suggests that surface temperature is not simply a function of received radiation. [C482]

"Dual-frequency Scattering Measurement System for Radar Cross-Section Imaging"

X band and Ka band front-ends are integrated into one measurement system in order to get radar cross section and images of complex objects, software defined radio is applied in system design. Then ISAR processing technology is investigated to gain two dimension scattering centers distribution and radar cross section imaging and CBP algorithm is verified to obtaining object information efficiently. [C483]

"Maritime target cross section estimation for an ultra-wideband forward scatter radar network"

Preliminary investigation has shown that a chain of buoy based ultra-wideband (UWB) forward scattering radar (FSR) transceivers could potentially be used to overcome clutter problems for the detection of small marine targets on the sea surface. As one stage of a more in depth system investigation, it was deemed that a thorough analysis of the forward scatter radar cross section (RCS) of typical small maritime targets is required for full

understanding of the radar system performance. This paper describes the preliminary results of this study, through use of numerically simulated 3-D FS RCSpsilas of complex target models and comparisons with a proposed simplified analytical FS RCS description. [C484]

"Illumination of air environment using radiation of SW broadcasting stations"

The possibility of air objects location in bistatic radars employing as illumination the signals of broadcast SW stations is considered in this paper. The spectrums of illumination signal are investigated experimentally. The requirements to the direct signal blanketing degree for the location assurance at given distances. The possibility of building of bistatic systems complex employing broadcast SW stations and providing location of acquiring object employing the information of Doppler frequency translation of signal receiving from object is considered. The proposed approach can be used in constructing multi-position radars using for illumination the radiation in microwave range of the average orbital navigation satellites GPS and GLONAS, as well as the radiation in ultrashort wave range of low orbital meteorological satellites NOAA. [C485]

"Approach to Optimum Performance in Random Spreading CDMA by Linear-Complex LAS Detectors"

In this paper, we first present a BER upper bound for the family of LAS detectors. Then the upper bound is applied to analyze the performance of local maximum likelihood (LML) detectors in large random spreading CDMA (LRS-CDMA) channels where user number A' and spreading gain N tend to infinity and KIN keeps a constant. The LRS-CDMA channels are shown to possess the LML characteristic. In the regime of K/N < 1/2-1/(4ln2) and Nsigma2equal to a constant where sigma2is the noise power, an LML point is almost surely a global maximum likelihood (GML) point and the asymptotic multiuser efficiency of all the LML detectors converges almost surely to one. Given a practical CDMA system with fixed finite K and N, we then propose to construct a quasi-LRS-CDMA channel where bits are extended by a factor of B and spread by unit-length BN-chip sequences and each user transmits B extended bits. Simulation results show that in the regime of BK > 1000, K/N < 1.0 and SNR ges 4 dB, while their average per-bit complexity is less than 0.79BK, the LAS detectors can achieve the BER indistinguishable from the large-system limit BER of the GML detector. [C486]

"A Sparse Signal Representation-based Approach to Image Formation and Anisotropy Determination in Wide-Angle Radar"

We consider the problem of jointly forming images and determining anisotropy from wide-angle synthetic aperture radar (SAR) measurements. Conventional SAR image formation techniques assume isotropic scattering, which is not valid with wide-angle apertures. We present a method based on a sparse representation of aspect-dependent scattering with an overcomplete dictionary composed of elements with varying levels of angular persistence. Solved as an inverse problem, the result is a complex-valued, aspect-dependent response for each spatial location in a scene. Our formulation leads to an optimization problem for which we develop a tractable, graph-structured approximate algorithm. We present experimental results on realistic electromagnetic simulations demonstrating the effectiveness of the proposed approach. [C487]

"Results of Computer Imitation Modeling of Immunity of Correlator Affected by Active Continuous Interferences at the Processing of Wideband Noise or LFM Sequences of Pulses"

Recently the more complex conditions of radar exploitation are connected with saturation of some areas with many radio engineering systems creating complex interference situation. The purpose of this work is: an analysis and estimation of immunity of the multi-channel correlator under matched processing of sequences wideband noise pulses (NP) in condition of the influence of the active continuous interferences (CI) of different types and parameters using criterion of immunity on signal level; a selection of dangerous types of such CI and revision of the conditions of their setting up; a revealing the peculiarities and advantage of the using the noise signal of the given structure with a large time-bandwidth product and small power spectrum density for ensuring of immunity of its correlating processing in condition of the active continuous interferences. [C488]

"The Contour Analysis of Low-Sized Complex-Shaped Objects Based on R-Functions, Atomic Functions and Wavelets"

The parameter processing of radar signals plays a great part in various fields of physics and engineering. The contemporary level of the development of the radar systems gives the opportunity to obtain rather complete information about an examining object. The great part in this process plays the processing of gained radar images, as they represent the main information, concerning the shape and the parameters of an object. Therefore, the main problems are the following: the rise of resolvability, the improvement of the quality of gained

images as well as the creation of new fast-acting algorithms of radar information processing. [C489]

"Distributed and Layered Sensing"

One can easily envision future military operations and emerging civilian requirements (e.g. intelligent unmanned vehicles for urban warfare, intelligent manufacturing plants) that will be both complex and stressing and will demand innovative sensors and sensor configurations. The goal of our research into distributed and layered sensing is to develop a cost effective and extendable approach for providing surveillance for a variety of applications in dynamically changing military and civilian environments. Within distributed and layered sensing, we foresee a new sensor archetype. In this paradigm, sensors and algorithms will be autonomously altered depending on the environment. Radars will use the same returns to perform detection and discrimination, to adjust the platform flight path and change mission priorities. The sensors will dynamically and automatically change waveform parameters to accomplish these goals. Disparate sensors will communicate and share data and instructions in real-time. Intelligent sensor systems will operate within and between sensor platforms such that the integration of multiple sensor data provides information needed to achieve dynamic goals and avoid electromagnetic fratricide. Intelligent sensor platforms working in partnership will increase information flow, minimize ambiguities, and dynamically change multiple sensors' operations based upon a changing environment. Concomitant with the current emphasis on more flexible defense structures, distributed and layered sensing will allow the appropriate incremental application of remote sensing assets by matching resources to the situation at hand. In this paper, we discuss the electromagnetic compatibility (EMC) issues that must be addressed and understood as part of the development of a futuristic intelligence, surveillance and reconnaissance concept utilizing distributed and layered sensing waveform diverse systems. These systems involve the innovative integration of cutting edge technolog- ies such as: knowledge-based signal processing, robotics, wireless networking waveform diversity, the semantic web, advanced computer architectures and supporting software languages. This concept is projected as an autonomous constellation of air, space, and ground vehicles that would offer a robust paradigm to build toward future deployments. The goal is to develop waveform-time-space adaptive processing for distributed apertures that could reduce EMC issues. [C490]

"Use of frequency-randomized SAR waveforms for the detection and mitigation of small-motion effects in precision RCS measurement"

The use of SAR and ISAR imaging is an important tool in the laboratory RCS characterization of scattering patterns across signature critical platforms. Despite measures to the contrary, air turbulence and mechanical vibration can produce unwanted complex perturbations of the target during the imaging process. The slow sweep time of many laboratory stepped-frequency CW radars means that a target can undergo significant motion even during a sweep, leading to substantial and time-varying defocusing of range profiles, unsuited to conventional motion-correction schemes. Model code was written to provide simulations of representative complex motions for a string-suspended target. Comparison of images produced using monotonic and randomized waveforms could detail the presence and pattern of very small motion-related changes in RCS. The ability to do this was found to have a complex dependence on the relative lengths of the radar sweep time and the characteristic oscillation period of the motion. When the sweep time and oscillation period are comparable, it may be possible to accurately retrieve the target's entire motion history, from the phase perturbation recoverable from the difference of the monotonic and randomized waveforms in the raw frequency domain. This can then be applied back to the data as a motion correction. [C491]

"Tsunami Monitoring by HF Ocean Radar: Time and Space Scales"

HF coastal ocean radars are ideal instruments for detection of surface currents in coastal waters and have had wide application for monitoring tidal and wind driven surface currents. This paper addresses the questions of spatial and temporal scales for optimal detection of tsunami properties by HF radar at the shelf break and on the continental shelf itself. Two approaches are used in this evaluation. One is a stylized tsunami wave approaching a shelf which has parallel bathymetry contours and a shelf with uniform depth. In this case the non-linear effects at the edge of the shelf are the same at all points along the shelf edge, and the subsequent wave train emerging onto the shelf has parallel wave fronts. The second approach is a case study of a real section of shelf-edge and shelf bathymetry. In this case numerical modelling indicates that there is a complex pattern of surface currents at the shelf break which varies in space and time. The subsequent wave train has a complex wave front which can be considered to be generated from point sources along the shelf edge. These wave fronts are shaped by local shelf bathymetry as well as interference of waves from the originating source points at the shelf edge. In the case of real bathymetry there are complexities in the surface current field which will produce different outcomes for direction-finding and phased array types of HF radar facilities. Because of its ability to resolve spatially complex current patterns, the phased array system is preferred for tsunami observation networks. [C492]

"Optimal Sniffers Deployment On Wireless Indoor Localization"

Location determination of indoor mobile users is challenging due the complex and volatile indoor radio propagation signals. A radio-frequency (RF) based indoor localization system, like RADAR or ARIADNE, typically operates by first constructing a lookup table mapping the radio signal strength at different known locations in the building, and then a mobile user's location at an arbitrary point in the building is determined by measuring the signal strength at the location in question and searching the corresponding location from the above lookup table. Usually, the mobile's signal strength is measured by three or more sniffers deployed inside the building. Obviously, the number of sniffers and their positions greatly affect the localization performance. This paper presents a detailed analysis and experimental results that explore the impact of the sniffers deployment on the performance of the indoor localization. The results demonstrate that the best localization performance is obtained when the center of gravity of the equilateral triangular (formed by three sniffers) coincides with that of the floor plan; and in order to provide optimal localization for all positions of a large floor, it is necessary to deploy more than three sniffers in a semi-mesh style such that any position in the building is always covered by three nearby sniffers. [C493]

"DCT Local Adaptive Filtering of Images Corrupted by Fluctuative Noise with a Priori Unknown Statistical Properties"

A DCT based locally adaptive filter has been proposed and applied for processing of real and imaginary components of bispectrum for solving a problem of unknown signal shape (waveform) reconstruction. The bispectrum is a 2-D complex function and in its real and imaginary components a strongly non-stationary noise is present. Thus, the filter designed can be also effectively applied to processing different kind of images for which non-stationary noise with a priori unknown local statistical properties is present. The modifications of DCT based filters have been successfully used for removal of pure multiplicative, speckle and film-grain noise. [C494]

"Low Frequency GPR in Difficult Terrain"

Many subsurface investigations are requested in areas unsuitable for most geophysical methods. In some instances, difficult terrain prevents surface coupling with transmitters, receivers, or other instrumental components. In other instances, such as in urban areas, spatial restrictions prohibit the use of seismic methods. Ground penetrating radar (GPR) is one method that can be used to attempt data collection in these difficult areas. In this paper, we will demonstrate the application of low frequency GPR to map a sloping bedrock surface configuration in an urban setting with the aforementioned site limitations. The sloping bedrock surface with a relief of approximately 21.5 meters underlies a stabilized slide area resulting from a failed retaining wall. 40-MHz and 100-MHz antenna systems were employed on boulder rip-rap (used to stabilize the slide area) and within an apartment house complex. Seismic refraction and surface wave investigations were performed to help constrain the GPR data interpretation and to provide bedrock integrity information. [C495]

"Frequency-Dependent Attenuation and Velocity Characteristics of Magnetically Lossy Materials"

In many situations, the magnetic properties of sub-surface materials are often considered unimportant when compared to their 'dielectric' characteristics (i.e., permittivity and conductivity). However, if significant amounts of magnetic minerals exist, such as magnetite, hematite, maghemite and/or iron in its free state, then the relaxation phenomena of these magnetically lossy particles can have an overriding effect on the complex effective permittivity spectrum of the material. In this paper, the effective permittivity, attenuation and propagation characteristics of a range of nano-to-micro scale quartz/magnetite mixtures are investigated with the aim of determining how lossy magnetic minerals affect the macroscopic properties of the material as a whole. In addition, the measured results are compared to popular 'dielectric-based' mixing models (such as the Complex Refractive Index Model CRIM) and the nature of the magnetic relaxation mechanisms is discussed from the aspect of composite mediums. Results indicate that even relatively small amounts of magnetite can have a considerable effect on both signal attenuation and wave propagation velocity and that the current range of mixing models are inadequate for the description of magnetically lossy mixtures. [C496]

"Inversion of dispersive APVO GPR curves: a thin-layer approach for fracture characterization on a vertical cliff"

Reliability of stability assessment of prone to fall rock masses suffers from the lack of information about the geometry and the properties of the fracture networks. GPR profiles associated to Common Mid-Point (CMP) data, all recorded on the cliff wall, recently proved their efficiency to image correctly the extension of fractures with a satisfying resolution. However, besides velocity, CMP data also contain information generally not used, i.e. Amplitude and Phase variations of the reflectivity for a given reflector as function of Offset (APVO) and

frequency. In this study, we analyzed the potential of these curves in the context of thin layers, where multiple reflections generate interferences and complex patterns. We notably present an inversion of real APVO curves derived from a CMP profile acquired directly on a limestone cliff wall. The reflected wave was primary deconvoluated in order to correct wave propagation effects and to evaluate radiation patterns. In a second step, APVO curves were inverted considering a neighborhood algorithm. This procedure permitted to obtain the Jonscher parameters describing the complex permittivity of the thin-layer and of the limestone formation, as well as the aperture and depth of the studied fracture. [C497]

"Multi-frequency ground-penetrating radar method for revealing complex sedimentary facies"

We attempted to resolve deltaic facies in Taylor Valley, Antarctica by using pulses centered near 120, 300 and 880 MHz, the latter of which has not yet been tried in this setting. The 120 MHz profiles clearly defined gross material changes, while the 300 MHz profiles added significant resolution to the topset, foreset and bottomset beds. The additional, higher frequency provided only about 2.5 m penetration however, the 10-15 cm pulse length revealed and defined multiple, fine-scale features that were not observed with the lower frequencies. The dip of these features is, in some instances, opposite to that of larger features profiled with the lower frequencies. Profiling with 880 MHz not only confirmed the greater complexity of the sedimentary architecture, but also allowed more robust interpretation of depositional processes. Generally, we recommend pulses centered near 300-400 MHz for detailed sedimentary profiling to about 6m depth. [C498]

"A Multilevel Traffic Incidents Detection Approach: Identifying Traffic Patterns and Vehicle Behaviours using real-time GPS data"

This paper presents a multilevel approach for detecting traffic incidents causing congestion on major roads. It incorporates algorithms to detect unusual traffic patterns and vehicle behaviours on different road segments by utilising the real-time GPS data obtained from vehicles. The incident detection process involves two phases: (1) Identifies of road segments where abnormal traffic pattern is observed and further divides the 'abnormal segments' into smaller segments in order to isolate the potential incident area; (2) Performs a hierarchical analysis of the vehicles' GPS data, using predefined rules to detect any occurrence of abnormal behaviour within the 'abnormal' road section identified in phase 1. The strength of such approach lays in isolating road segments sequentially and then analysing vehicle data specific to the identified road segment. In this way, the processing of vast data is avoided which is an essential requirement for the better performance of such complex systems. The approach is demonstrated using a simulation of motorway segments near Coventry, UK. [C499]

"Complex Wishart Distribution Based Analysis of Polarimetric Synthetic Aperture Radar Data"

Multi-look, polarimetric synthetic aperture radar (SAR) data are often worked with in the so-called covariance matrix representation. For each pixel this representation gives a 3 times 3 Hermitian, positive definite matrix which follows a complex Wishart distribution. Based on this distribution a test statistic for equality of two such matrices and an associated asymptotic probability for obtaining a smaller value of the test statistic are given and applied to change detection, edge detection and segmentation in polarimetric SAR data. In a case study EMISAR L-band data from 17 April 1998 and 20 May 1998 covering agricultural fields near Foulum, Denmark, are used. Soon the Japanese ALOS, the German TerraSAR-X and the Canadian RADARSAT-2 will acquire space-borne, polarimetric data making analysis based on these methods important. [C500]

"The broadband device for nondestructive measurements of dielectric permeability of lossy media"

The opportunity of creation of the device and a corresponding method for measurement of complex dielectric permeability of solid, liquid, loose environments in ultra short wave and in microwave ranges without breaking of their structure is investigated. The given problem is actual in many areas, including geophysics, radio physics, underground radio sounding and the like. For nondestructive materials testing it is necessary to use only flat constructions of the measuring cell, for example, as unbalanced strip line (SL), slot line or coplanar waveguide. Use of shielded coplanar waveguide (SCPW) as a measuring cell of the complex dielectric permeability tester is base. Results of development of a broadband Instrument on basis SCPW for measuring an electrical parameters of lossy materials, methods of its calibration and testing are presented. [C501]

"SAR Imaging of a Moving Target"

In the proposed work new synthetic aperture radar geometry named generalized inverse synthetic aperture radar (GISAR) geometry is addressed. A new three-dimensional (3D) model of deterministic components of GISAR trajectory signals with stepped frequency modulation is suggested. 3D GISAR geometry is described by means of the analytical geometry. The geometry and kinematics of the object and GISAR observation system are described in separate 3-D Cartesian coordinate system. The stationary objects are presented in 3-D regular grid

of isotropic point scatterers, relatively moving with respect to GISAR system at the velocity of the SAR carrier. The SAR carrier is considered unmoving placed in the origin of the coordinate system of observation. The stationary targets are moving at the complex velocity equal to the geometrical sum of the target velocity and SAR carrier velocity. The analytical expressions to compute the range distance to point scatterers of the stationary scene and moving targets are derived. The image reconstruction procedure includes both range and azimuth compression: cross correlation technique to GISAR signal to realize range compression and short time frequency transform to realize azimuth compression. A range alignment and an autofocusing technique are applied to GISAR signal. To illustrate the capability of the 3D ISAR signal model numerical experiment is implemented. [C502]

"Canonical Framework for ATI and DPCA"

The topic of moving-target detection in clutter has been extensively studied, there are many methods, such as along-track interferometric (ATI) phase, displaced phase center antenna (DPCA) method, space-time adaptive processing (STAP), or some other metrics. A canonical framework is proposed that encompasses ATI and DPCA. The statistical test metric for ATI and DPCA is established in an simple form, via the definition of the complex central Wishart distribution, deduces the statistics of the test metric, the probability distribution of the test metric for ATI and DPCA have the complex central Wishart distribution of 1times1 case, namely the chi2-distribution. The theory foundation offers the possibility to construct the united multi-channel SAR GMTI detector, and derive the constant false-alarm rate (CFAR) detector tests for separating moving targets from clutter. [C503]

"The Hardware Design of Three-channel EIG Monitoring System Based on S3C2410X and GPRS"

A kind of ECG monitoring system, which can monitor ECG all the time and can give an alarm when the abnormal ECG signals are found, is described in this paper. The system is designed using S3C2410X and GPRS, and its software is designed based on Linux. The system can monitor the patient's ECG all the time. When the abnormal ECG signals are found, the system will send the short message automatically through GPRS. [C504]

"Telemedicine Center"

This paper describes a stationary unit at the Telemedicine Center (TMC) which is one part of the advanced care and alert portable telemedical monitor. The TMC is software based on a JAVA server platform running on a Windows PC with a GPRS data link and installed in hospitals. It facilitates, tracks, monitors, and reports the patient condition anytime anywhere. It can run on the platform continuously and constantly and can be used to trigger emergency health alerts immediately when abnormalities are detected. Additionally, we help a physician identify useful information from a huge amount of sensor data collected by the body sensor network on a patient and hence to reduce communication costs. Another important is the sensor data can be auto-backuped in case of accidental broken . [C505]

"The Development of Embedded EGG Recorder Based on ARM9"

An embedded ECG recorder based on ARM9 and Linux RTOS is introduced in this paper. It is based on S3C2410X which is a 32-bit low power micro-controller manufactured by Samsung Company. We transplant Linux RTOS into S3C2410X and develop the application based on Linux. MiniGUI is adopted to design the user interface. This system could acquire ECG signals, display and analyze ECG and send alarm via GPRS when ECG signal is abnormal. [C506]

"An EGG wireless Monitoring Instrument Based on GPRS"

An ECG wireless monitoring system was introduced in this paper. The core unit of instrument is MSP430 micro-controller. The function of instrument includes ECG sampling, analysis and alarm. When the system detects the abnormal ECG from a patient, it will send an alarm message via GPRS wireless module. It is very important for the patient to be salvaged promptly. [C507]

"Improving cooperation between Air Traffic Controllers: a design issue"

Reaching a high level of mutual awareness and comprehension in ATC electronic environments is usually considered as a challenge. The fact that the cognitive processes involved in the building of shared representations are by essence complex and hidden constitutes one of the trickiest reason of this difficulty among all the others. Thus, not only is the analysis of the current processes involved difficult in a "paper" environment (i.e. with paper strips and radar image) but when it comes to the design of an electronic stripping environment, basing the design on the adaptation of those processes may be difficult if not counterproductive.

Actually, as any evolution of the environment modifies the activity in a non-deterministic way, it is quite difficult to anticipate to what extent those processes would remain adequate in an electronic environment. Instead of that option, applying an adapted design methodology may be a way to handle this issue. The purpose of this paper is to take a current instance of the ASTER project (assistant for terminal sectors) initially dedicated to the executive controller, aiming at providing assistance for the terminal sectors, i.e. sectors dealing with traffic inbound or outbound from one or several major airports, and outline the design process. In the first part of the paper, we will briefly introduce the ASTER concept and the VertiDigi HMI product. In a second step, we will focus on the cooperation issue and describe the way the design process was build in order to tackle this issue. [C508]

"Wideband Sonar Waveform Design using Linear FM Signals and Hermite-Rodriguez Functions"

A new approach for the design of wideband sonar waveforms using linear FM signals and Hermite-Rodriguez functions is proposed. The use of Hermite-Rodriguez functions make it possible to formulate the waveform design problem as an optimal parameter selection problem with a positive definite objective function and linear and bilinear constraints. Such a formulation is quite flexible and can accommodate both frequency and time domain design specifications and constraints. The approach used to solve the optimization problem is to convert the nonlinear and nonconvex complex-domain constraints to simple linear and bilinear real-domain constraints by introducing extra optimization variables. Some preliminary numerical results are presented to illustrate the effectiveness of the proposed method. [C509]

"An Overview of Ultra-Wideband Technique Application for Medial Engineering"

As a novel technique, the UWB has many applications worth to researching on. This paper mainly describes current research on UWB equipments for medical applications. The unique features of UWB technique make UWB adapt to medical field. Based on introducing the key features of UWB technique, two existing main biomedical applications are presented. Then the safety of UWB medical equipments is discussed, which is fundamental of the biomedical applications. Finally a brief assessment of future trends for the UWB technique with a focus on biomedical applying engineer is provided, which is that the UWB technique has a wide application expectation for medical engineering. [C510]

"A waveguide/free-space measurement setup for panels and joints of large dielectric radomes"

The problem of characterizing panels and joints of large dielectric radomes is attacked in two ways. Small panel samples are placed in a waveguide setup, in order to measure the complex permittivity of its dielectric layers in their actual configuration. A proper free-space setup is instead used to directly characterize the transmission and scattering properties of the structures. Thanks to the use of TRL calibration and further signal processing, the developed system removes the effect of panel and joint edges as well as the scattering from the supporting structures without the necessity of an anechoic chamber. Experimental data are provided for a C-band panel, an uncompensated joint and the compensated one developed at the IEIIT-CNR. [C511]

"Implementation of advanced radar processes on TMS320C5x processors"

With respect to the advent of radar systems technology, necessity of using advanced and complex processing in the receivers, transfer of high volume of data and need of real time processing in relation to radar signals, appropriate processor must provide the required processing speed. This performance usually is provided with programmable digital signal processors. In this paper, first, processes such as pulse compression with phase coding method, clutter canceling with delay line canceller and Doppler filter bank methods are introduced, then several procedures of parametric and clutter map constant false alarm ratio along with combination of these two methods are described and finally possibility of implementation of these processes on a Texas Instrument DSP are investigated. [C512]

"Localization of ahead vehicles with on-board stereo cameras"

This paper introduces a vision based algorithm that detects and localizes ahead vehicles elaborating images taken by a stereo camera installed on an intelligent vehicle. The algorithm is based on the analysis of stereo images, estimating the ground plane by least square fitting of disparity data, and segmenting the obstacles by a rule based split/merge strategy. Quantitative experiments on complex real world sequences validate the approach. The method is demonstrated to operate in real-time. [C513]

"L-VCONF: A Location-Aware Infrastructure for Battlefield Videoconferences"

Audio and videoconference technologies make complex coordination processes easier, especially when mobile

participants need to synchronize their action in critical environments. The need for an infrastructure providing such a functionality may arise in complex scenarios where an IP network is not available, as for instance in battlefield or other critical environments. This paper describes L-VCONF, an architecture for geo-located conferencing based on a mobile/cellular network (i.e. GPRS, UMTS, WiMax technologies), quick-and-dirty mobile/cellular geolocation, SIP protocol and presence server. Our architecture supports IP audio/videoconferences enriched with geo-located coordination functionalities in complex environments. The approach described in the paper is robust w.r.t. uncertainty while handling location update notification for SIP presence server. [C514]

"Architectural Challenges in Memory-Intensive, Real-Time Image Forming"

The real-time image forming in future, high-end synthetic aperture radar systems is an example of an application that puts new demands on computer architectures. The initial question is whether it is at all possible to meet the demands with state-of-the-art technology or foreseeable new technology. It is therefore crucial to understand the computational flow, with its associated memory, bandwidth and processing demands. In this paper we analyse the application in order to, primarily, understand the algorithms and identify the challenges they present on a basic architectural level. The processing in the radar system is characterized by working on huge data sets, having complex memory access patterns, and doing real-time compensations for flight path errors. We propose algorithm solutions and execution schemes in interplay with a two-level (coarse-grain/fine-grain) system parallelization approach, and we provide approximate models on which the demands are quantified. In particular, we consider the choice of method for the performance- intensive data interpolations. This choice presents a trade-off problem between computational performance and size of working memory. The results of this "upstream " study will serve as a basis for further, more detailed architecture studies. [C515]

"Application in Fuse Simulation of Algorithm for Near Field Scattering by Complex Target"

The paper discusses the algorithm of GRECO for near field scattering by complex targets and application in radar fuze simulation. The models of a certain fuze and a typical target meeting are established by the algorithm and computed to obtain the variety characteristics of echo signals in time domain. A certain type of fuze target simulator of an air-to-air missile is realized according to the echo data of missile-target meeting and modulation elements. The simulator has been successfully applied in the synthetical test system to the fuze of the weapon system and the usage effect in practice is perfect. [C516]

"UWB measurement, complex-amplitude texture, and Walled-LTSA array in plastic landmine visualization"

We describe the importance of ultra wideband (UWB) reflection measurement in the adaptive target visualization. We use a complex-valued self-organizing map (CSOM) to deal with complex-amplitude texture obtained by stepped-frequency UWB reflection measurement. We distinguish targets from clutter by paying attention to the difference in texture in space and frequency domains. In the technique, a wideband measurement is desirable to obtain precise texture. We employ a newly developed antenna, walled LTSA, with which we can construct a wideband, dense array for high-resolution imaging. [C517]

"Recent Advances and Applications of M-Sequence based Ultra-Wideband Sensors"

Ultra-wideband (UWB) sensing is an upcoming technique to gather data from complex scenarios such as nature, industrial facilities, public or private environments, for medical applications, non-destructive testing and many more. Currently it is hard to estimate the full spread of future applications. The measurement approach traditionally used is based on stimulation of the test objects by either short sub-nanosecond impulses or sine waves which are stepped/swept over a wide spectral band. This paper deals with an alternative approach, which uses very wideband pseudo-noise binary signals such as M-sequences for example. Such devices have a very high time stability, enable high measurement speed and do not burden the test objects with high voltage peaks. Furthermore, the device concept promotes monolithic circuit integration in a low cost semi-conductor technology. In what follows, the basic device concept and some extensions will be considered as well as some selected applications will be discussed. [C518]

"IEEE 1641 signal modelling as a learning aid"

A requirement arose to specify test facilities for a complex radar system. For the digital and low frequency analogue parts of the system, there was no problem. However, the radar knowledge possessed by the engineer undertaking the assessment, one of the authors of this paper, was some 20 years out of date and gained when he was a maintainer rather than an engineer. What was needed was a better understanding of the nature and characteristics of a radar signal. This paper shows how a modeling tool for IEEE Std. 1641 (Signal & Test

Definition) m was able to assist the engineer to gain the necessary knowledge to make a valid assessment. [C519]

"Interferometric Synthetic Aperture Microscopy: Physics-Based Image Reconstruction from Optical Coherence Tomography Data"

Optical coherence tomography (OCT) is an optical ranging technique analogous to radar-detection of back-scattered light produces a signal that is temporally localized at times-of-flight corresponding to the location of scatterers in the object. However the interferometric collection technique used in OCT allows, in principle, the coherent collection of data, i.e. amplitude and phase information can be extracted. Interferometric synthetic aperture microscopy (ISAM) adds phase-stable data collection to OCT instrumentation and employs physics-based processing analogous to that used in synthetic aperture radar (SAR). That is, the complex nature of the coherent data is exploited to give gains in image quality. Specifically, diffraction-limited resolution is achieved throughout the sample, not just within focal volume of the illuminating field. Simulated and experimental verifications of this effect are presented. ISAM's computational focusing obviates the trade-off between lateral resolution and depth-of-focus seen in traditional OCT. [C520]

"A Linear Programming Approach for Multiple Object Tracking"

We propose a linear programming relaxation scheme for the class of multiple object tracking problems where the inter-object interaction metric is convex and the intra-object term quantifying object state continuity may use any metric. The proposed scheme models object tracking as a multi-path searching problem. It explicitly models track interaction, such as object spatial layout consistency or mutual occlusion, and optimizes multiple object tracks simultaneously. The proposed scheme does not rely on track initialization and complex heuristics. It has much less average complexity than previous efficient exhaustive search methods such as extended dynamic programming and is found to be able to find the global optimum with high probability. We have successfully applied the proposed method to multiple object tracking in video streams. [C521]

"A statistical method for processing SAR Multichannel ATI sea surface images"

A statistical analysis is presented of the process whereby weighted complex-valued Multichannel ATI (MATI) images of the sea surface are linearly combined so as to maximise or minimise the visibility of selected image features in the resulting filtered image. It is assumed that the modulated features are a result of local fluctuations in mean intensity which can be described statistically by a compound distribution. The background consists of unmodulated Gaussian scatterers. These scatterers and the modulated ones have different (and finite) Doppler spectra. It is shown that with these assumptions, maximising (or minimising) the normalised standard deviation of the filtered image maximises (or minimises) the visibility of the image modulations whatever the spectra may be or the compound distribution. This result means that it is not necessary to know the shape or pattern of the images modulations in order to enhance them. The analysis presented in this paper is aimed particularly at horizontally polarised images. A result is presented showing the effectiveness of the technique. [C522]

"HF radar ship detection and tracking using WERA system"

High frequency (HF) radars are capable to detect and track targets at extremely long ranges. The signal environment that includes external noise, different kinds of clutter and interference will significantly limit the detection performance and system capability. This paper considers a new approach to solve the ship detection and tracking problem in a complex HF radar signal environment. It uses a conventional constant false-alarm-rate (CFAR) detection procedure but the thresh-olding scheme is based on regression analysis of power spectrum values along range and Doppler cells. The ship tracking scheme includes the model in polar coordinates that uses tracking state vector consisted of range, azimuth and velocities and fixed-coefficient filter parameters to get smoothed tracks. The proposed detection and tracking schemes have been tested using real HF radar data from WERA system. [C523]

"The spectrum of scattered radar signals from complex ground targets"

This paper records the spectrum of some types of radar pulses scattered by complex ground based targets. A frequency-domain full wave Electromagnetic (EM) model of targets reveals significant distortion of the spectrum of the scattered signal in relation to that of the incident signal in many cases. Scattering is examined in monostatic cases only. The results lead into a deeper understanding of the scattering mechanisms and the quantification of echoes of complex ground targets. This can lead one to categorise ground targets differently from other features such as surface clutter and target shadows. [C524]

"Detecting personnel in wooded areas using MIMO radar"

This paper discusses the problem of detecting personnel in wooded areas using radar. Radio wave propagation at high frequencies suffers severe attenuation in forests which means low-frequency radar is required. However, stand-alone compact low-frequency radars have a poor angular resolution, which suggests use of a distributed radar system. A proposed solution to the problem is the use of multiple-input multiple-output (MIMO) radar. This approach exploits the angular diversity of widely spaced transmit and receive antennas to combat dynamic range and multipath problems associated with the complex scattering environment present in the forest. We assess the feasibility of the concept through simulation of radio propagation in a forest using a simple point scatterer model and a more detailed radio frequency scattering approximation using a CAD model of a forest. [C525]

"Investigation of the Effect of Fading Correlation on Performance of MIMO Systems Using an RCS Channel Model"

In this paper, the effect of receive and transmit antenna correlation on the performance (BER vs. SNR) of MIMO (multiple input multiple output) systems is determined by using an RCS (radar cross section) channel model. In this physical model, the scatterers existing in the propagation environment are modeled by their RCS so that the correlation of the receive signal complex amplitudes, i.e., both magnitude and phase, can be estimated. The proposed RCS channel model is then compared with classical models. [C526]

"Clustering Polarimetric SAR Image Under Deorientation Theory"

In natural complex terrain surfaces, scattering targets with random orientations produce random fluctuating echoes which lead to confused classifications by directly using target decomposition on polarimetric SAR (PolSAR) image. In order to reduce the influence, the target vector is transformed into the state with minimization of cross-polarization. Then a set of new parameters u/v/w are used to characterize scattering mechanisms under the deorientation theory, and the fuzzy membership is adopted instead of "hard" division of parameter plan. Characterizing the sample coherency matrices as complex Wishart distribution, the PolSAR image is clustered based on Bayes maximum likelihood (ML) criteria. Experiment is carried out on an L-band NASA/JPL SIR-C PolSAR image over Danshui town, Guangdong, China. Comparison results with the popular used methods show that the proposed method provides a significant improvement in classification and the associated scattering mechanism of class is more accurate and beneficial for automatic terrain recognition. [C527]

"Information Theory Based Radar Signature Analysis"

The ability to make radar signature databases portable for use within similar sensor systems is critical to the affordability of airborne signature exploitation systems. The capability to hybridize measured and synthetic signature database components will maximize the investment required to build complex radar signature databases. Radar target scattering response signatures and sensor related effects can be modeled and analyzed as a random process to enable sensor optimization. Information theory based methods are proposed as a means to identify those components within the signal subspace that are highly linked to target separability. Mutual information is developed as a measure of similarity to compare measured field data to modeled synthetic data. The approach is demonstrated using synthetic signature sets comprised of both "similar targets" and "dissimilar targets". [C528]

"Multiresolution Subspace Beam Formation Using a Partially Coherent Model"

Traditional beam formation and waveform techniques rely on fixed apertures with single frequency assumptions that restrict the geometry of the aperture. This approach results constraints on the functionality of radar systems such as having simultaneous imaging and tracking ability, eliminating complex interference, and working with platforms that have limited bandwidth and processing resources. We propose an adaptive multiresolution orthogonalized sub-space beam formation method (AMOS) that allows optimization of apertures that may have non-uniform spacing with limited bandwidth. We combine this model with a partially coherent electromagnetic wavefront propagation model. We will show how this method compares to similar methods from a theoretical lower bound standpoint. [C529]

"Maximising the benefits of sophisticated electronic countermeasures systems"

As electronic countermeasure systems become more complex, the time taken between the equipment being specified, designed, developed and eventually fielded has lengthened significantly. During this development, advances in radar processing are likely to change the requirements for countermeasure waveforms, and the original specification from which the system was designed may no longer be appropriate. The hardware within

modern countermeasure systems is designed in a flexible manner that will support the generation of waveforms not explicitly defined during the specification process. However, the functionality of this hardware is constrained by the inflexible nature of the support tools that prevent novel waveforms from being defined within the system. This paper provides background to the evolution of countermeasure systems and their support tools, and continues to discuss more flexible approaches to the definition of countermeasure waveforms such that maximum benefit can be gained from modern technology in an ever-changing environment. [C530]

"On the application of pattern recognition to identification of simple targets based on resonance and polarization diversity"

In this paper, target radar features based on extracting the polarization matrix of each of the radar target's complex natural resonances (CNRs) in the time domain is investigated. These resonance frequencies and their complex residues (amplitudes) in a co- and cross-polar configuration form a polarization matrix decomposition of the target in late time and are also related to the principal dimensions of the target and their relative physical orientation. We have developed and investigated new radar target features, whereby, for incident circular polarization we generate horizontal and vertical complex residue patterns for each known target at the first few dominant resonance frequencies over a number of aspect angles. [C531]

"Quantifying the benefits of complex radar resource management techniques for airborne electronically scanned radars"

This paper describes a study aimed at quantifying the performance improvement achievable through use of complex radar resource management schemes, instead of basic schedulers, for an electronically scanned airborne surveillance radar system. Through computer simulation of representative scenarios, it is demonstrated that a highly adaptive approach, based upon an entropy metric, enables a radar to establish tracks at significantly longer ranges whilst maintaining overall surveillance performance. [C532]

"Correlation model of distributed small satellites SAR signals"

Both across-track and along-track baselines exist in Distributed Small Satellite Synthetic Aperture Radar (DSS-SAR). The along-track baseline would bring the Doppler frequency difference between SAR images, which complicates the correlation of DSS-SAR signal. According to the model of the single-look complex SAR images in DSS-SAR, a more exact correlation model of single-look complex images for DSS-SAR was proposed. The new model was derived taking into account both of across-track baseline and along-track baseline in DSS-SAR and would describe the signal more accurately. In the end, computer simulation is given and the results validate the correction of analysis in this paper. [C533]

"A novel approach to residual video phase removal in spotlight SAR image formation"

An ad hoc residual video phase (RVP) removal algorithm is developed for a spotlight SAR system employing dechirp-on-receive, and working with the polar format algorithm (PFA). In comparison with the existing RVP compensation approach, just two additional complex multipliers are required in the new algorithm to accomplish the range resampling of the polar formatting, in the meantime of RVP removal. [C534]

"Investigating the effect of a target's time-varying Doppler generating axis of rotation on ISAR image distortion"

ISAR imaging has potential in assisting with the classification of non-cooperative targets. Blurred ISAR imagery may however lead to misleading classification results. Much research has been done to understand some of the causes of distortion in ISAR imaging mostly under the limited assumption that a target's axis of rotation is constant over the CPI. This paper investigates how the target's time-varying Doppler generating axis of rotation, caused by the complex 3D motion of a target at sea, contributes to ISAR image blurring. Quaternion algebra is used to aid the characterisation of a time-varying Doppler generating axis of rotation on the migration through cross-range cells. Real motion data of a sailing yacht is used to examine the effects of 3D rotational motion on ISAR imagery of point scatterer like simulated targets and the associated blurring. Simulation results show that small yaw rate perturbation during side-view ISAR imaging intervals gives rise to significant changes in the direction of the Doppler generating axis which results in scatters migration through cross-range cells. [C535]

"Shadow enhancement in SAR imagery"

Shadow cast by features on ground can be an important aid in object classification in synthetic aperture radar (SAR) images. Synthetic aperture imaging causes a fundamental limitation to shadow clarity due to the fact that the illuminator is moved during the data collection. This leads to a blend of echo and shadow, or geometrical fill-

in in the shadow region. The fill-in is most dominant for wide beam synthetic aperture imaging systems. By treating the shadow as a moving target and compensating for the motion during the synthetic aperture imagery, we avoid the geometrical shadow fill-in. This new technique, referred to as the fixed focus shadow enhancement (FFSE) can be used directly as an imaging method on raw SAR data or as a post processing technique on the complex SAR image. In this paper, we demonstrate the FFSE technique on publicly available SAR data. [C536]

"Radar target-ground interaction"

An investigation of the X-band (10GHz) Electro-Magnetic (EM) scattering of a complex vehicle in-situ is reported. The aim of this work is to characterise radar multi-path effects in Synthetic Aperture Radar (SAR) imagery, and further to demonstrate how an appropriate choice of polarimetric basis can allow its mitigation. Ground-target multi-path effects reduce the interpretability of imagery by adding artefacts. Additionally, multi-path impacts on Automatic Target Recognition (ATR), because for any given situation it will not be clear what kind of ground should be employed for the training database. [C537]

"Accurate and efficient analysis of the EM environment due to naval radars"

The application of computational Electromagnetic (EM) tools to analyse the effects of radar systems on large, complex platforms are presented in this paper. In particular, significant cost and time savings are achieved early in the design process with the accurate modelling of applications such as RF hazards and the siting/installed performance of radars. The effectiveness of computational analysis is dependent upon on both the sophistication of the EM software and the quality of the CAD in containing perhaps physically small but electromagnetically significant detail. An example is given of the effect of a surveillance radar onboard the UK Aircraft Carrier (CVF). [C538]

"Threat Estimation of Multifunction Radars: Modeling and Statistical Signal Processing of Stochastic Context Free Grammars"

Multifunction radars (MFRs) are sophisticated sensors with complex dynamical modes that are widely used in surveillance and tracking systems. It is shown in this paper that the stochastic context free grammar (SCFG) is an adequate model for capturing the essential features of the MFR dynamics. We model MFRs as systems that "speak" according to a SCFG, and the grammar is modulated by a Markov chain representing MFRs' policies of operation. We then deal with the statistical signal processing problems of the MFR signal, especially the problem of threat evaluation (electronic support). Maximum likelihood estimator is derived to estimate the threat of the MFR and Bayesian estimator to infer the system parameter values. [C539]

"Rapid-fluctuating Radar Signal Detection with Unknown Arrival Time"

We study the rapid-fluctuating radar signal detection, where the arrival time of the received signal, i.e., the range cell index of the target, as well as the complex amplitude of the signal and the noise are unknown. We show that even in additive white gaussian noise (AWGN) environment, uniformly most powerful invariant (UMPI) test does not exist. Instead, the UMPI detector in known SNR is used as an upper performance bound for performance evaluation of any invariant detector performance. In addition, we derive generalized likelihood ratio (GLR) detectors for this signal in AWGN with unknown noise variance and also in clutter with unknown covariance matrix. The GLR test statistic for AWGN represents the ratio of the maximum power over all cells to the total power. The GLRT for a clutter environment is also a power ratio which is the maximum over all range cells of the Euclidean norms of the spatially whitened observed sequence. Simulation results demonstrate that the performance of the proposed GLR test in AWGN is very close to the upper bound performance, i.e., to the UMPI test in known SNR. [C540]

"Digital Signal Generator and Receiver design For S-band Radar"

The new generation of radar has to be equipped with a high performance exciters and receivers to cope with the threat in an Electronic Warfare scenario. The threat in a complex environment with interfering signals requires a reliable signal generation with proper frequency agility and efficient gain controls in receiver units. This is quite cumbersome to achieve in analog domain. Due to digital technology advancements, it is possible to have efficient and high performance Analog-to-Digital converters (ADC),processors, high-density memories and efficient algorithms to realize highly reliable, flexible and upgradeable exciters and receivers. In this design, exciter unit comprises of various digital modules for waveform generation, clocks and synchronization signal generation for different sub-systems of the radar and digital code generation for the frequency to be synthesized. These codes are used to control the Local Oscillators (LOs) output utilized for the up-conversion. In the Receiver unit main focus is on the digital implementation of gain control like sensitivity-time-control (STC),

Generation of various controls required by Synthetic noise generator and Automatic Gain Control (AGC) and Digital amplitude Phase Demodulation (DAPD) of down-converted sampled intermediate frequency (IF) signals. This work projects the digital design methodology behind the various modules identified for the Radar Signal Generation and Receiver units. The main highlight of the paper is that the entire design models described are implemented using digital methods using FPGAs. The Xilinx System Generator (XSG) design tool is used to accomplish this, which generates directly the code for a Xilinx FPGA on a target board. [C541]

"A Performance Comparison of Two Time Diversity Systems using TM-CFAR Detection for Partially Correlated Chi-Square Targets in Nonuniform Clutter and Multiple Target Situations"

In automatic detection, performance of time diversity systems is proved to be sensitive to how the multiple-pulse sample echoes, from commonly encountered nohomogeneities, are accumulated within the same receiver. Based upon the "non conventional time diversity system"(NCTDS), we derive exact expressions for the probabilities of false alarm and detection of a pulse-to-pulse partially correlated chi-square target with 2K degrees of freedom for the trimmed mean constant false alarm rate (TM-CFAR) detector. Because of the complex mathematics induced by the "conventional time diversity system" (CTDS), detection performance of this system is carried out using Monte Carlo simulations. The obtained results show that, while the NCTDS achieves a better nonuniform clutter resilience than the CTDS, the latter outperforms the former in multiple target situations. Hence, when both nonhomogeneities are concomitantly present, the two systems performances become nearly similar. [C542]

"Invariant Detection of a Constant Magnitude Signal with Unknown Parameters in White Gaussian Noise"

In this paper, we use invariant tests for the detection of a complex signal with unknown phase variation and unknown amplitude in additive white Gaussian noise (AWGN). We show that in this problem, the uniformly most powerful invariant (UMPI) detector exists only if the signal-to-noise-ratio (SNR) is known. We derive the UMPI detector in known SNR and use it as the upper performance bound for any invariant test. In addition, we derive the generalized likelihood ratio (GLR) detector and evaluate its performance against the UMPI performance bound. We show that the GLR detector asymptotically approaches the UMPI test in large SNRs. Simulation results illustrate the close performances of the two detectors even at low SNRs, while in contrast of the UMPI test the SNR is unknown in the proposed GLR test. In order to understand, why the knowledge of SNR is not so important in this detection problem, we also derive the GLR test for the case of known SNR. Interestingly, the resulting GLR detector (derived for the case of known SNR) turns out equivalent with the one derived for unknown SNR, i.e., the knowledge of the SNR is not used in any of GLR tests. This reveals why the knowledge of the SNR is not so useful in this detection problem. [C543]

"The Short-Time Multifractal Spectral Analysis Based on the Singularity Exponents"

In this paper, a short-time multifractals models has been proposed, which is an extension of multifractals models. In the section 2, the mind of short-time multifractal spectrum has been introduced. In section 3, the short time multifractal spectrum based on the singularity exponents have been proposed. In section 3 is the calculation method of short time multifractal spectrum, and we analyzed the short-time multifractals characteristics of sea clutter, the simulation shows that the multifractal spectrum is time-varying, and the short-time multifractal spectrum is a new tools on complex fractal signal. [C544]

"Study on a Nonlinear Frequency Modulation Signal with Polarization-Coded Modulation"

This paper proposes a kind of complex radar signal with polarization agility based on nonlinear frequency modulation (NLFM) signals. This signal has the characteristics of NLFM signals and the anti-jamming ability and performance of low probability of intercept (LPI) can be improved by using the polarization-coded modulation technique. The mathematical expression of the signal is given and the methods of signal processing and target detection are discussed. The performance of the signal is analyzed and simulated when the target signal and the interference are in the different range cells, the results indicate that the target can be detected and the interference can be suppressed by two dimension signal processing when the target can be distinguished from the interference in polarization domain. [C545]

"Adaptive estimation of unknown phase offset between sub-arrays in distributed aperture systems"

It has been recently shown that angle-dependent complex phase and gain offsets between separately calibrated distributed subarrays can be compensated for during beamforming via a modification of a subspace detection approach. In addition to normal estimation and detection losses associated with such an adaptive filter, an additional loss is incurred using this approach. This loss is derived analytically and compared with previously

simulated losses. [C546]

"A Wireless Location System for Sensing the Relative Position between Mining Vehicles"

In this paper a novel system and concept for sensing the relative position between mining vehicles is introduced. The localization is based on secondary radar like distance measurements between radar basestations on the excavator and transponders on the truck. Based on a novel geometry-matching algorithm it is possible to determine the relative position between truck and excavator precisely even in complex measurement and environmental conditions. The geometry-matching algorithm overcomes problems of usual triangulation based approaches because it efficiently reduces the risk to get an underdetermined set of geometric equations in conditions where measuring paths are shadowed or disturbed. The proposed concept allows for a steady and flexible control of all movements of the truck relative to an excavator and thus can contribute effectively to increase automation and productivity in future mining systems. The results of first full-scale experiments show the consistency and good performance of the proposed approach. [C547]

"Additive Functions Provide A Powerful Tool For T/R Module Modeling"

T/R module behavior as a function of RF frequency, temperature, RF power input, commanded phase shift, commanded gain setting, and over a population of modules can be easily modeled using additive functions. Additive function model equations are completely and simultaneously analytic over the entire operating range of all independent variables and provide rapid solutions for response to complex RF waveforms such as amplitude weighted linear FM CHIRP signals and beam side lobes formed by amplitude weighted array illumination. Degradation of ability to resolve close targets of different amplitude due to non-linear transmitter amplifier waveform compression is easily evaluated. Array beam side lobe degradation due to phase shifter errors and transmitter amplifier saturation is also easily evaluated. This paper is a brief tutorial showing the application of additive equations in modeling transmit and receive functions and how easily digital commands to phase shifter and gain control circuits can be incorporated in the models. [C548]

"Multipass SAR Processing for Urbanized Areas Imaging and Deformation Monitoring at Small and Large Scales"

A new processing chain that allows monitoring ground deformations, both at small scales and large scales, is discussed. Core of the chain is the spatial differencing (SD) algorithm that allows very quick estimation of the small scale (low resolution) mean deformations velocity and residual topography by means of the use of spatial differences between adjacent and non-adjacent pixels. Small scale deformation time series is then generated by using the Enhanced spatial differences (ESD) that permits separating atmospheric phase contribution, linear and non-linear deformation velocity and residual topography. Deformations and target localization at large scales (full resolution) is provided by the application of a multi-dimensional (4D) imaging (differential-tomography) that exploits the complex nature of the received signal to focus the data in the space-time domain. [C549]

"Intelligent Radar Management Techniques in High Frequency Surface Wave Radar"

This paper has highlighted and provided some background as to why HFSWR has been a leader in intelligent radar techniques as without them the robust radar performance cannot be achieved. The use of basic Intelligent Radar Techniques has provided the ability for the radar to operate in a complex environment effectively and robustly. However the high level of complexity combined with the experience also leads to a general conclusion that real time evaluation and modelling of radar performance against the chosen goals could enhance the efficacy of the radar, but to achieve this goal an extra layer of analysis and control software is required to exploit the ground work laid by the current and very effective system. [C550]

"An Efficient Computational Approach in the Matrix Pencil Method to Find One Dimensional and Two Dimensional Direction of Arrival"

The problem of estimating the direction of arrival (DoA) of the various sources impinging on a phased array has received considerable attention, in many fields including radar, sonar, radio astronomy and mobile communications. A very efficient computational procedure in the Matrix Pencil (MP) method to compute the one dimensional direction of arrival (1D-DoA) of the signals impinging on the linear array operating in the presence of undesired electromagnetic effects is given in this paper. This procedure reduces the complexity of the computation significantly by using a unitary matrix transformation. This technique is applied directly to the corrected data by applying the transformation matrix to compensate the undesired electromagnetic effects such as mutual coupling between the antenna elements without forming a covariance matrix. A unitary transform can convert the complex matrix to a real matrix along with their eigenvectors and thereby reducing the computational

cost at least by a factor of four. Finally, a new technique based on the above procedure is proposed and applied to a planar array to find the two dimensional direction of arrival (2D-DoA). Limited numerical examples are presented to illustrate the performance and accuracy of the proposed techniques. [C551]

"Monitoring of Flooding in Urban Areas"

Urban areas are crowded environments, where a disaster can bring dramatic consequences, if not adequately forecasted and faced. Remote sensing instruments can be fruitfully used for both prediction and aid organization purposes. In particular, in this paper we present innovative synthetic aperture radar (SAR) techniques for the detection of a flooded area in urban settlements. A SAR raw signal simulator is presented and used, in order to improve the comprehension of the main physical phenomena and to plan the most adequate sensor characteristics for detection purposes. The single and multiple scattering phenomena, in conjunction with strong layover effects make the SAR images relative to urban areas extremely involved. The presented study is focused on a canonical environment, in order to provide a complete and powerful instrument for the comprehension of the complex texture of urban area SAR images. [C552]

"Multiple Constraint Space-Time Adaptive Processing Using Direct Data Domain Least Squares (D3LS) Approach"

In this paper, a new direct data domain least squares (D3LS) approach is developed for multiple target detection in space-time adaptive processing (STAP). The advantage of the D3LS technique is that it does not rely on any statistical information of the interference as opposed to conventional STAP algorithms. The modified version of D3LS when more than one target is in a radar scenario will be discussed. This is equivalent to forming multiple beams simultaneously while suppressing all other interference at the radar receiver. Numerical simulations show that multiple beams are directed towards target directions correctly and maintain their gain constraints along those directions such that the target signal intensities or complex amplitudes can be estimated. [C553]

"Polarization Diversity Using Mutual Information"

An information-theoretic criterion is introduced for waveform polarization type selection in a synthetic aperture radar (SAR) configuration. The criterion is based on the concept of mutual information (MI). Specifically, the MI criterion (MIC) minimizes the MI between the radar return signal at two distinct instants of time: one is the just-received return due to the last-transmitted pulse with known polarization type, and the other is the to-be-received return due to the pulse to be transmitted next with to-be-determined polarization type. In that manner, the polarization type selected for the pulse transmitted next will result in the collection of the largest amount of new information, as measured by a formal criterion. The MIC involves the radar system model and the probabilistic definition of the clutter, interference, and noise processes. In particular, when all these processes are proper Gaussian processes, the MIC attains a simple analytic form. The formulation and simulation-based results are presented in the context of a first-order radar system model, for simplicity, but the MIC can be extended to cover more complex models in a straightforward manner. In addition, the MIC is applicable to other radar modes and sensor types. The results presented show that the MIC is an effective method for polarization type selection in a SAR. [C554]

"Short-data-record Adaptive Detection"

The classical problem of detecting a complex signal of unknown amplitude in colored Gaussian noise is revisited in the context of adaptive detection with limited training data via the auxiliary-vector (AV) filter estimation algorithm. Based on statistical conditional optimization criteria, the iterative AV algorithm starts from the target vector and adding non-orthogonal auxiliary vector components generates an infinite sequence of tests that converges to the ideal matched filter (MF) processor for any positive definite input autocorrelation matrix. Computationally, the algorithm is a simple recursive procedure that avoids explicit matrix inversion, decomposition, or diagonalization operations. When the input autocorrelation matrix is replaced by a conventional sample-average estimate, the algorithm effectively generates a sequence of MF estimators; their bias converges rapidly to zero and the covariance trace rises slowly and asymptotically to the covariance trace of the familiar adaptive matched filter (AMF). For finite data records, the generated sequence of estimators offers favorable bias/covariance balance and members of the sequence are seen to outperform in probability of detection (for any given false alarm rate) all known and tested adaptive detectors (for example AMF and the multistage Wiener After algorithm). White the issues treated refer to general adaptive detection procedures, the presentation herein is given in the context of joint space-time adaptive processing for array radar. [C555]

"An Experimental Study on Using Electronically Scanning Microwave Radar Systems on Surface Mining Machines"

Using a series-model of an automotive short range radar sensor (SRR) and a recently completed experimental radar system, field tests have been performed in a surface mine. It was examined, to what extent low-cost electronically scanning radar sensors can provide useful data for assistance systems in large scale mining machines. The series SRR sensor using mono-pulse principles for cross range measurement, proved to be useful to supervise the safety zone of a bucket wheel excavator. The more complex and sophisticated experimental radar system using digital beam-forming for cross range processing, can clearly detect and map the contours of trenches and escarpments. The overall promising results refer to many more potential applications for electronically scanning radar in surface mining and motivate to adapt the experimental sensor for such applications. [C556]

"VHF PortMap Sea Surface Radar Observations in a Shipping Channel"

A new sea surface radar system is described, which gives a spatial resolution of 100 m and operating ranges to up to 3 km. The deployment of the dual-radar system at the Lido Entrance to the Venice Lagoon gave current flow data in the channel and provided detail of a complex counter-flow at the end of the channel where it debouches into the Adriatic Sea. This circulating flow near the end of the channel is similar to that observed in wide-mouthed natural channels and is bringing turbid water into the channel The presence of the circulation at the end of the channel has some consequences for sediment dynamics at the site. This deployment demonstrates the functionality of the PortMap radar in a busy shipping channel. [C557]

"Complex scene analysis from Time-Frequency statistics of POLSAR data"

This article presents a statistical approach for the study of PolSAR images using Time-Frequency (TF) correlation properties. PolSAR information is analyzed using a linear time- frequency (TF) decomposition which permits to describe a scene polarimetric behavior for different azimuth angles of observation and frequencies of illumination. A TF signal model is proposed and studied using two statistical descriptors related to the signal stationary aspect and coherence in the time-frequency domain. These indicators are shown to provide complementary information for an enhanced description of the scene. [C558]

"First steps towards multimodal georeferencing of 3D VHR optical and X-band SAR imagery"

With the advent of new, more widely available very high resolution (VHR) SAR and optical sensor satellite constellations, the issue of jointly exploiting the corresponding imaging data in the best possible way naturally arises. Our ultimate goal is the pixel-level fusion of these modalities and their visualization in a 3D context, i.e. draped over terrain data, itself obtained from interferometric SAR processing. In this paper, we investigate the issues associated with adapting tools originally developed for low-resolution C-band SAR imagery to high-resolution X-band SAR imagery (both spaceborne). Specifically, we consider the issues associated with SAR interferometry (InSAR) and more particularly those associated with complex interpolation and phase unwrapping. We found that the existing chirp-Z transform complex interpolator previously used at low resolution is perfectly suitable for handling VHR SAR data. We also found that, while the selected phase unwrapping procedure works well when the resolution is reduced by averaging, it is deficient at full resolution, in part due micro-reliefs and specific phase responses. [C559]

"Radiation of planar stripline ultra-wideband antenna for WPAN systems"

The paper presents results of design and computer simulation of planar monopole pulse ultra-wideband (UWB) antenna for WPAN applications. A complex approach to design of UWB antennas was used. Problem of radiation of UWB signals by the antenna was discussed. Electric fields radiated by the antenna for chosen directions were calculated and shown. [C560]

"Localization of the reflecting centers using multifrequency and multiposition antenna scanning"

The problem of processing for multifrequency and multiposition cross-section scanning data has been considered. The method of quasisolution searching with compromise model of interaction of the reflecting centers and antenna has been used. The accuracy properties of the method have been analyzed. [C561]

"Radiation, scattering and receiving of pulse signals for subsurface object identification"

In many papers there are approaches for solving subsurface sensing and identification of subsurface objects based on FDTD methods with original method of identification (Pockok et al., 1998, Rao et al., 2002). There are not efficient for complex objects and lengthy object (its geometrical size is larger than pulse longitude). In this paper a numerical model for calculating far field scattered by complex objects is described. An evaluation is based on analytical evaluations. The results for some testing objects are represented. [C562]

"Ground deformation retrieval of urban and suburb areas based on multi-baseline DInSAR algorithm: A case study in Cangzhou City (China)"

This paper aims at ground surface deformation retrieval in wide areas including urban and suburb areas based on multi-baseline DInSAR algorithm proposed by Mora. Several progresses are made in order to extract good results. Firstly, a new complex network is presented to restrain noise influence on delaunay triangular network. Secondly, Based on a model coherence function, linear deformation velocity increments and height error increments between neighboring high coherent points (HCPs) are resolved. In order to integrate increments in network, least squares adjustment method and error controlling method are used to obtain stable parameters estimation. At last, by Combining complex and delaunay networks, wide areas deformation is investigated, from center urban areas to suburb areas. The algorithm is performed to investigate the subsidence of CangZhou City, Hebei province (China) during the time of 1993-1997 by using 9 scenes of ERS SAR data. The experiment results show serious subsidence in the region and are validated by leveling data and groundwater wells data. [C563]

"Application of C and Ku-Band scatterometer data for catchment hydrology in northern latitudes"

Spatially continuous soil moisture information is on high demand globally. A database which is available from active microwave data (ERS scatterometer, C-band, 50 km) has been assessed over two large basins (Mackenzie and Lena) in northern latitudes. This information was combined with snowmelt patterns which can be derived based on diurnal thaw-refreeze of the snow cover from a further scatterometer (Quikscat, Ku-band, 25 km). Relative soil water information has been averaged over each basin and compared to discharge measurements for the summer periods 1996-2000. A correlation (logarithmic function) of 0.78 is observed for the Lena basin. The Mackenzie is much more complex and thus the relationship is less obvious. This is also reflected in the snowmelt data. Whereas 80% of basin area undergoes melting at the same time in the Lena basin in 2000, at maximum 40% can be observed for the Mackenzie during the same year. Maximum runoff in the Lena basin is observed when snowmelt ceases for the entire basin. This is delayed by three weeks for the Mackenzie although increased runoff can be observed already after 70% of the basin is snow-free. [C564]

"Evaluation of the influence of land cover on the noise level of ERS-scatterometer backscatter"

In this study we assess the impact of different land cover types on the azimuthal noise of backscatter signal using multi-year ERS-scatterometer data. Results indicate a strong response of the azimuthal noise level to the different land cover types like rainforests, lakes, rivers, floodplains, coastal areas, permanent snow or ice, urban areas, and deserts as well as topography. Complex topography with high standard deviation in heights, ridge-shaped features oblique to the satellite track on the surface, and water-contaminated areas are the main causes of the high azimuthal noise in scatterometer measurements. The azimuthal noise fluctuations generally show a minimum over rain forests and maximum over sand deserts. Changes in the level of azimuthal noise of backscatter signal clearly reflect changes in land cover or surface roughness. [C565]

"Stochastic models of SLC HR SAR images"

The paper presents two algorithms for texture primitive feature extraction on Single Look Complex (SLC) and Polarimetric Synthetic Aperture Radar (PolSAR) SLC data. We assume the data to be modeled by a Gauss-Markov Random Field (GMRF): a complex GMRF model for characterizing the spatial correlation in SLC data and an extension of the model for inter-band correlation characterization. The complex GMRF characterizes the spatial relationship of a two-dimensional complex signal, i.e. SLC SAR data. The extended model characterizes the spatial interaction and the inter-band pixels correlation between the polarimetric complex channels. The Bayesian approach permits to deal with model fitting and selection in a direct way. The results are presented on a polarimetric E-SAR L band scene of Mannheim, Germany. [C566]

"Grecosar, a SAR simulator for complex targets: Application to urban environments."

This paper presents a preliminary study about the scattering properties of urban-like scatters based on simulated SAR images. A simple target performed by a box of gypsum located over a perfectly conducting flat plane is analyzed for different views in both ISAR and SAR fully-polarimetric modes. The results are analyzed with the Pauli decomposition theorem and they show that the scattering response of such a target is dominated by a strong scatter, which polarimetric behavior depends on the relative orientation of the target with respect to the radar. Tests with interferometry shows that the height of the box can be reasonably retrieved despite of model simplicity. [C567]

"A new algorithm to calculate sea ice concentration from the SSM/I 85GHz observations"

A new algorithm has been developed to calculate sea ice concentration from any set of passive microwave observations. It was applied to estimate total ice concentration and partial concentration of three ice types using SSM/I 85 GHz observations. The essence of the algorithm is a mathematical optimization technique to determine the best solution from multi-channel observations of a heterogeneous footprint that contains ice types of highly complex and overlapped brightness temperature. Results were validated against ice concentrations from Radarsat image analysis; an operational product from the Canadian Ice Service (CIS). They have proven the successful performance of the algorithm. [C568]

"Ferromagnetic Nanoparticles in Broad Band Radar Absorbers"

The construction of thin, broad band absorbers using magnetic materials rely on the presence of high magnetic losses. In this paper, we discuss the possibilities of realizing these losses by studying the Landau-Lifshitz-Gilbert model of ferromagnetic materials. The small signal permeability derived from this nonlinear model is then combined with modern homogenization techniques to study a composite material made up of nanosized magnetic particles embedded in a background material. This is used to produce bounds in the complex plane as to what effective material parameters can be achieved from such a composite material. [C569]

"Building Corner Feature Extraction Based on Fusion Technique with Airborne LiDAR Data and Aerial Imagery"

Generally, automatic building corner or linear feature extraction from urban area aerial imagery is based on traditional computer vision corner or edge detection techniques. However, challenges and difficulties remained due to the complex characteristic of objects in urban images. Visually, the linear features in airborne LiDAR are much more distinct than those in aerial imagery, however, common criticisms arising from the low horizontal accuracy of LiDAR data. To overcome these difficulties, this study proposes a building corner extraction algorithm based on information fusion technology by integrating aerial imagery and airborne LiDAR data. According to experiment results, the proposed method can obtain the distinct building corners not only with the characteristics of uniform spatial distributed pattern based on Voronoi graph theory, but also with the shape, length, and height constrained conditions derived from LiDAR linear features. The proposed algorithm resolves the heterogeneous remote sensing data registration difficulties between LiDAR data and raw aerial imagery. [C570]

"Statistical Modeling and ML Parameter Estimation of Complex SAR Imagery"

Accurate statistical models for the complex pixels forming fine-resolution synthetic aperture radar (SAR) images are needed for several engineering applications, including coherent signal detection in SAR clutter, automatic target recognition, and automatic SAR RCS calibration without calibration targets. We derive the maximum likelihood estimator for the parameters of a complex generalized Gaussian distribution and show that it can be efficiently computed. Applying this to fine-resolution SAR images representing a wide variety of scene contents, we show that this model very accurately captures both the central regions and tails of the data distribution. [C571]

"Optimal Beamforming with Mobile Robots"

Detection using distributed networks have received significant attention in the space-time adaptive processing literature. The paper examines the use of a new dimension-the mobility of robots to improve the output signal-to-interference-plus-noise- ratio (SINR) of an array of antennas. It is proposed that by optimizing over the positions of the antennas in the plane, the SINR can be significantly improved, extending the well-known method of beamforming using optimal complex weights. Initial simulations using a simplistic system scenario show that large gains in SINR are indeed possible when combining the optimal weights and local optimal positions of the receiving antennas. [C572]

"A Handheld Texel Camera for Acquiring Near-Instantaneous 3D Images"

A Texel camera is a device which synchronously captures depth information via a ladar and digital imagery of the same scene. The ladar and digital camera are co-boresighted to eliminate parallax. This configuration fuses the ladar data to the digital image at the pixel level, eliminating complex post-processing to register the datasets. This paper describes a handheld version of a Texel Camera which can be used to create near-instantaneous 3D imagery. The hardware configuration of the Texel Camera, issues and method associated with ladar/camera calibration, and representative imagery are presented. [C573]

"A Simulation of the Synthetic Aperture Radar Observation of a Manufactured Object in Sea Clutter using Finite Differences"

A simulation of the synthetic aperture radar (SAR) observation of a complex sea scene is proposed. The observed sea patch consists of sea clutter and a metallic, steady object. The simulation process is based on a local, discrete calculation using the finite difference method in the time domain. This approach turns out to be relevant when considering precise, complex scenes such as depicted in the study, despite a few drawbacks that are enlightened in the article. Antenna synthesis is performed upon a series of simulations using finite differences, and leads to the formation of a SAR image of the studied scene. [C574]

"Wavelet-Based ECG and PCG Signals Compression Technique for Mobile Telemedicine"

One of the emerging issues in telehealth care system is how effectively the limited and well established mobile technologies that are now almost globally usable are exploited. The main challenge is to develop a mobile telemedicine system to transmit biosignals directly to a specialist in an emergency medical care unit for monitoring/diagnosis using an unmodified mobile telephone which provides the patient's information on the spot without unnecessary delays in seeking care, access to health facility and provision of adequate care at the facility. To provide a practical mobile telemedicine in GSM/GPRS/EDGE/UMTS limited capacity for transmitting the cardiac data for the diagnosis of cardiovascular diseases (CVD) which are widespread health problems with unpredictable and life-threatening consequences in most regions throughout the world, the implementation of biosignals compression technique is focused in this paper. Therefore, a new and simple target data rate (TDK) driven Wavelet-threshold based cardiac signals compression algorithm is presented for mobile telemedicine applications. The performance of the compression system is assessed in terms of compression efficiency, reconstructed signal quality and coding delay. This algorithm is tested using MIT-BIH ECG databases and qdheart PCG database records and the experimental results are compared with other Wavelet based ECG coders. The presented algorithm is less complex because it does not require QRS detection, amplitude and period normalization and period sorting. [C575]

"Resolution limits of closely spaced random signals given the desired success rate"

Fundamental limitations on estimation accuracy are well known and include a variety of lower bounds including the celebrated Cramer Rao Lower Bound. However, similar theoretical limitations on resolution have not yet been presented. We exploit results from detection theory for deriving fundamental limitations on resolution. In this paper we discuss the resolution of two zero mean complex random Gaussian signals with a general and predefined covariance matrix observed with additive white Gaussian noise. The results are not based on any specific resolution technique and thus hold for any method and any resolution success rate. The theoretical limit is a simple expression of the observation interval, the user's pre-specified resolution success rate and the second derivative of the covariance matrix. We apply the results to the bearing resolution of two emitters with closely spaced direction of arrival impinging on an array of sensors. The derived limits are verified experimentally by model order selection methods such as the Akaike Information Criterion and the Minimum Description Length. [C576]

"SAR image denoising based on wedgelet and dual-tree complex wavelet transform"

Image denoising based on wedgelet transform and dual-tree complex wavelet transform (WDT-CWT) is proposed in this paper. Wedgelet transform is a new method that has a good performance in approximating edges. The limitation of wedgelet transform is that it smoothes the flat region excessively, leading to the loss of some texture features. To reduce this limitation, we employed dual-tree complex wavelet transform (DT-CWT) to improve the detection of texture information. Through a combination of the wedgelet transform and DT-CWT, we develop a detector of texture, edge and direction information. The experimental results show that WDT-CWT outperforms many traditional approaches both visualization and in terms of evaluation values. [C577]

"Data Exploration for Multidisciplinary Research"

The metadata oriented query assistant (MOQuA) is a web application for exploring complex collections of data via a highly interactive and intuitive interface. MOQuA development has been motivated by the evolution of climate and ecosystem studies towards highly interdisciplinary research programs that depend on data drawn from a variety of sources. Present generations of earth science data systems are not structured to support exploration through a data space that is simultaneously rich in measured parameters, yet sparse in geographic and temporal coverage. We have implemented MOQuA for the Autonomous Ocean Sampling Network 2003 field program data set, which includes observations from a diverse collection of platforms such as drifters, autonomous underwater vehicles and ships, fixed measurement assets (such as moorings and radar), and

remote measurements from satellites and aircraft. It also includes output from three oceanographic models. Measured and derived data are stored in several formats, residing within numerous data management systems. [C578]

"Image fusion using a NSDFB-based contourlet packet"

In this paper, a new contourlet packet (CP) is constructed based on a complete wavelet quadtree followed by a nonsubsampled directional filter bank (NSDFB). By combing the finer approximation characteristic of wavelet packet with the invertible characteristic of NSDFB, the proposed CP can give more accurate reconstruction of images than WP. After the proposed CP transform on the fusing images, the low-frequency subbands are compared to preserve the coefficients whose module are minimum, local inner-product rule is performed on the high-frequency subbands of the images. Then the fusion image can be obtained by taking an inverse CP transform. The experiment results show the superiority of the method to Contourlet, Wavelet packet, NSCT, stationary Wavelet, complex wavelet and WBCP based fusion methods, both in image clarity and standard deviation, information entropy, average gradient, average cross [C579]

"Dielectric spectroscopic model for tussock and shrub tundra soils"

In this paper, the measured microwave dielectric data are presented for some soils collected in the tussock and shrub tundra area located on the North Slope, Alaska, near Toolik Lake, at N 68deg 38', W 149deg 35' with an elevation of 730 m. The measured samples represented the organic rich soil picked up from the middle and base of tussock, organic poor soil from the depth of 20 cm in the valley between tussocks, and organic rich soil from the depth of 20 cm in the shrub tundra site. The measurements were carried out in the range of frequencies from 0.5 to 16.0 GHz and temperatures from -30degC to +25degC. On the basis of that data, the spectroscopic model of complex dielectric constant was developed for the moist soils measured, using the methodology of the generalized refractive mixing dielectric model [1]. This model takes into account contributions from the organic/mineral contents of soil, soil ice, free liquid soil water, and bound soil water arising due to interaction of soil water molecules with the surface of organic/mineral and ice particles. The complex dielectric constants for all the types of soil water observed were shown to follow the Debye formulas, with a single relaxation frequency for every distinct type of soil water. The temperature dependences were obtained for the parameters of the generalized refractive mixing dielectric model, including the parameters of soil water Debye relaxation, that is, the low and high frequency limits of dielectric constant and relaxation time, as well as the ohmic conductivity relating to every component of the soil water. The previously unknown physical phenomenon of liquid soil water transformation into a transition type of bound water, instead of ice, was observed in the range of temperatures below -6degC, which appeared to arise in the organic rich soils studied. The results obtained can be considered as a substantial contribution to the soil dielectric database, to be employed in the physically based data processing algorithms for radar and radiometry remote sensing of the northern circumpolar region. [C580]

"Cassini RADAR: investigation of titan's surface parameters by means of Bayesian inversion technique and gravity-capillary waves modelling of liquid hydrocarbons surfaces"

During the first two years of the Cassini mission, a great amount of data dealing with Titan's surface has been collected. In particular, the analysis derived from the SAR imagery reflects the complex Titan's surface morphology. In fact, in the different Cassini radar images a certain number of areas with peculiar features has been identified, such as: dark and bright areas (Ta, T3), periodic structure ("sand dunes") and, above all, hydrocarbon lakes [2],[11]. The proof for the presence of hydrocarbons lakes on Titan has been obtained during the T16, the radar pass performed on Titan by the Cassini spacecraft on 22 July 2006 [12]. In this paper, the investigation of Titan's surface parameters (physical and morphological) has been carried out by the means of Bayesian inversion technique, and simulations of the wave motion for the hypothesized hydrocarbons liquid surfaces has been performed. [C581]

"Pulse electromagnetic sounding of the petroleum- containing layered medium"

In this research, propagation of super wide-band pulse in a frequency dispersive medium representing the oil-saturated collector. The capability of their use for geonavigation in techniques of lateral drilling is discussed on the basis of the results of simulation obtained. The complex dielectric constant of oil-saturated rock was calculated on the basis of refraction mixing dielectric model, the oil, sodium chloride solution, methane, quartz and bentonite being contained in each layer. The thin cylindrical vibrator of finite dimensions was used as antenna, being excited by voltage the like one period sinus pulse of nanosecond duration. The time-domain structure of pulse propagation in a plane-layered medium was calculated. Attenuation of power flow pulse reflecting from oil-bearing bed was studied. The gain-frequency characteristic relating to each particular layer was analyzed proving the medium of petroleum collector to operate like a low-pass filter. [C582]

"Ship detection with the fuzzy c-mean clustering algorithm using fully polarimetric SAR"

A fuzzy c-mean clustering algorithm to detect ships is proposed using fully polarimetric SAR data. The algorithm is unsupervised. It does not need the statistical decision and the performance is not data specific, as often arises with CFAR methods. A distance measure, based on a complex Wishart distribution, is applied using the fuzzy c-means clustering algorithm. The algorithm makes use the statistical properties of polarimetric data, and takes advantage of a clustering algorithm. It is thus expected that the algorithm could include fully polarimetric backscattering information for ship detection. Its effectiveness is demonstrated by applying it to detect the targets in a set of AIRS AR data. [C583]

"Volume and double-bounce decorrelation effects in the OVoG model for Single-Tx PolInSAR"

The formulation of the complex interferometric coherence for the oriented volume over ground model (OVoG) has been recently proposed for the case of dominant double-bounce mechanism from the ground when the interferometer is operated in single-transmit (bistatic) mode. This paper analyzes the two contributions to the total coherence function: the volume and the double-bounce terms. The study is performed by observing the model predictions of the coherence loci for several agricultural crop scenarios and with system parameters corresponding to the TanDEM-X mission. For low vegetation depths (up to 1 m) neither of the two contributions is negligible when the ground-to- volume ratio is low. However, when the backscattering returns from ground and vegetation are similar, i.e. ground-to-volume ratios around 0 dB, the volume decorrelation terms does not affect the coherence so much. As predicted by theory, higher vegetation layers yield an increase of the influence of the volume term and more differences between polarimetric channels. [C584]

"Disaster monitoring and environmental alert in Taiwan by repeat-pass spaceborne SAR"

The prevailing complex geological and ecological conditions of Taiwan have drawn considerable attention from various geo-ecological communities because of their vulnerability to produce various natural hazards at different scales. Located in the tropical/subtropical zone of the Pacific Rim, its ecological and rugged mountainous properties are environmentally sensitive making monitoring and observations especially difficult because of the high population density. For example, in terms of natural hazard mitigation tectonically active regions are used for analyzing the cause of abundant risk events, such as earthquakes, landslides and land subsidence. In fact Taiwan is well suited as a test site for studying those geologically disastrous processes. Implementing novel techniques of space remote sensing has proved to be an effective means in recent years for greatly improving our understanding of these phenomena. In this paper we report on the monitoring of such events using multi-modal polarimetric and/or interferometric SAR images at C and L band from ERS, JERS-1, RADARSAT-1, ENVISAT, and from the recent ALOS satellite. For crustal and surface deformation, we used radar image pairs with long temporal baselines and large areas of coverage for investigating deformation over Western Taiwan. Pre-seismic and co-seismic deformation patterns are spatial-temporally analyzed. The other topic deals with the coastline changes observed from a sequence of ERS-1/2 SAR images within the years of 1996 to 2005. Waterlines were extracted using multi-scale procedures of edge detection and were corrected with tidal motion data. Substantial analyses were carried out in conjunction with ground surveys and lidar mapping. The topographic feature changes due to large scale landslides triggered by torrential rains were also monitored. In addition, the SAR interferograms were used to analyze the deposition changes along the riverbeds and riverbanks for short-intervals using optimal baselines. Su--mmary and remarks on the implementation of such multi-modal polarimetric and/or interferometric SAR imagery for environmental monitoring are provided. [C585]

"Parallel computation of synthetic SAR raw data"

For modern SAR data acquisition, bi- and multistatic SAR missions become increasingly important. Established methods for processing monostatic SAR signals need to be adapted to new algorithms for signal processing. In order to support the evolution and development of these new algorithms simulated SAR raw data of arbitrary bi- and multistatic SAR scenarios are essential. This paper refers to a modular SAR simulator, which is able to simulate complex bi- and multistatic SAR scenarios. It focuses on the geometrical simulation approach of the simulator and the computationally intensive synthesis of SAR raw data. The main part descripts the parallel implementation of the radar lobe footprint scan and of the succeeding SAR raw data generation executed on a compute cluster. An example will be shown, which compares the simulation of the same SAR scenario on three different compute systems and their runtimes. [C586]

"Spaceborne SAR raw signal simulation of ocean scene"

According to fractal ocean surface model, electromagnetic scattering model under Kirchhoff approximation and the raw signal simulation procedure of dynamic scene based on time domain, spaceborne synthetic aperture

radar (SAR) raw signal of ocean scene is generated. The SAR images obtained from the echo of both simple cosine wave and complex fractal ocean surface are in accordance with the tilt modulation and the velocity bunching theoretically, and also with the statistical properties of real ocean SAR images, which validate the simulation procedure. The raw signal could be the input data of studying along-track InSAR (ATI) for ocean current measurements. [C587]

"Unsupervised land cover classification of SAR images by contour tracing"

The potentiality of synthetic aperture radar (SAR) images for land cover mapping is an important area of research. For single band, single polarized SAR images, information is available in the form of intensity and texture only. Land cover classification of SAR images requires exploitation of spatial relationship of pixels also, in addition to pixel level segmentation. SAR images can be segmented successfully if the regions with homogeneous intensity and texture areas can be identified and grouped together. So far, contour tracing has been used only in demarcating sea and land. Identifying contours in a domesticated area with a mixture of water, urban and vegetation areas require complex analysis of the spatial distribution of pixels. In this paper, we have presented an unsupervised classification algorithm using maximum aposteriori(MAP) segmentation for SAR images in which SAR image is classified into monotone, texture and edge regions. Monotone and textured regions are labeled as land cover types like water, urban and vegetation areas using K-means classification. SAR image of the region with latitude varying from 77.86deg to 77.91deg and longitude varying between 29.89deg and 29.85deg of Haridwar region, India is considered for segmentation. We have compared the segmented image obtained by this methodology with the topographic map of the corresponding region. The water, urban and vegetation areas are clearly recognized with the proposed classification approach which represents a very good agreement with the original topographic sheet. [C588]

"Dyadic resolution multilook image generation by wavelet packettransform correlation of complex SAR signals"

We present a signal processing approach for generation of multilook SAR intensity images at dyadic scales of resolution. Orthogonal subband decomposition inherent in discrete wavelet packet transform is utilized in shift-invariant manner to produce multiresolution complex SAR images. The symmetry of detailed subband spectra is utilized in separating the disjoint spectra to produce multilook image. Analytical results and sample imagery of diffused reflection are presented. [C589]

"The equivalence of Cameron's unit disc and Poincarй's sphere for symmetric scattering characterisation and classification"

Cameron's coherent target decomposition and classification is able to represent a symmetric scatterer onto a unit disc in the complex plane, and assign it to one of the six symmetrical elemental scatterer classes. Recently, Touzi et al. proposed a variation of Cameron's method by introducing a coherent analysis. Moreover the Poincare's sphere, was used instead of the unit disc for representing symmetric scattering because it was considered a more suitable domain. The aim of this work is to demonstrate the equivalence of using Poincare's sphere domain and Cameron's unit disc, in term of characterisation and classification of symmetric scattering types. [C590]

"Extracting tree crown properties from ground-based scanning laser data"

The spatial organization of above-ground plant material plays an important role in controlling not only plant functional activities like photosynthesis and evapotranspiration, but also the photo-vegetation interactions. To improve our understanding of such interactions, the acquisition of highly detailed information about the 3D architecture of individual plants and communities of plants is required. Recently, Light detection and ranging (LiDAR) sensors, both at the ground and the airborne-level, have emerged as useful tools for mapping 3D plant structure. One such ground-based instrument is the Intelligent Laser Ranging and Imaging System (ILRIS 3D), which was developed at Optech Incorporated. This laser scanner, generates a 3D digital reconstruction of any scene, by actively emitting laser pulses and recording the time elapsed for the return of a pulse, thereby measuring the distance of any given object. It is the objective of this research to utilize the ILRIS 3D to measure structural, and biophysical information of individual trees for use as direct inputs into complex radiative transfer models. The key parameters under investigation are crown dimensions (i.e. shape, area, and volume), crown-level gap fraction (GF) and crown- level leaf area index (LAI). The ILRIS 3D was used to acquire 3D point clouds of an artificial 6' Ficus tree, in a controlled laboratory environment. Measured XYZ point cloud data was segmented to retrieve laser pulse return density profiles, which subsequently were used to estimate gap fraction and LAI . Gap fraction estimates were cross-validated with traditional methods of histogram thresholding of digital photographs (r2= 0.96). Crown LAI estimates were compared with the actual values (r2= 0.95, RMSE =

0.45). The next challenge was to implement the developed algorithms to real crowns, namely olive (Olea europaea L.) orchards in southern Spain. Individual tree-level ILRIS 3D data was collected from 24 structurall- y diverse crowns. Crown dimensional profiles were extracted for ILRIS data that was collected from a horizontal view (i.e ground-based) and a nadir view (i.e from platform 12 meters above ground). Preliminary retrievals from the olive orchards dataset is described here, while current ongoing field measurements are being conducted to validate the findings. Successful demonstration of extracting crown-level structural parameters like gap fraction and LAI from ground-based LiDAR will be important new information that can be used for detailed radiative transfer modeling in olive orchards and likely lead to more robust inversion algorithms. [C591]

"Radar network characterization"

The use of dense networks of small radars for weather sensing is being investigated by the Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere, with a first test-bed of this new paradigm well underway. The potential benefits of closely-deployed, overlapping, short-range weather radars are easy to see intuitively, and can be summarized as a greater ability to mitigate the effects of the Earth curvature and sense close the ground in all of the network domain, an increased spatial and temporal resolution, the capability of performing multiple-radar measurements, and the capability of adaptively tasking the individual radars according to the meteorological scene, while using less complex radar units. Virtually all of these potential benefits are governed by the trade-offs generated by the characteristics of the particular radar units employed and their spatial distribution, creating different data outcomes depending on the individual radar capabilities, the radar network layout, and the resulting number of radars with overlapping coverage. [C592]

"Global analysis of a 2 Year ERS-2 wavemode dataset over the oceans"

Starting in 1991, the ERS-1 and (later) ERS-2 satellites have collected wavemode data over the global oceans whenever no image mode data acquisition was requested. Wave- mode data are full resolution SAR data covering small areas of size 5 km times 10 km every 200 km along the orbits thus forming a dataset giving information from all global oceans daily. In the scope of the WAVEATLAS ESA AO Project, ESA provided two years (Sep. 1998-Nov. 2000) of raw ERS-2 wave mode data to DLR which were processed into more than one million single look complex images, so-called imagettes, using DLR's BSAR processor. The algorithms CWAVE and LISE were applied to estimate wind and wave parameters such as significant wave height, wind speed and sea surface elevation fields together with several single wave parameters. The paper presents global statistics with emphasis on wave parameters, namely significant wave height, single wave crest height, and wave height. Areal and seasonal distribution of high sea states is discussed and the relevance of the analysis for extreme sea state mapping is pointed out. As far as possible, the results are related to existing theoretical knowledge and compared to observational data (Hogben atlas) as well as model results. The outcome of this processing will be compiled into a new unique atlas on global waves and extreme events. It is planned to extend the atlas back to 1991 when ERS-1 was launched and forward to present times thus covering a more than 15 years period. [C593]

"Corn monitoring and crop yield using optical and RADARSAT-2 images"

In agriculture, soil and crop conditions change from day to day and throughout the growing season. Agricultural targets also vary spatially with differences observed from field to field, as well as within individual fields. The heterogeneity of corn-growing conditions in Mexico makes accurate data for crop type, crop condition and crop yield prediction difficult to obtain. Yield predictions are needed by the federal government to estimate, ahead of harvest time, the amount of corn required to be imported in order to meet the expected domestic shortfall. In this project a methodology for the estimation of corn yield ahead of harvest time is developed which uses radar and optical remote sensing and which specifically considers the corn-growing situation in Central Mexico. Radar based crop type classification requires data sets with multiple polarizations. Recent research to assess relative classification accuracies of multi-polarized combinations for target crops using airborne data has been reported. In addition to identifying crop type and variety, identifying crop growth stage is valuable. Crop condition, loosely defined as the vigor or health of a crop in a particular growth stage, is related to crop productivity and yield; however, the relationship is complex. Main crop condition indicators include biomass, height, leaf area and contents of plant water, chlorophyll and nitrogen. Crop-type and crop-condition mapping are among the applications that are expected to benefit the most from the technical enhancements embodied by RADARSAT-2. The potential of RADARSAT-1 data for these applications has been rated as "limited", whereas for RADARSAT-2 data this potential is anticipated to be "strong". The Science and Operational Applications Research for RADARSAT-2 Program (SOAR) is promoting the evaluation of Synthetic Aperture Radar (SAR) capabilities by providing images to selected research projects which include the present one.objectives of this project are: a) use RADA- RSAT-2 data and optical data to determine cultivated areas and monitor crop condition for obtaining better estimations of crop yield; b) obtain polarization signatures from RADARSAT-2 data for corn and relate

these to Leaf Area Index and photosynthetic active radiation (PAR) crop parameters and vegetation indexes, to establish indicators of crop condition and produce estimates for crop yield; c) use field data collected for three key corn crop growth stages over 300 pilot plots during 2001-2006, and increase the number of plots to build a database to support accuracy studies using RADARSAT-2 data.The expected benefits of this project are: to obtain knowledge about crop type, crop condition and crop yield with better accuracy than with current methodologies; to support national corn farmers associations; to design agriculture related activities within State agriculture plans; to support the corn product industry and aid government decision making. Relevant results and economical impact will imply operational usage of RADARSAT- 2 data in the agricultural sector in Mexico. [C594]

"A comparison of the methods for the urban land cover change detection by high-resolution SAR data"

The land cover change detection method using the standard deviation of the backscattering coefficient was suggested. Comparing with the previous method using spatial information such as correlation coefficients, it reduced the commission errors in the agricultural areas. It was found that the detection accuracy increased when the target area was large, but each changed target was difficult to detect for crowded and complex urban areas, even though high-spatial resolution airborne SAR data was used. [C595]

"Disaster monitoring and environmental alert in taiwan by repeat-pass spaceborne SAR"

The prevailing complex geological and ecological conditions of Taiwan have drawn considerable attention from various geo-ecological communities because of their vulnerability to produce various natural hazards at different scales. Located in the tropical/subtropical zone of the Pacific Rim, its ecological and rugged mountainous properties are environmentally sensitive making monitoring and observations especially difficult because of the high population density. For example, in terms of natural hazard mitigation tectonically active regions are used for analyzing the cause of abundant risk events, such as earthquakes, landslides and land subsidence. In fact Taiwan is well suited as a test site for studying those geologically disastrous processes. Implementing novel techniques of space remote sensing has proved to be an effective means in recent years for greatly improving our understanding of these phenomena. In this paper we report on the monitoring of such events using multi-modal polarimetric and/or interferometric SAR images at C and L band from ERS, JERS-1, RADARSAT-1, ENVISAT, and from the recent ALOS satellite. For crustal and surface deformation, we used radar image pairs with long temporal baselines and large areas of coverage for investigating deformation over Western Taiwan. Pre-seismic and co-seismic deformation patterns are spatial-temporally analyzed. The other topic deals with the coastline changes observed from a sequence of ERS-1/2 SAR images within the years of 1996 to 2005. Waterlines were extracted using multi-scale procedures of edge detection and were corrected with tidal motion data. Substantial analyses were carried out in conjunction with ground surveys and lidar mapping. The topographic feature changes due to large scale landslides triggered by torrential rains were also monitored. In addition, the SAR interferograms were used to analyze the deposition changes along the riverbeds and riverbanks for short-intervals using optimal baselines. Su- mmary and remarks on the implementation of such multi-modal polarimetric and/or interferometric SAR imagery for environmental monitoring are provided. [C596]

"Evaluation of the interaction between SAR L-band signal and structural parameters of forest cover"

The objective of this paper is to evaluate the interaction between backscatter (sigmadeg) from polarimetric L-band SAR data (collected by the airborne sensor R99-B/SIPAM) and biophysical parameters of the primary forest and secondary succession sites. The area under study is located in the region of Tapajos (Brazil), where SAR data were collected in May 2005. Another approach under investigation is the evaluation of the contribution from basic backscatter mechanisms, using the Freeman-Durden decomposition technique, applied to complex SAR images, where the physiognomic-structural characteristics of the forest stands give a significant contribution. In brief, it was possible to verify that the variable "tree height" has better relations with the backscatter values, when compared to other biophysical variables, especially when the model also includes variations of the incidence angle of the stripes imaged. The decomposition technique showed that the volumetric scattering component has the strongest influence on the SAR response at primary and secondary tropical forests. [C597]

"A physically consistent stochastic model to observe oil spills and strong scatterers on SLC SAR images"

A speckle model to characterize low backscatter areas and areas with strong scatterers in marine SLC SAR images is presented. The model allows using high resolution speckled SAR images instead of dealing with multi-

look SAR images where, at the expense of a poorer spatial resolution, the speckle is mitigated. The new approach is based on the use of the three parameters of the generalized K probability density function. This speckle model embodies the Rayleigh, the Rice and the K-distribution scattering scenes, which are descriptors of scenes dominated by Bragg scattering, scenes in which a dominant scatter is present and scenes with a non-Gaussian signal statistic, respectively. A large data-set of ERS 1/2 SLC SAR images, provided by the ESA under the Project C1P-2769, is employed. Results show the effectiveness of the approach. [C598]

"Atmospheric vertical profiles obtained by Lidar over Йvora during CAPEX project"

CAPEX is a European project to investigate aerosol particles, radiation, cloud properties, precipitation and radioactivity over Portugal. During the campaign, carried out during the first fortnight June 2006 at Evora, Portugal (38deg34' N, 7deg54' W, 293 m a.s.l.), synoptic conditions favoured the arrival of air masses coming from Europe, Northern Africa and Mediterranean basin at several levels. In this study, two complex profiles, including layers coming from Europe and Sahara desert, are analyzed by a combination of Lidar and Cimel CE-318-4 data. Good agreements were found between them. [C599]

"Two-dimensional surface river flow patterns measured with paired riversondes"

Two RiverSondes were operated simultaneously in close proximity in order to provide a two-dimensional map of river surface velocity. The initial test was carried out at Threemile Slough in central California. The two radars were installed about 135 m apart on the same bank of the channel. Each radar used a 3-yagi antenna array and determined signal directions using direction finding. The slough is approximately 200 m wide, and each radar processed data out to about 300 m, with a range resolution of 15 m and an angular resolution of 1 degree. Overlapping radial vector data from the two radars were combined to produce total current vectors at a grid spacing of 10 m, with updates every 5 minutes. The river flow in the region, which has a maximum velocity of about 0.8 m/s, is tidally driven with flow reversals every 6 hours, and complex flow patterns were seen during flow reversal. The system performed well with minimal mutual interference. The ability to provide continuous, non-contact two-dimensional river surface flow measurements will be useful in several unique settings, such as studies of flow at river junctions where impacts to juvenile fish migration are significant. Additional field experiments are planned this year on the Sacramento River. [C600]

"Combining modern techniques for urban 3D modelling"

This paper will give an insight into modern ways of buildings modelling considering the case of TU Delft's campus with the use of classic photogrammetry tools and terrestrial laser scanning data. In addition we will use airborne LIDAR (Light- Imaging Detection and Ranging) for generating of extrusion models. The used methods aim to obtain models which can be used in Geographical Information Systems supporting different level of details. The detail factor may vary from pure city models, which are only blocks containing no facade information, to more complex 3D models with facade information as a texture and/or geometry. In our paper we will make some comparisons using a building model and discuss upon its information type and the achieved accuracy. Further more we will show an application example for the extrusion models. [C601]

"Knowledge-Aided, Physics-Based Signal Processing For Next-Generation Radar"

In this paper we describe knowledge-aided signal processing to improve the performance of radar systems operating in complex clutter environments. The paper describes two paradigms based on either direct or indirect application of prior knowledge. A physics-based, knowledge- aided, parametric approach to clutter estimation is discussed. We provide numerical analysis demonstrating the performance enhancements offered by the proposed methods relative to baseline techniques when operating in the presence of heterogeneous clutter. [C602]

"Application of particle swarm optimization to ultra-wideband multistatic radar used for protection of indoor environment"

A numeric simulation of a multistatic radar using the finite-difference time-domain (FDTD) method and particle swarm optimization (PSO) is implemented in order to localize an intruder inside a laboratory complex. In order to obtain high resolution and to avoid interference with other radiosystems, the radar operates with ultra-wideband pulses and spectral spreading. The transmitted signal has a spectral peak at 1 GHz and the bandwidth of approximately 1 GHz. To estimate the location of the target, two transmitters and nine receivers are used. The transmitters operate in TDM mode in order to avoid interference between them. [C603]

"Multi-range and multi-pulse radar detection in correlated non-Gaussian clutter"

This work presents a multi-range cell and multi-pulse approach to radar detection problem. The derived detector performs clutter estimation using the neighboring range cells, clutter cancellation, threshold setting simultaneously and it eliminates the need for a separate CFAR operation. The radar clutter is modeled as compound-Gaussian and assumed to have fully-correlated unknown texture among the range cells in the window of interest. The target signal is composed of an unknown complex return and known Doppler steering vector. Generalized likelihood ratio test (GLRT) is derived by means of estimating the clutter texture parameter and complex target return. Performance of the detector is investigated by means of numerical analysis and Monte-Carlo simulations. [C604]

"Investigating the influence of the antennas on UWB system impulse response in indoor environments"

UWB applications will primarily be used in indoor environments due to the power constraints given by the FCC in 2002. Therefore, investigating and modeling the indoor propagation of ultra wideband signals is of great interest. It has been shown, how a narrowband ray tracing tool developed at the Institut fur Hochstfrequenztechnik und Elektronik describing indoor wave propagation can be extended to ultra wideband channels, and first simulation results describing the channel impulse response without antenna influence have already been reported. In this paper, antennas are taken into consideration by combining data of measured complex antenna patterns with the extended Ray Tracing method whereas the antennas are typical UWB antennas. The impulse response of the UWB system including antennas is called system impulse response. Since frequency dependent complex pattern information is used, the system impulse response includes the transient response of the antennas in the time domain. After determining the UWB system impulse response, the differences between channel impulse response and system impulse response are investigated. Furthermore, in both cases, a distance estimation between transmitter and receiver is performed to investigate the impact of antennas in UWB localization applications. [C605]

"The sub-aperture range-doppler imaging algorithms for bistatic SAR of arbitrary mode"

In the bistatic synthetic aperture radar systerm, the Doppler frequency is determined by both transmitter and receiver motion. The bistatic SAR has many advantages on the military affairs, but it also pays the price for system and imaging complexity. The bistatic SAR of arbitary mode lies more smart, thus more complex. The paper establishes the geometry coordinates ,derives doppler parameters of the signal on this mode. A new imaging algorithm is proposed in this paper based on the solution of range equation and Doppler equation. The validity of the algorithm is validated by simulated point target and scatter cell array. [C606]

"Evaluation of the Bistatic Range migration processor"

The bistatic image formation process is more complex than the monostatic one, because the bistatic range equation consists of the sum of two hyperbolas. Several bistatic SAR processors have been presented in the last years. One of them is the bistatic range migration processor, which will be evaluated in this paper not only with regard to translational invariant configurations but also in view of variations from a model assumption. The bistatic range migration processor will be compared with a bistatic generic time domain SAR processor. The processing quality will mainly be evaluated by measuring the resolution and PSLR of point target responses. [C607]

"Radar emitter signals classification using kernel principle component analysis and fuzzy support vector machines"

Field=03 In this paper, a novel approach based on QTFDs and kernel principle component analysis (KPCA) is proposed to extract features of radar emitter signals. Then, these discriminative and low dimensional features achieved were fed to a Support Vector Machines (SVMs) based on FCM (fuzzy c-means) clustering for multi-class pattern recognition. Experimental results show that the proposed methodology was efficient for the different complex radar emitter signals detection and classification. [C608]

"A simple implementation of multi-baseline INSAR"

Multi-baseline INSAR is a kind of technology that obtains terrain height information using multiple SAR images, therefore, it has a better performance than single-baseline INSAR. There are primarily two methods to increase the accuracy of terrain height estimation. One increases the quality of the interferometric absolute phase image by utilizing several single-look complex images. The other decreases the errors of the terrain height estimation through iterative ways. Integrating the former method and noise-immune phase unwrapping method, this paper presents a realistic method to implement multi-baseline INSAR. This method mainly includes two steps; the first

one is about how to obtain multi-baseline interferometric absolute phase image whereas the second one is the unwrapping mechanism. Then, through simulation, the achieved results not only demonstrate the validity and practicability of the method, but also prove that the performance of the multi-baseline INSAR is much better than single-baseline INSAR. [C609]

"Resolution enhancement based on sparse distributions of complex-valued SAR Image"

According to the sparsity nature of SAR images, the enhancement of the resolution of objects is investigated. Ideal SAR images may be modeled as a small number of dominant scatterers in a nearly black background. Therefore, sparse statistical distributions should be considered to model the complex-valued SAR images. With a statistical perspective, we follow the MAP criterion and present models to enhance the resolution of objects in SAR images. And an iterative algorithm is presented. Numerical simulations using MSTAR data demonstrate the effective performance of resolution enhancement and the computational efficiency. [C610]

"Electromagnetic simulation of ISAR imaging with supper-resolution"

A full-wave electromagnetic simulation of inverse synthetic aperture radar (ISAR) using two-dimension (2-D) finite difference time domain method (FDTD) is presented with multiple signal classification (MUSIC) method used to investigate the scattering center in radar image. Full-wave electromagnetic simulation can account for multiple scattering effect usually exists in real case, but ignored when ideal point-targets are treated as scattering centers, so it can help us understand the scattering mechanism of complex target. Fourier-based imaging algorithms are fast and robust, but they are limited in resolution and dynamic range. Subspace eigen-value analysis based methods, such as MUSIC, is able to provide superresolution and accurately recover the scattering center locations even for a small number of correlated samples. Simulations show that with techniques of full-wave electromagnetic calculation and superresolution, one can get an insight into the relation between multiple scattering effects and scattering centers formed in ISAR imagery. [C611]

"Adaptive S-method based ISAR imaging of maneuvering targets"

The range-Doppler imaging algorithm is a basic method for ISAR imaging, which is based on the uniform rotation of a target in a fixed plane. For maneuvering target, however, its rotational velocity and the axle often vary with time, so the second-order phase terms are induced to target echoes. Aimed at this situation, an adaptive S-method based imaging algorithm is proposed in this paper. First, translational motion compensation is implemented to the raw data. Then, this algorithm is applied to the echo of each range cell, to eliminate second-order phase terms and obtain ISAR imaging in the range frequency-Doppler domain. Since it only requires complex multiplications and adding, this algorithm has low computational complexity in practical use. In addition, due to the adaptiveness, it can adjust itself according to the returned signals, and reduce the influence of cross-terms for each range cell at the same time. The measured data has proved the validity of this algorithm. [C612]

"Multiscale Variational Threshold SAR Image Denoising Based on Quad-tree Complex Wavelet Packets Transform"

A new image transform, namely, the quad-tree complex wavelet packets transform (QCWPT) is introduced ,which both has shift invariance and good direction analysis ability and other merits of the dual-tree complex wavelet transform (DCWT), and has the ability of analyzing the high frequency detail signal carefully like the wavelet packet transform (WPT). Furthermore, a novel image denoising scheme based on QCWPT was presented via setting multiscale variational thresholding method,which accords with the characteristic that the high frequency coefficient modules and the variance of the noise attenuate rapidly along with the decomposition scale increasing, the best complex wavelet packets basis was determined and processed at the largest scale. In numerical comparison with various methods, the presented scheme outperforms the traditional Wiener filtering, DCWT and QCWPT in terms of the equivalent number of looks (ENL), the figure of merit (FOM) and visual effects. Experiments also show that the presented scheme could not only remove the noises effectively, but also reserve the SAR image texture and edge details better. [C613]

"Multi-range and multi-pulse radar detection in correlated non-Gaussian clutter"

This work presents a multi-range cell and multi-pulse approach to radar detection problem. The derived detector performs clutter estimation using the neighboring range cells, clutter cancellation, threshold setting simultaneously and it eliminates the need for a separate CFAR operation. The radar clutter is modeled as compound-Gaussian and assumed to have fully-correlated unknown texture among the range cells in the window of interest. The target signal is composed of an unknown complex return and known Doppler steering vector. Generalized likelihood ratio test (GLRT) is derived by means of estimating the clutter texture parameter

and complex target return. Performance of the detector is investigated by means of numerical analysis and Monte-Carlo simulations. [C614]

"Why a Complex Valued Solution for a Real Domain Problem"

An insight into the potential benefits of using complex valued models for real valued data is provided. The problem itself is not new; it is however timely and important to revisit this issue, due to a plethora of modern applications based on multidimensional and multichannel measurements which can be cast into an equivalent problem in the field of complex numbers C. The analysis and simulations highlight the duality between several classes of real domain problems and their complex valued representations. This is supported by case studies on image processing, modelling of point processes for brain prosthetics, and forecasting of vector fields. [C615]

"Radar cross section of a semi-elliptic channel in a ground plane loaded by multi -dielectric layerers"

An analytic solution to the problem of scattering of a plane electromagnetic wave by a lossy or lossless dielectric confocal elliptic shell loading a semi-elliptic channel is derived. The incident, scattered and transmitted fields in every region are expressed in terms of complex Mathieu functions. Applying the boundary conditions at various faces and interfaces along with the partial orthogonality properties of angular Mathieu functions, the unknown scattered and transmitted field coefficients are obtained and written in matrix form. The presented numerical results show a good agreement with the published data especially for the case of a lossless dielectric shell loading a semi-circular channel. [C616]

"A study on RCS of missile models using the method of moments"

Simulation of electromagnetic signals scattered by objects is a complex issue, although its fundamentals have long been known. In the design of modern military aircrafts and vessels in general, advantages can be taken from their physical properties for reducing the intensity of radar signals, which are scattered back to the enemies. This leads to the definition of stealth plane or ship. A couple of design guidelines should be followed in order to achieve this goal. One of them is the geometric optimization of the vehicle shape. Much of the literature on this subject is classified; moreover, the computing burden to tackle such a design is quite demanding. In this work, a conventional PC running a commercial electromagnetic code based on a modified Method of Moments is used to analyze four different simplified missile models. Design rules are established in view of reducing the monostatic radar cross section (RCS) scattered signal. [C617]

"Analysis of fully polarimetric SAR data based on the Cloude-Pottier decomposition and the complex Wishart classifier"

An estimation of the number of clusters is proposed for fully polarimetric SAR data analysis, and a corresponding unsupervised segmentation algorithm is also given based on the Cloude-Pottier decomposition and the complex Wishart clustering. The Monte-Carlo Cross-Validation (MCCV) is used to estimate the optimal number of clusters to reveal the inner structure of the data. Since it is a quantitative estimation of the classification performance, the MCCV algorithm also has the potential capability to perform the unsupervised segmentation validation. The effectiveness of the MCCV estimation and the segmentation algorithm is demonstrated using ESAR data acquired. [C618]

"Apodisation, denoising and system identification techniques for THz transients in the wavelet domain"

This work describes the use of a quadratic programming optimization procedure for designing asymmetric apodization windows to de-noise THz transient interferograms and compares these results to those obtained when wavelet signal processing algorithms are adopted. A systems identification technique in the wavelet domain is also proposed for the estimation of the complex insertion loss function. The proposed techniques can enhance the frequency dependent dynamic range of an experiment and should be of particular interest to the THz imaging and tomography community. Future advances in THz sources and detectors are likely to increase the signal-to-noise ratio of the recorded THz transients and high quality apodization techniques will become more important, and may set the limit on the achievable accuracy of the deduced spectrum. [C619]

"Multidimensional speckle noise reduction in synthetic aperture radar images"

A new approach to filter speckle noise in multidimensional SAR data, based on the multiplicative-additive speckle noise model, is presented. This approach is based on processing the elements of the sample covariance

matrix differently, according to the complex correlation coefficient. As it is demonstrated with experimental PolSAR data, the filter does not produce a loss of information, but an improvement of the capabilities to filter speckle noise. [C620]

"Sub-band interferometry on polarimetric SAR dataset"

Complex SAR image spectral analysis has been shown to provide interesting information about the scattering media, highlighting differences in behavior between homogeneous areas with a fully-developed speckle and point scatterers potentially presenting a more coherent radar spectral response. In the line of previously published works by other groups dealing with coherent scatterers, we have studied the statistics of their occurrence as a function of several parameters like frequency, resolution or polarization. The first step of our procedure consists in selecting two or more sub-bands in the Doppler spectrum (in the azimuth direction) or in the distance direction. The sub-bands are subsequently frequency-shifted in order to provide a nonzero correlation. The resulting inter sub-band interferograms are explored to identify the points presenting a significant coherence and the relevance of the associated phase is investigated. The number of detected coherent scatterers, and the associated complex correlation coefficient is analyzed, with respect to the different polarizations, the width of the sub-bands and the distance between the sub-bands. Different polarimetric high resolution SAR datasets acquired with the ONERA airborne system RAMSES have been used. The large panel of RAMSES acquired datasets allows the exploration of the influence of frequency (P, L and X bands) and landscape. The theoretical approach will be detailed, and experimental results will be discussed. [C621]

"Nanosecond phase coherent pulse generation at 94GHz at kW power levels"

Next generation millimetre wave radars and pulsed electron spin resonance (ESR) instruments require complex pulse sequences consisting of very short, high power pulses that are pulse-to-pulse phase coherent. We have previously demonstrated 200 mW coherent pulses at 94 GHz with pulse lengths as short as 110 ps, and showed how they can be used to make high range resolution radar measurements. We now report results where a commercial extended interaction Klystron amplifier (EIKA) is used to amplify these pulses to kW power levels for use in advanced pulse ESR instrumentation. The instantaneous bandwidth of the EIKA now limits the minimum pulse length, but we demonstrate 1 kW peak power pulses down to 1.5 ns, dropping to 0.8 kW at Ins and 0.25 kW at 800 ps. We demonstrate that complex high power pulse sequences can be used in a mm-wave pulse ESR system, and also report on the level of broadband noise or "dark noise" from the amplifier (when there is no input signal), which can limit receiver sensitivity. We also detail the average power handling characteristics of various quasi-optical components. [C622]

"Tools and Practices for Measurement-based Network Performance Evaluation"

As networks and applications running on them become more complex, there is a need for an efficient framework supporting experimental performance evaluation based on real measurements. Towards this end, this paper presents: a) an advanced architecture for a traffic generation tool capable of producing complex traffic profiles, b) the architecture of a traffic analysis tool, and c) methods that allow for efficient monitoring and measurements of delay and loss-oriented metrics in packet networks. The effectiveness of these tools and the applicability of the measurement methodology are illustrated through experiments that evaluate the performance of vertical handovers between GPRS and WLAN networks. [C623]

"Detection of buried metal structures using ground penetration radar techniques: A numerical study"

This paper investigates the resonance characteristics of metal structures based on numerical analyses. The complex natural resonances (CNR) are calculated using the FDTD method. Although CNRs are intrinsic to a metal structure, it is found that many factors affect their extraction from the scattered signals. We investigate some of these factors and point out useful guidelines that may be employed in the characterization of buried metal. [C624]

"Complex-Weighted OFDM Transmission with Low PAPR"

In this paper the novel method of complex weighting for peak-to-average power (PAPR) reduction of OFDM signal is addressed. Combination of different amplitude weighting factors (including rectangular, Bartlett, Gaussian, raised cosine, half-sin, Shannon, and subcarrier masking) with phasing of each OFDM subcarrier using random phase updating algorithm is studied. The impact of complex weighting of OFDM signal on the PAPR reduction is investigated by means of simulation and is compared for the above mentioned weighting factors. Results show that by either amplitude weighting or random phase updating the PAPR can be reduced. Applying both techniques together will further reduce the PAPR For an OFDM system with 32 subcarriers and by

Gaussian weighting combined with random phase updating, a PAPR reduction gain of 3.2 dB can be achieved. In order to reduce the complexity, grouping of amplitude weighting and/or phasing is applied. Results show that grouping of amplitudes weighting and phases reduces the hardware complexity while not much impacting the PAPR reduction gain of the method. For even further reduction of the PAPR, complex weighting method with dynamic threshold is investigated. Results show that the PAPR can be further reduced by factor of 4.8 dB. [C625]

"On the feasibility of using GPR technology for the UXO detection and discrimination in the volcanic soil of Hawaii"

In this paper we describe the recent results from an ongoing project at the University of Hawaii to use advanced GPR technology for the detection and discrimination of UXO in the high iron content volcanic soil of Hawaii. To help determine a suitable frequency range for detecting targets at two feet depth from the surface, a soil characterization effort has been implemented. Both the dielectric and magnetic properties of the earth soil are being measured using a unique shunt capacitance terminating a transmission line method and a recently fabricated TEM cell. Both the reflection and transmission S-parameters are being measured to determine both the complex permittivity and permeability of the soil. Furthermore, a TLS-Prony method together with FDTD 3D simulations of typical detection environments are being used to extract the complex natural resonance frequencies (CNR) of targets from the late arrival signals associated with the scattering mechanisms from these targets. A UXO testbed has been development to help experimentally validate simulation results and provide data to check and improve the accuracy of the detection/discrimination algorithm. Results from this study including dielectric and magnetic characterization of the volcanic soils, and CNR of typical UXO targets encountered in Hawaii will be presented. [C626]

"Hybrid Adaptive Receive Processing for Multistatic Radar"

For multiple radars operating within the same spectrum, the resulting mutual interference can severely degrade sensitivity. Recently, the multistatic adaptive pulse compression (MAPC) algorithm has demonstrated the ability to partially suppress multistatic interference to better estimate the illuminated range profiles. This estimation is accomplished by jointly determining, in an MMSE sense, the range cell complex amplitudes associated with each of the received radar waveforms. As the number of received radar signals increases, the residual error after the application of MAPC increases as well. However, instead of jointly estimating all the received signals, one may wish to selectively minimize the residual error for a particular received radar (e.g. the monostatic returns from the co-located transmitter). In this paper, selective error minimization is achieved by utilizing a MAPC-based variant of the CLEAN algorithm. The resulting hybrid CLEAN algorithm is shown to provide significant sensitivity improvement over MAPC alone. [C627]

"Utilizing the energy of each of the extracted poles to identify the dominant complex natural resonances of the radar target"

A novel technique, based on utilising the energies of the CNRs, has been introduced in this paper to identify the dominant poles, from a pool of extracted CNRs, of a simple PEC target in free space with different Signal-to-Noise ratios. The proposed dominant poles identification scheme does not require any knowledge of the modal order of the system. Applying this new technique to low Quality-Factor (Q-Factor) target and dielectric target will be the subject of further investigations. [C628]

"Variational Unsupervised Segmentation of Multi-Look Complex Polarimetric Images using a Wishart Observation Model"

We address unsupervised variational segmentation of multi-look complex polarimetric images using a Wishart observation model via level sets. The methods consists of minimizing a functional containing an original data term derived from maximum likelihood Wishart approximation and a classical boundary length prior. The minimization is carried out efficiently by first order expansion of the data term and a new multiphase method which embeds a simple partition constraint directly in curve evolution. Results are shown on both synthetic and real images. Quantitative performance evaluation and comparisons with another method are also given [C629]

"Unifying the Experiment Design and Constrained Regularization Paradigms for Reconstructive Imaging with Remote Sensing Data"

In this paper, the problem of estimating from a finite set of measurements of the radar remotely sensed complex data signals, the power spatial spectrum pattern (SSP) of the wavefield sources distributed in the environment is cast in the framework of Bayesian minimum risk (MR) paradigm unified with the experiment design (ED)

regularization technique. The fused MR-ED regularization of the ill-posed nonlinear inverse problem of the SSP reconstruction is performed via incorporating into the MR estimation strategy the projection-regularization ED constraints. The simulation examples are incorporated to illustrate the efficiency of the proposed unified MR-ED technique [C630]

"A Strategy Improving Registration Accuracy Progressively for INSAR Complex Image"

Registration accuracy of InSAR is a key index in the procedure of the processing InSAR data. To obtain better measuring results, A multi-steps matching method is proposed to improve registration accuracy progressively for InSAR complex image. First, we calculate the approximate offsets by using software EnView. Then, we perform pixel level's primary matching and sub-pixel level's precise registration. The primary matching algorithm is based on texture structure information. Considering that the presented algorithms are based on the amplitude map and ignore the integration, the algorithm by using global relaxation matching on account of the phase is proposed in the last matching step to reduce the matching errors and improve matching precision. The experiment verified the nicer validity of this algorithm. [C631]

"Combined Unscented Kalman and Particle Filtering for Tracking Closely Spaced Objects"

Tracking closely spaced objects with resolution limited sensors is a difficult problem. One way to address this issue is to track these targets individually, and employ relatively complex data association approaches as a means of pairing detections and tracks. The algorithm outlined in this paper takes a different approach, and instead estimates the group velocity using an unscented Kalman filter (UKF). The UKF state estimate is then employed within a particle filter, which estimates the distribution of objects within the group. It is shown that this approach can be very effective, especially for groups of irregularly spaced objects [C632]

"A New DCT-based Multiresolution Method for Simultaneous Denoising and Fusion of SAR Images"

Individual multiresolution techniques for separate image fusion and denoising have been widely researched. We propose a novel multiresolution discrete cosine transform based method for simultaneous image denoising and fusion, demonstrating its efficacy with respect to discrete wavelet transform and dual-tree complex wavelet transform. We incorporate the Laplacian pyramid transform multiresolution analysis and a sliding window discrete cosine transform for simultaneous denoising and fusion of the multiresolution coefficients. The impact of image denoising on the results of fusion is demonstrated and advantages of simultaneous denoising and fusion for SAR images are also presented [C633]

"SVC & K-Means and Type-Entropy Based De-Interleaving/Recognition System of Radar Pulses"

First, the paper shows a novel de-interleaving method based on support vector clustering (SVC) and K-means clustering. Secondly, it presents a notion of type-entropy and the recognition technology based on type-entropy is introduced into de-interleaving system so that a novel joint de-interleaving/recognition system of radar pulse sequence is to be presented. The simulation experiment result shows that the system can sort efficiently radar signals in the high density and complex pulses environment [C634]

"The Apply of the Expert Systems of Signal Processing with Frequency and Polarizations Characteristics"

This paper is devoted to studying the principles of the system construction of the signal processing with frequency and polarizations descriptions for the complex missions of air traffic control and air supervision. The expedience of consulting model of data processing is considered [C635]

"Detecting Small Slow-moving Sonar Targets Using Bottom Reverberation Coherence"

The detection of small targets that appear suddenly or are moving slowly in strong bottom reverberation is a challenging problem for sonar surveillance in shallow water. Based on a new reverberation model, this paper proposes a target detection scheme that provides target sub-clutter visibility in the presence of reverberation. Experimental evidence shows that the bottom reverberation as seen by a stationary sonar is coherent, or at least partially coherent from ping to ping. Therefore, the bottom reverberation from a particular range cell is modeled as a complex signal composed of a stationary or slowly varying coherent component, plus a rapidly varying diffuse component. The coherent component is easily estimated using a recursive mean estimator and then removed by a simple subtraction so that the target need only compete with the diffuse component. Experimental results show a detection gain, as measured by the coherent-to-diffuse ratio, as high as 30dB [C636]

"A Nonparametric Sinusoid Detector with CFAR in White Noise"

A nonparametric detector called SFCD (segments frequency checking detector), the Pfa(false alarm probability) of which is constant and can be easily calculated, is put forward for the problem of detecting a sinusoid of unknown amplitude, frequency and phase in complex white Gaussian or non-Gaussian noise of unknown variance and probability distribution. The decision will be made on the basis of a statistical hypothesis test vector that is composed of a group of discrete frequency bins, which are scaled coarse frequency estimations of hypothetical sinusoid in all length-equal and non-overlapping segments of signal samples. A sinusoid is believed to exist in the received signal if all the absolute values of the difference between the first element and the others of the vector equal zero or one. The basic principle of the proposed algorithm in this paper introduced on condition of white Gaussian noise. The Pfaand Pd(detecting probability) are proved independent of the probability distribution of white noise by Monte Carlo simulation, although the performance of Pdis shown to deteriorate less than 4 dB compared with optimal parametric detector as far as samples length of 256 and Pfaof 1e-4 is concerned [C637]

"SBR waveform and processing parameters as a function of array distortion"

Structural distortions in large antennas have impact on antenna gain, sidelobe level and adaptive interference rejection. Partial compensation for the distortion of space-based radar (SBR) phased-array antennas and array-fed reflectors can be achieved by adjusting the phase-shifter settings to compensate for the distortion, if it can be accurately measured. This approach is effective in regaining the antenna gain and sidelobe levels, but the adaptive rejection of interference and clutter is much more complex. This paper addresses the ground moving target indication (GMTI) performance for a large active electronically scanned array (AESA) at a medium-earth orbit (MEO) altitude of 10,000 km, and a maximum sinusoidal mechanical distortion of 10 cm modeled across the horizontal aperture. To evaluate the impact of mechanical distortion on GMTI performance, the full-dimension space-time adaptive processing (STAP) matched filter (MF) and the reduced-dimension joint-domain localized (JDL) algorithms were evaluated using signal-to-interference-plus-noise ratio (SINR), SINR loss and minimum discernable velocity (MDV) as the GMTI performance metrics [C638]

"A Novel ISAR Imaging Algorithm for Maneuvering Targets Based on Sparse Signal Representation"

A novel imaging algorithm is proposed for inverse synthetic aperture radar (ISAR). Sparse signal representation, with great flexibility in matching structure in the data, can be used for maneuvering targets imaging. However, for complex-valued radar signals, the popular basis pursuit and FOCUSS (focal underdetermined system solver) algorithms have big computation. An efficient iterative method is presented as a novel imaging algorithm, which was first proposed for regularized problems. Applying the new algorithm into simulating and real radar data can obtain ISAR images with good quality. It shows that the proposed method is an efficient and a promising ISAR imaging method for maneuvering targets [C639]

"Recognition of Building Roof Facets by Merging Aerial Images and 3D Lidar Data in a Hierarchical Segmentation Framework"

We investigate in this paper an original methodology for detecting roof facets through the fusion of aerial images and lidar data (3D point cloud). Based on a hierarchical segmentation of the image, we define a cost function that manages the merging order of regions. It depends on both radio-metric similarities of two neighbouring regions as well as on extracted information from lidar data. Considering that lidar data have been filtered into points belonging either to ground or non-ground classes, we define semantic and geometric rules in the binary merging process. Building roof facets are finally detected by selecting a level of generality for representing roof building components. Some remarks are given concerning the reliability of the integration of lidar and image data. Reconstructed roof facets are finally shown onto complex buildings [C640]

"Phase Cancellation for Synthesizing Range Profile of Target with Micro-motion"

Micro-motion, such as nonuniform motion, induces complex range-Doppler coupling effect, which results in distortion in synthesizing range profile. To eliminate or suppress the distortion of the synthetic range profile (SRP), conventional technology such as motion compensation requires velocity estimation. Unfortunately, for a high-speed moving target with micro-motion, it is difficult to achieve real-time accurate estimation of the velocity of the target Based on phase cancellation; a new technology is proposed to achieve range profile of a target with micro-motion via stepped-frequency waveform (SFW). The emulation result confirms the effect of the new technology [C641]

"Radar Automatic Target Recognition Based on Complex High-Resolution Range Profiles"

Radar high-resolution range profile (HRRP) has received intensive attention from the radar automatic target recognition (RATR) community. Usually, complex HRRPs are not fully used for RATR but only their amplitude vectors, while the phase information of them is discarded due to the fact that the initial phase of a complex HRRP is strongly sensitive to target position variation. However, the phase information of complex HRRPs may also contain valuable target discriminant information, which may further improve the recognition performance. This paper concerns RATR using complex HRRPs. To' deal with the initial phase sensitivity of complex HRRPs, we extract the complex HRRPs' feature subspace within each target-aspect sector of each target via principal component analysis (PCA) as the corresponding template during the training phase, while in the test phase, project the test sample onto each feature subspace and search the optimal approximation of the test sample with the minimum reconstruction error to decide which target the test sample belongs to. It is shown that the whole process is independent of the initial phases of complex HRRPs. Furthermore, to make the proposed recognition method more practical, a fast time-shift compensation algorithm is proposed. In the recognition experiments based on measured data, the proposed recognition method using complex HRRPs achieves better recognition results than that using only the amplitude vectors of the complex HRRPs [C642]

"Fast and Accurate Polynomial-Phase Signal Parameter Estimation"

A new method for estimating the parameters of a complex polynomial-phase signal in complex white Gaussian noise is proposed. Its computational complexity is comparable to the S.peleg's method, but it approaches the Cramer-Rao bound (CRB) down to much lower signal-to-noise ratio (SNR) values. Simulation results are included to demonstrate the performance of the proposed method [C643]

"A Method for Ship Target Extracting from Broadened Bragg Lines in Bistatic Shipborne SWR"

The Doppler frequency shifts of the sea echoes in bistatic shipborne surface wave radar (BS-SWR) are simultaneously modulated by the velocity components projected from the motion of the radar transmitter and receiver and, therefore the Doppler spectrum in BS-SWR is much more complex than it's counterparts in monostatic mode. The characteristics of the broadened first-order bistatic Bragg lines are first analyzed in this paper and, then a model of radar return received by an arbitrary element in the receiving antenna array is proposed. Finally, a method for ship target extracting from broadened Bragg lines in BS-SWR is presented, which is based upon the azimuth differences between the Bragg waves and the moving targets whose Doppler spectrum fall into the same Doppler resolution cell. Simulation results show that the method suggested in this paper is effective in the bistatic shipborne surface wave radar applications [C644]

"Detection of unknown nonlinear fm signals by time-frequency morphological filtering"

A new energy integration detection scheme is proposed to detect an unknown nonlinear frequency modulated (FM) signal buried in strong complex additive white Gaussian noise (CAWGN). In this scheme, the Smoothed-Pseudo Wigner-Vill Distribution (SPWVD) is used to realize local coherent integration of a signal and thresholding and mathematical morphological filtering are jointly used to extract the time-frequency (TF) support region of the signal from the time-frequency distribution (TFD) image of an observation. The simulated results show that the proposed scheme is effective in strong noise background. The scheme can be applied to the target detection in the over-the-horizon radar (OTHR), such as the sky wave OTHR and the surface wave OTHR. [C645]

"Subpixel Processing for Target Scattering Center Extraction from SAR Images"

In high frequency region, the response of an extended target is well approximated as a sum of responses from individual scattering centers. This work presents two subpixel processing techniques for target scattering center extraction from synthetic aperture radar (SAR) or inverse SAR (ISAR) images. Using the proposed techniques, procedures for scattering center extraction are developed and used to characterize the electromagnetic (EM) scattering of complex targets. Typical results demonstrate the superior performance and usefulness of the current techniques [C646]

"Surface Current Extraction by Onboard High Frequency SAR"

To meet the requirement of extracting sea surface current information by a single station, we present the new concept of high frequency SAR (HF-SAR), and consider the feasibility of extracting sea surface current by HF-SAR. Firstly the implementation aspects are described, then system model and velocity estimation algorithm are designed, and finally simulation model to extract surface current is implemented on a single resolution cell. Additive complex Gaussian noise is included in the model of SAR echo, and also an iterative approach is

adopted to estimate the parameters of chirp signals. Simulation results show that by estimating the phase parameters from azimuth echoes, the velocity estimates of surface current are obtained, and the precision is enough to meet the requirements. It indicates that HF-SAR is theoretically feasible to be used in sea surface current extraction [C647]

"DTM Generation from LIDAR Data using Skewness Balancing"

Light detection and ranging (LIDAR) data for terrain and land surveying has contributed to many environmental, engineering and civil applications. However, the analysis of digital surface models (DSMs) from complex LIDAR data is still challenging. Commonly, the first task to investigate LIDAR data point clouds is to separate ground and object points as a preparatory step for further object classification. In this paper, the authors present a novel unsupervised segmentation algorithm-skewness balancing-to separate object and ground points efficiently from high resolution LIDAR point clouds by exploiting statistical moments. The results presented in this paper have shown its robustness and its potential for commercial applications [C648]

"Detection, Location and Imaging of Fast Moving Targets Using Non-uniform Linear Antenna Array SAR"

In this paper, a new system called non-uniform linear antenna array SAR (NULA-SAR for short) is proposed. Using multiple complex images formed by multiple antennas with special configuration, NULA-SAR can not only suppress the stationary clutter, but also locate and image both slowly and fast moving targets accurately. Numerical experiments are presented to demonstrate the effectiveness of NULA-SAR [C649]

"Level Set Evolution Based Logic Fusion: A Novel Man-made Objects Segmentation from Radar Image"

Our purpose is to explore an application of level set evolution theory to seek the solution of objects (as bridge or dam) segmentation above river from radar imagery with unwelcome effects. We present a novel level set evolution formulation for improving accuracy of segmentation. Critically, a logic fusion term is constructed using logic operators defining in multi-source satellite imagery with high precision of registration by logical operations, such as union, intersection and negation, then incorporated into the general evolution equation. Under the logic framework, we combine diverse features both from radar and optical image into evolution equation so as to overcome disadvantages, such as missing information, image artifacts and weak boundary and help objects segmentation to radar image. Results of experiments on pairs of ERS and LANDSAT imagery and pairs of RADARSAT and SPOT imagery, demonstrate effectiveness and robust of our method to objects segmentation in complex cases [C650]

"Low spurious signal homodyne digital receiver"

Digital superheterodyne receivers employing two or more frequency conversion stages have been successfully employed in radars and communication equipment for many years. More recently, less complex single frequency conversion receivers, termed "homodyne receivers," have been revived and employed in lower performance equipment. The most significant problem limiting the performance in single frequency conversion directly to baseband is that of spurious signals due to the non-linear effects in the components. This paper describes a simple means in which second-order spurious signals that are generated from out-of-band signals can be cancelled while maintaining the signal of interest. Given that these fairly low, yet significant, spurious signals are cancelled and the in-band signal of interest is not to large, this new homodyne receiver does not have the issues with images that are present in superheterodyne receivers and furthermore, it may be smaller, less expensive, less complex, and should draw less power than the superheterodyne receivers. This receiver concept, if proven to be successful, might be employed in digital array radars (DAR). In this DAR application, ones own echo signals would only be of modest power levels but the out-of-band interfering signals that can be present could be of very large power levels. Furthermore, there may be similar applications in communications. [C651]

"A novel approach for distributed maneuver detection"

Quickest and accurate maneuver detection is critical to modern tracking systems. In this paper, the target maneuver detection problem when using multiple sensors is investigated. The target dynamic model and measurement model may exhibit complex nonlinearity and non-Gaussianity. Therefore, particle filters are implemented at the local sensors to predict the target state. At each time step, local sensors transmit binary data to the fusion center, where decision fusion is performed to detect the potential occurrence of target maneuver. Since the sensors observe the same dynamic process, their measurements, and thus the local decisions, are correlated, which has to be taken into account at the fusion center. By considering correlation and using the

Bahadur-Lazarsfeld expansion in the fusion rule, we can achieve better system design (local decision rules and fusion rule) than that achieved by assuming independence between sensors. Experimental results show that the distributed maneuver detection system achieves much better performance than using only a single sensor; the correlated design outperforms the independent design, and is very close to the optimal performance, especially for high correlation scenarios. [C652]

"Space-time transmit signal construction for multi-mode radar"

This paper addresses the problem of constructing, selecting, and/or evaluating non-separable space-time transmit functions for radar transmitters. By expressing a constrained space-time transmit function as a superposition of space-time basis functions, this problem is recast as finding an optimal set of superposition weights, which are collected and expressed as complex transmit vectors. Optimality in this problem is defined as the transmit vector that results in an optimal radar measurement, and thus depends on the radar task, target scenario, and receiver construction. After discussing the properties of the ideal (but unobtainable) radar measurement, an information theoretic criterion is presented as a logical method for selecting optimal transmit vectors. A numeric simulation demonstrates the efficacy of this method. [C653]

"Direct RF sampling employing time-skewed analog to digital converters and complex finite impulse response filters"

This paper presents an approach to directly sample and baseband an RF signal without the use of mixers. The technique utilizes an array of time-skewed analog to digital converters (ADC) combined with complex finite impulse response (FIR) filters to provide digital I and Q samples of the complex envelop of the RF signal. Since the process is complex, the analog to digital conversion rate need only be commensurate with the signal bandwidth, and not the carrier frequency. This device is referred to as a complex analog to digital converter, or simply, CADC. The CADC is based on the use of FIR filters with complex coefficients. These can be used to filter and demodulate a sampled signal of arbitrary bandwidth to baseband-without the use of a demodulator or mixer. The CADC uses aliasing to effectively demodulate the signal of interest to baseband, which obviates the complex demodulators often used in sampled data systems. For high frequency applications, such as radar, this can eliminate the need for analog mixers often used to mix frequencies to an intermediate frequency (IF) prior to analog to digital conversion. Since the conversion rate need only be commensurate with the signal bandwidth, slower ADCs can be used with respect to other direct RF sampling methods. These slower ADCs tend to have more effective number of bits (ENOB) than those which operate at higher rates, resulting in the wider dynamic range often desired in radar applications. The CADC architecture is more immune to ADC matching errors such as amplitude, phase, and DC offset, which are often encountered with the more traditional time-interleaved ADC arrays. The CADC also reduces the impact of jitter and quantization noise because of its filtering characteristics. The filtering thus acts to increase the ENOB over that of each ADC. [C654]

"Tracking the mode of operation of multi-function radars"

One of the important objectives of a radar warning receiver (RWR) aboard a tactical aircraft is to evaluate the level of threat posed by hostile radars in an extremely complex electronic warfare (EW) environment in reliable, robust and timely manner. For the RWR objective to be achieved, it passively collects electromagnetic signals emitted from potentially hostile radars. One class of such radar systems is the multi-function radar (MFR) which presents a serious threat from the stand point of a RWR. MFRs perform multiple functions simultaneously employing complex hierarchical signal architecture. The purpose of this paper is to uncover the evolution of the operational mode (radar function) from the view point of a target carrying the RWR when provided with noisy observations and some prior knowledge about how the observed radar functions. The RWR estimates the radar's threat which is directly dependant on its current mode of operation. This paper presents a grid filter approach to estimate operational mode probabilities accurately with the aid of pre-trained observable operator models (OOMs) and hidden Markov models (HMMs). Subsequently, the current mode of operation of a radar is estimated in the maximum a posteriori (MAP) sense. Practicality of this novel approach is tested for an EW scenario in this paper by means of a hypothetical MFR example. Finally, we conclude that the OOM-based grid filter tracks the mode of operation of a MFR more accurately than the corresponding HMM-based grid filter. [C655]

"Dissipation of microwaves propagating through atmospheric pressure glow discharge plasma"

Summary form only given. The atmospheric pressure glow discharge (APGD) is a cold collisional, non-equilibrium plasma that explores wide applicability of plasma for modifying aerodynamic properties specially the drag reduction and also for radar cross-section (RCS) reduction by microwave invisibility. The experimental study has been carried out to develop some information for microwave dissipation in the plasma to cease the radar

function. The cold plasma produced at atmospheric pressure can absorb the microwave power because of its complex dielectric constant and diffuse density profile. The attenuation of microwaves in the plasma depends on the discharge operating parameters to create sufficient plasma density and thickness, incident wave frequency and electron-neutral collision frequency for momentum transfer etc. The uniform glow discharge was ignited between parallel-plate dielectric covered electrodes as well as on a planar surface in helium gas at atmospheric pressure. The first experiment was performed with the measurements in parallel-plate electrode geometry. The electron plasma density has been measured using optical emission spectroscopy with helium line intensity ratio method that was verified by electron density obtained by microwave attenuation measurements. Hence, the measurement of microwave attenuation was also used as a diagnostic method to estimate the electron plasma density. The microwave signal was launched to the plasma by a Gunn oscillator (X-band) and transmitted signal was detected by high sensitivity microwave detector. The attenuation in transmitted signal was measured for various operating parameters. The measured attenuation was in good agreement with the theoretical prediction for defined plasma parameters. Further experiments are in progress to measure the microwave attenuation in planar surface discharge at various plasma and wave parameters. The details of the experimental setup and results of these studies will be presented [C656]

"Blind source separation for extraction of target scattering centers"

This paper focuses on using blind source separation of complex signals to extract scattering centers of radar targets that can then be used for target identification. The concept introduced in this paper assumes that the signal returned (or scattered) from a target is linear or convolutive mixture of several scattering centers along the body of an unknown aircraft. This information can then be used in a pattern recognition scheme for the purpose of identifying the non-cooperative unknown target. The results presented prove the concept using synthetic radar data. Work is ongoing to apply this concept to real radar data as received through an array of sensors (antennas) [C657]

"Incorporating Doppler Velocity Measurement for Track Initiation and Maintenance"

Performance of multiple target tracking algorithms in complex environments heavily relies on the success of track initiation and measurement-to-track association algorithms. Doppler velocity measurement is the major discriminant of clutter from the target of interest with relatively higher velocities. This work summarizes the analytical derivations and presents simulation results about track initiation and maintenance using Doppler velocity reports along with the 3D position measurements extracted by a phased array radar. [C658]

"Information Theoretic Criterion for Waveform Selection"

A novel criterion for waveform selection in adaptive radar and other sensing applications is presented that is based on the information theoretic concept of mutual information. In addition, its application to the area of waveform diversity for synthetic aperture radar (SAR) systems is examined. Mutual information is a measure of the information (in the sense of Shannon) in a random variable or vector about another random variable or vector. It is shown herein that such a framework provides the basis for a conceptually simple and powerful criterion for context-dependent evaluation of candidate waveforms, as well as context-dependent design of waveforms. Furthermore, in the special case of zero-mean Gaussian-distributed clutter, interference, and noise, the criterion attains an analytically simple form-a scalar function of the singular values of a specific cross-covariance matrix. The criterion can be used in distinct optimization contexts (minimization or maximization) as a function of the problem to be addressed. In addition, the criterion inherently includes the statistical information of the sensed parameters. More specifically, in the context of a SAR system the criterion includes the covariance matrix of the set of illuminated ground scatterers. The formulation and simulation-based results are presented in the context of a first-order radar system model for simplicity, but the approach can be extended in a straightforward manner to cover more complex models. Results presented show that the criterion is an effective means for waveform selection in an adaptive SAR system [C659]

"Adaptive Radar Detection of Distributed Targets in Partially-Homogeneous Noise Plus Subspace Interference"

This paper addresses adaptive radar detection of distributed targets embedded in noise plus interference assumed to belong to an either known or unknown subspace of the observables. We assume that a set of noise-only data is available (the so-called secondary data). Detection algorithms have been derived modeling noise vectors, corresponding to different range cells, as zero-mean, complex normal ones, sharing the same structure of the covariance matrix up to possibly different power levels between primary and secondary data. The common structure and the power levels are unknown at the receiver. The performance assessment confirms the effectiveness of the newly-proposed detection algorithms also in comparison to previously-proposed ones [C660]

"Single-Stage Waveform Selection for Adaptive Resource Constrained State Estimation"

We consider the problem of optimal waveform selection. We would like to choose a small subset from a given set of waveforms that minimizes state prediction mean squared error (MSE) given the past observations. This differs from previous approaches to this problem since the optimal waveforms cannot be computed offline; it requires the previous observations. Since the optimal solution to this subset selection problem is combinatorially complex, we propose a convex relaxation of the problem and provide a low complexity suboptimal solution. We present a specific model and show that the performance of this suboptimal procedure approaches that of the optimal waveforms [C661]

"Three-Way Arrays for Harmonic Retrieval: the Colored Noise Case"

In this work, we deal with multilinear representations of an harmonic process composed by a mixture of complex sinusoids contaminated by a colored Gaussian noise of unknown probability density function. high-order statistics, and in particular fourth-order cumulants (FOC), are popular tools to mitigate the effect of the colored noise and can be viewed as a natural enhancement of the noisy mixture. As the FOC of an harmonic process is a multilinear function, it seems natural to map this quantity onto a structured multi-way array (aha. tensor). However, an harmonic process can be understood as a pure stationary random process or as a deterministic process corrupted by a stationary noise. In this paper, we explore the relation existing between these two models in the context of the multilinear decomposition theory [C662]

"GLRT-Based Direction Detectors in Noise and Subspace Interference"

In this paper we propose decision schemes to distinguish between the H0hypothesis that range cells under test contain disturbance only (i.e., noise plus interference) and the H1hypothesis that they also contain signal components along a direction which is a priori unknown, but constrained to belong to a given subspace (H) of the observables. The disturbance is modeled in terms of complex normal noise vectors plus deterministic interference assumed to belong to a known subspace (J) of the observables. At the design stage we resort to either the plain generalized likelihood ratio test (GLRT) or the two-step GLRT-based design procedure. Moreover, we assume that a set of noise only (secondary) data is available. A preliminary performance analysis, conducted by resorting to simulated data, shows that the one-step GLRT performs better than the two-step GLRT-based design procedure [C663]

"AutoVision-flexible processor architecture for video-assisted driving"

Summary form only given. Future automotive security systems will benefit from visual scene analysis based on a fusion of video, infrared, and radar images. Today we have already functions like lane departure warning and automatic cruise control (ACC) for pretty well defined driving environments, such as highways and primary roads. Recent research activities concentrate on more complex environments, such as city traffic with a wide variety of traffic participants moving in an unpredictable manner, e.g. bikes, pedestrians, children, and even animals, and under changing weather and lighting conditions. The ITRS semiconductor roadmap for microelectronics forecasts a continued doubling of transistor capacity per chip every 2 to 2.5 years enabling billion transistor ASIC designs in the near future. Multi processor system on chip (MPSoC) solutions with 8, 16 or even more standard RISC CPU cores, mega-bytes of fast (ns access latencies) on-chip SRAM memories, giga-byte per second interconnect buses or NoC (network on chip) meshes, high-speed serial I/Os and, last but not least, million gate equivalent dedicated hardware accelerator functions in eFPGA (embedded field programmable gate array) logic are becoming reality on a single silicon substrate. Examples of current research projects shall illustrate our perception on how this tremendous increase in functionality and computational performance per chip area may impact automotive control unit (ACU) architectures for driver assistance applications. The AutoVision processor is a dynamically reconfigurable MPSoC prototype where video-specific pixel processing engines are on-the-fly loaded or exchanged without interrupting regular system operations. For the time being, pixel processing engines cover functions such as object edge detection or luminance segmentation, and are implemented as dedicated hardware accelerators to ensure real-time frame processing capabilities of the AutoVision processor. Dynamic replacement of processin--g engines ensures an automatic and area efficient adaptation to various driving conditions. Segmented objects are, in a subsequent step, characterized by means of standard MPEG-7 descriptors and entered as search criteria into traffic scene analysis databases. Goal is to obtain a clean distinction between passenger cars, trucks, and big rectangular traffic signs, and to identify pedestrians or bikers in complex traffic situations. The AutoVision processor project is supported by the German Research Foundation (DFG) in the special emphasis research programme "reconfigurable computing" [C664]

"Wideband modelling and measurement of trans-ionospheric radar waveform propagation"

A propagation model has been developed to simulate the corruption of wideband radio waveforms (such as radar chirps) as they pass through a non-homogeneous ionosphere. The ionosphere is modelled by a series of phase changing screens and a split-step Parabolic Equation method is used to describe the propagation of the complex electromagnetic field in planes normal to the propagation vector. Wideband characteristics of the channel are calculated by propagating spectral components of the waveform spectrum through the phase screens and then reconstituting the signal at the ground via a Fourier transformation into the time (delay) domain. By estimating the ionospheric drift velocity, the channel scattering function (signal power vs Doppler frequency and time delay) is calculated for a given satellite orbit and pulse repetition frequency (PRF). [C665]

"Demonstrated direct sampling & demodulation of UHF & S-band signals"

A set of time-skewed analog-to-digital converters (ADCs) in combination with a complex finite-impulse response (FIR) filter has been utilized to directly sample and demodulate RF signals. This architecture is referred to as a complex analog-to-digital converter (CADC) B.W. Tietjen. The clock signals driving the ADCs are staggered in time such that the system achieves an effective sampling rate commensurate with the carrier frequency of interest, while each ADC need only run at a rate greater than the immediate bandwidth of interest. The output of each ADC is fed into the complex bandpass filter, which suppresses the input signal's image frequency to produce I and Q data. The data rate out of the filter is equal to the ADC clock rate; thus the RF band of interest is aliased down to baseband or a low IF band. Hardware implementations of the CADC architecture have been achieved for both UHF and S-Band. The measured values of signal-to-noise ratio (SNR) and image rejection for both prototypes closely match expected results. Furthermore, by using the CADC to down-convert the RF band of interest to a low IF band, a second digital filter can be used to easily suppress any harmonics introduced by the ADC hardware. This provides superior spurious-free dynamic range (SFDR) and increased SNR performance. This technique is demonstrated using the UHF prototype. An automatic filter-tuning algorithm is also implemented to adaptively balance the amplitude and phase of the ADC channels composing the CADC. This technique allows the CADC filter to operate as expected despite hardware imperfections. [C666]

"3D Building Detection and Modeling from Aerial LIDAR Data"

This paper presents a method to detect and construct a 3D geometric model of an urban area with complex buildings using aerial LIDAR (Light Detection and Ranging) data. The LIDAR data collected from a nadir direction is a point cloud containing surface samples of not only the building roofs and terrain but also undesirable clutter from trees, cars, etc. The main contribution of this work is the automatic recognition and estimation of simple parametric shapes that can be combined to model very complex buildings from aerial LIDAR data. The main components of the detection and modeling algorithms are (i) Segmentation of roof and terrain points. (ii) Roof topology Inference. We introduce the concept of a roof-topology graph to represent the relationships between the various planar patches of a complex roof structure. (iii) Parametric roof composition. Simple parametric roof shapes that can be combined to create a complex roof structure of a building are recognized by searching for sub-graphs in its roof-topology graph. (iv) Terrain Modeling. The terrain is identified and modeled as a triangulated mesh. Finally, we provide experimental results that demonstrate the validity of our approach for rapid and automatic building detection and geometric modeling with real LIDAR data. We are able to model cities and other urban areas at the rate of about 10 minutes per sq. mile on a low-end PC. [C667]

"A Novel Joint De-Interleaving/Recognition System of Radar Pulse Sequence"

First, the paper shows a novel sorting method based on delaminating coupling and support vector clustering (SVC). Secondly, it presents a notion of type-entropy. And recognition technology of type-entropy is introduced into signal sorting system so that a novel radar sequence signal sorting system is to be presented. The experiment result shows that the system can sort efficiently radar signals in the complex pulses environment [C668]

"Adaptive combined bispectrum-filtering signal processing in radar systems with low SNR"

The application of adaptive techniques for obtaining bispectrum estimates in additive Gaussian noise and random shifts of received signals is considered. An approach using joint adaptive robust forming of bispectrum estimates and processing of complex-valued signal Fourier spectrum estimates by discrete cosine transform-based filtering with local variance estimation within each block is proposed. The advantages of the proposed approach in comparison to the conventional signal waveform recovery from bispectrum are illustrated by computer simulations [C669]

"Need for large local FPGA-accessible memories in the integration of bio-inspired applications into embedded systems"

Advanced Principles Group (APG) has developed a reconfigurable computing board (RCB) based on the Xilinx Virtex-II Pro FPGA family, potentially capable of 1.5-2.0 TeraOps of compute power, 100 Gbps I/O on front panel, 4 Gbps I/O on backplane, as well as containing more than 4 GBytes of on-board memory. Computationally complex applications such as software-defined radio, synthetic aperture radar, hyper-spectral imaging and cellular neural networks drive similar wide bandwidths and therefore require super-computing I/O and signal processing densities far exceeding the capabilities of current and future microprocessor-based system technology. We illustrate how such applications benefit from the large amount of local FPGA-accessible memory (4+ GBytes) provided on the RCB [C670]

"Amplitude-phase method allowing the determination of the complex dielectric permittivity of underlying surfaces using polarimetric radar remote sensing"

An amplitude-phase method is proposed allowing the determination of the complex dielectric permittivity of underlying surfaces based on the results of relative measurements of the signals in the orthogonal channels of a polarimetric radar receiver. The method assumes the determination of the voltage ratio and the phase difference in the orthogonal channels [C671]

"Enhanced Tunable Ultra-Wideband Pulse Generation Based on Variable Edge-Rate Compression"

The most recurrent pulse generator design approach described in literature employs a series step recovery diode (SRD) and pulse-duration tuning subsequent to Gaussian pulse formation. Although this conventional approach is advantageous in fixed pulse-duration designs, it leads to relatively complex designs for tunable generators. This paper presents a variable edge-rate compression (VERC) approach, to tunable ultra-wideband (UWB) generator design, that entails tuning prior to Gaussian pulse formation and a shunt configuration of forward and reverse biased SRDs. Compared to the conventional approach, VERC offers performance advantages that include broader tuning range, improved tuning sensitivity, increased design simplicity and reduced cost. A comparison of the series and shunt SRD configurations reveals that input-signal slew rate has a dominant effect on pulse-duration tuning for an SRD in a shunt configuration. As slew rate may be modified using frequency, rise time or voltage, the VERC approach also offers greater design flexibility and is more advantageous for tunable UWB generator design [C672]

"Evolution of Sensor Suites for Complex Environments"

We present a genetic algorithm (GA) based decision tool for the design and configuration of teams of unmanned ground sensors. The goal of the algorithm is to generate candidate solutions that meet cost and performance constraints. The GA evolves the membership, placement, and characteristics of a team of cooperating sensors. Previous work shows that this algorithm can generate successful teams in simple, obstacle free environments. This work examines the performance of our algorithm in environments that include obstacles [C673]

"Hardware/software interface for high-performance space computing with FPGA coprocessors"

Complex real-time signal and image processing applications require low-latency and high-performance hardware to achieve optimal performance. Building such a high-performance platform for space deployment is hampered by hostile environmental conditions and power constraints. Custom space-based FPGA coprocessors help alleviate these constraints, but their use is typically restricted by the need for TMR or radiation-hardened components. This paper explores a framework that allows Earth and space scientists to use FPGA resources through an abstraction layer. A synthetic aperture radar application is used to demonstrate the power of the system architecture. The performance of the application is shown to achieve a speedup of 19 when compared to a software solution and is able to maintain comparable data reliability. Projected speedups, for the same case study executing on the proposed flight system architecture, are several times better and also discussed. This work supports the Dependable Multiprocessor project at Honeywell and the University of Florida, a mission for the Space Technology 8 (ST-8) satellite of NASA's New Millennium Program [C674]

"Anti-Jamming Process for Reply Extraction of MSSR"

This paper is about MSSR reply decoding and confidence bits. A novelty method is presented in this paper which can extract the reply code efficiently on highly high density reply occasion. The results of theoretical analysis and practical system-test have showed that this method can get very high detection probability and very low falsehood probability even in the environment of high density inquiring and complex jamming of FRUIT [C675]

"Phase Mode Excitation in Beamforming Arrays"

A complete theoretical model describing phase mode excitation of discrete and continuous uniform circular arrays is provided. Practical examples of beamspace radiation pattern synthesis are demonstrated using probe stimuli to control the complex amplitudes of individual modes [C676]

"A Time-frequency Atom Approach to Radar Emitter Signal Feature Extraction"

In this paper, a novel approach to extract the features of radar emitter signals in the high density, complex and variable signal modulation environment is presented. Based on the over-complete time-frequency atom dictionary, the signals are decomposed into a linear expansion of atoms by the method of matching pursuit (MP). Then, improved quantum genetic algorithm is applied to effectively reduce the time-complexity at each search step of MP, and thus some optimal time-frequency atoms describing features of signals are obtained, which can provide some new feature parameters for the deinterleaving and recognition of the radar emitter signals subsequently. Experiment result proved the validity and feasibility of the approach and that the extracted atoms had the features of certain extent noise-suppression ability [C677]

"A Novel Method for Resolving Problem of Tolerance in Radar Signal Sorting"

Firstly, the problem of tolerance of radar signal sorting is analyzed in modern electronic warfare that faces even more complex and dense pulses environments. It has become a vital factor to reduce the efficiency of sorting of the conventional multi-parameters signal sorting system. Secondly, a novel radar signal sorting method is to be presented based on support vector clustering (SVC) and cascade coupling according to the idea of statistics learning theory. It prevented tolerance from affecting radar signal sorting. The simulation experiment shows that this method is efficient on high dense pulses and complex signals environments [C678]

"Multiple-Parameter De-Interleaving System in ESM Data Processing Scheme"

First, the paper shows a novel sorting method based on cascade coupling and support vector clustering (SVC). Secondly, recognition technology of type-entropy is introduced into signal sorting system so that a novel radar sequence signal sorting system is to be presented. The experiment result shows that the system can sort efficiently radar signals in the complex pulses environment [C679]

"Simultaneously estimating azimuth and elevation angles along with the wavelength of the incoming signals by using matrix pencil method"

In this paper we describe a method for simultaneously estimating the direction of arrival (DOA) of the signal along with its unknown frequency. In a typical DOA estimation problem it is often assumed that all the signals are arriving at the antenna array at the same frequency, which assumed to be known. The antenna elements in the array are then placed half wavelength apart at the frequency of operation. However, in practice seldom all the signals arrive at the antenna array at a single pre-specified frequency, but at different frequencies. The question then is what to do when there are signals at multiple frequencies, which are unknown. This paper presents an extension of the matrix pencil method to simultaneously estimate the DOA along with the operating frequency of each of the signals. This novel approach involves approximating the voltages that are induced in a three-dimensional antenna array, by a sum of complex exponentials by jointly estimating the direction of arrival (both azimuth and elevation angles) along with the carrier frequencies of multiple far-field sources impinging on the array by using the 3-dimensional matrix pencil method. The variances of the estimates computed by the matrix pencil method are quite close to the Cramer-Rao bound. Finally, we illustrate how to carry out the broadband DOA estimation procedure using realistic antenna elements located in a conformal array. Some numerical examples are presented to illustrate the applicability of this methodology in the presence of noise. The Cramer-Rao bound for the estimators are also provided to illustrate the accuracy and the computational efficiency of this new methodology [C680]

"Time-Delay Estimation for Complex LFM Signal Based on Cyclic Cross-Correlation Amplitude"

In this paper, the time-delay estimator of complex LFM is discussed and constructed based on the cyclic cross-correlation amplitude. Then, the mean and variance of estimating error are deduced and the estimator performance is analyzed in detail. Finally, the performance of the estimator is given through computer simulation, which is in agreement with the analytic results [C681]

"Data Fusion for Ground Moving Target Tracking"

The aim of ground surveillance is the large scale, continuous and near real time determination of a dynamical

ground picture. This task comprises detection and tracking of moving single targets and convoys, mobile weapon systems, and military equipment. The sensors of choice are airborne GMTI-radar (GMTI: ground moving target indicator) and SAR (synthetic aperture radar). As ground target tracking often suffers from dense target situations, high clutter, and low visibility, the integration and fusion of external background information is essential for providing precise and continuous tracks. We present multi hypotheses techniques for tracking several targets in complex ground situations with clutter. Methods to incorporate topographic information, in particular digital road maps, are described and demonstrated [C682]

"Advances in Phased Array Technology"

This paper presents an overview of developments at IMST in the area of steerable antennas, also often referred to as phased arrays. Such type of antennas have become a key area since the last few years. Various activities in this area have been conducted in the past, and are currently ongoing. Phased array antennas are, in general, rather complex systems that have to incorporate special features in order to perform beam steering, and have achieved ever more popularity during the last years, mainly driven by mobile multimedia applications. The complexity of the antenna systems, developed at IMST, ranges from small arrays with switchable elements, and partially mechanically and electronically steerable arrays (hybrid systems) to fully electronically steerable arrays. Such systems can be equipped with phase and amplitude shifters for each element, or the design can be based on digital beam forming (DBF). At IMST a large number of R&D projects reflects the broad spectrum of activities with respect to design and development of phased arrays. For the last 6 years, various projects have been carried out which all differ in topic, application and frequency range (L-band to Ka-band). It is intended to give here an overview of the work performed, and a global technical description [C683]

"Monostatic Radar Signatures of Significant Classes of Ground Targets, in the Time and Frequency-Domain"

The problem of characterizing the radar returns from complex man-made localized targets using airborne radar platforms has been and currently is a topic of tremendous interest. This paper presents results of modeling four generic types of ground targets, and analyzes the monostatic radar cross section (RCS) both in the frequency and the time domain. The recorded results reinforce the conclusion that in realistic situations return signals are complex enough to include higher order terms, other than the shifted in time and frequency replica of the transmitted signal. A mechanism is shown on how to estimate these higher order terms. The existence of these terms allows one to see how signals are structured in the time domain. This in turn may successfully lead in the development of suitable matched filters for the class of targets studied in this paper [C684]

"Gradient and Fixed-Point Complex ICA Algorithms Based on Kurtosis Maximization"

We present two algorithms for independent component analysis of complex-valued signals based on the maximization of absolute value of kurtosis and establish their properties. Both the algorithm derivation and the analysis are carried out directly in the complex domain, without the use of complex-to-real mappings as the cost function satisfies Brandwood's analyticity condition. Simulation results are presented that show the advantages of the new algorithms, especially when the number of sources in the mixture increases. [C685]

"Online Detection of the Nature of Complex-Valued Signals"

A novel method for on-line tracking of the changes in the nature of a complex-valued signal is proposed. This is achieved by analysing the time variation of the mixing parameter within a hybrid complex-valued nonlinear adaptive filter. The proposed hybrid filter consists of a combination of split- and fully-complex nonlinear gradient descent algorithms, whose outputs are mixed in a convex manner. A learning algorithm for this scheme is derived and the potential of such an approach for tracking of signal modality changes is highlighted. The potential of the proposed approach is supported by simulations on both a synthetic benchmark signal and on real-world radar data. [C686]

"Prediction of Sea Clutter Based on Chaos Theory with RBF and K-mean Clustering"

Artificial neural network (ANN) has been widely applied in time series analysis, typically, it can give an effective method to solve complicated problems which are too complex to understand in physic and statistic method, or observation data varied statistically and the data generated in nonlinear mechanism. Based on the underlying dynamic mechanism of the sea clutter, to reconstruct the nonlinear model of dynamical phase space, correlation integral (also called C-C method) and Cao method are used to get time delay tau and embedding dimension min this paper. Furthermore, an algorithm of radial basis function (RBF) with k-mean clustering to adjust and modify the networks is also presented to predict the nonlinear characteristic sea clutter for the goal of detecting the weak target signals beneath the sea clutter. With the new algorithms, computation complexity can be deduced

while its reliability can be greatly improved. It also can satisfy the real-time requirement in real application. More detailed calculates and test results are presented [C687]

"A 2nd Order 1-bit Complex Switched Capacitor Sigma-Delta ADC with 90dB SNDR in a 180kHz Bandwidth"

A complex switched capacitor sigma-delta ADC is described. The ADC is used in the VLIF RX path of a GSM/GPRS/EDGE phone and has an SNDR of 90 dB in a 180 kHz bandwidth, with the VLIF centered at 123 kHz. The use of a complex noise transfer function allows for a more optimal use of noise shaping. The ADC is 2ndorder, 1-bit, with a sampling rate of 52 MHz implemented in 90 nm CMOS. [C688]

"TerraSAR-X Antenna Pattern Estimation by a Complex Treatment of Rain Forest Measurements"

First Page of the Article [C689]

"Severe Weather Applications over the Oceans using ERS SAR Wavemode Data"

Due to the relatively small amount of in situ data available for the open oceans, particularly during extreme events, under such conditions remote sensing techniques take an important role in the retrieval of geophysical information. Up to now the only remote sensing system capable of providing information on two dimensional sea state on a global and continuous scale and under all weather conditions is the Synthetic Aperture Radar (SAR). In the scope of the project Wave Atlas, ESA provided a two years wave-mode dataset of ERS-2 SAR raw data, mainly collected during 1999 and 2000, which was reprocessed to single-look- complex imagettes at DLR using the BSAR processor. In this study the data were used for a statistical evaluation resulting in global ocean maps of different basic image parameters and oceanic parameters like wind speed, significant wave height, mean period and their respective regional and temporal variability during the seasons of the year using the empirical algorithms CWIND1.0 and CWAVE1.0. Global statistics are given for the time frame of 1998 to 2000 and examples of severe storms are analysed in detail. In future, the reprocessing of wavemode data is planned to be extended to the full lifetime of ERS-1 and ERS-2, which is at least 1991-2006. As wave mode data are also available from the ENVISAT mission, there is the possibility for future expansion. [C690]

"Cascade Coupling and Support Vector Clustering Based Novel Sorting Method of Radar Pulses"

A novel sorting method is presented in this paper. The 3-dimension feature information is composed of direction of arrival, radio frequency and pulse width in this method which sorts radar pulse sequences by employing support vector clustering (SVC) and cascade coupling. The experiment result shows that the method can sort efficiently radar signals in the complex pulses environment and the performance is superior to that of K-Means clustering sorting. [C691]

"Illumination of Air Environment Using Radiation of SB Broadcast Stations"

The possibility of air objects location in bistatic radars employing as illumination the signals of broadcast SB stations is considered in this paper. The spectrums of illumination signal are investigated experimentally. The requirements to the direct signal blanketing degree for the location assurance at given distances. The possibility of building of bistatic systems complex employing broadcast SB stations and providing location of acquiring object employing the information of Doppler frequency translation of signal receiving from object is considered. [C692]

"CFAR Target Detection Based on Gumbel Distribution for HF Radar"

High frequency (HF) radars are capable to detect and track targets at extremely long ranges. But the signal environment that includes external noise, different kinds of clutter and interference will significantly limit the detection and system capability. This paper considers a new approach to solve the target detection problem in a complex HF radar signal environment. It uses conventional constant false-alarm-rate (CFAR) detection procedure but based in this case on an untypical assumption of Gumbel distributed power spectrum values along range cells for thresholding. The CFAR detection test rule was combined with a local peak determination procedure. The proposed detection scheme was tested using real HF radar data and gave very promising results. [C693]

"Concept of the Coherent Autofocus Map-Drift Technique"

The paper presents concept of the coherent autofocus map-drift technique. The main goal of this work is to obtain high accuracy and sensitivity for autofocus technique in strip-mode SAR. Presented technique is based at

the well-known noncoherent map-drift algorithm and it also takes advantages of multi-look registration to estimate unknown platform velocity component. At the proposed coherent map-drift technique, opposite to the classical map-drift, the cross-correlation is not carrying out at the image intensity from multi-look processing, but at the complex multi-look image data. [C694]

"A Generalized Space-Time Formulation for Robust Persistent Scatterer Interferometry"

Differential synthetic aperture radar (SAR) interferometry allows measuring slow terrain movements. The extraction of this information is a complex task. Important advances were introduced by the persistent scatterer approach, with the ideas of minimizing the amplitude and phase dispersions in long series of SAR acquisitions. This approach exploits mainly the temporal properties of the signals. On the contrary, other approaches, more similar to classical differential interferometry, exploit first the spatial and then the temporal properties of the data. In this work, we present a generalized formulation of the persistent scatterer interferometry problem that contains the two approaches mentioned above as limiting cases. In the general case, the spatial and temporal properties of the data are exploited jointly, which helps recovering the correct solution even with a limited number of images. Tests performed on real ERS data show that the proposed approach is promising. [C695]

"Modular SAR Simulator for Bi- and Multistatic Constellations"

Bi- and multistatic SAR missions are becoming increasingly important for the SAR data acquisition. Established methods for processing monostatic SAR signals and for mission planning have to be adapted to the bi- and multistatic case. To support this evolution, a suitable flexible and powerful simulation tool is essential, which is able to handle such complex scenarios and to provide corresponding simulation data. This paper presents a new simulator architecture. In particular, the modular approach to implement and to simulate this kind of bi- and multistatic SAR scenarios is discussed and an example is given. [C696]

"A Complex of Multi-Frequency at 3GHz, 5.6GHz, 20GHz and 37GHz, Polarimetric, Combined, Short Pulse, Short Range Action Radar- Radiometers for Soil and Snow Remote Sensing and Surveillance"

A complex of polarimetric (dual polarization), spatio- temporally combined active-passive devices of S (~3GHz), C (~5.6GHz), Ku (~0GHz), and Ka (~37GHz) band of frequencies is represented, for bare and vegetated soils, waved water surface and land snow cover microwave reflective and emissive characteristics multi-frequency, polarimetric, simultaneous and spatially coincident measurements. The complex is dedicated to solve problems applied to soil (bear and vegetated) and snow moistures retrieval, to near water surface wind and wave field parameters retrieval, by synergetic application of various kind microwave means of remote sensing, as well as applied to surface and sub-surface targets detection and identification tasks solution. The complex is set in ECOSERV Remote Observation Centre's control-test experimental site, in Armenia, which is equipped by facilities for microwave devices absolute calibration, by spatially distributed stations for in-situ measurements of soil and moistures and temperatures, and has a local meaning small weather station. This paper has an aim to attract attention of researchers who are interested in such kind measurements and to invite them to perform their own or joint measurements using available facilities. [C697]

"Wetland Characterization using Polarimetric RADARSAT-2 Capability"

Wetlands play a key role in regional and global environments and are critically linked to many major issues such as climate change, water quality, the hydrological and carbon cycles, and wildlife habitat and biodiversity. Mapping wetlands and monitoring their change in a systematic and repeatable manner for the Canadian Wetland Inventory (CWI), led by the Canadian Wildlife Service of Environment Canada (EC), are important in order to manage and protect significant wetland areas in Canada. The use of RADARSAT-1 Synthetic Aperture Radar (SAR) data has been shown to be important for wetland water extent characterization. However, the limited capability of RADARSAT-1's single-polarization C-band SAR in vegetation type discrimination makes the use of clear-sky- dependent visible near-infrared (VNIR) satellite data necessary for wetland mapping. In this paper, the unique polarimetric capability of RADARSAT-2 is investigated for wetland classification. The roll invariant incoherent target decomposition, the TSVM-ICTD [11], is used for optimum characterization of wetland target scattering. It is shown that like RADARS AT-1 HH polarization, the magnitude of the complex symmetric scattering is not effective for vegetation type discrimination. The phase of the symmetric scattering type has to be used for a more complete characterization of wetland vegetation species. This new phase scattering parameter introduced in [11] has been shown to be very promising for wetland classification using Convair-580 polarimetric SAR data. [C698]

"Forest Height Estimation in Tropical Rain Forest using Pol-InSAR Techniques"

Tropical rain forest environments are highly complex and heterogeneous in terms of species composition and structure and is often difficult to access. Radar remote sensing is for large tropical regions the only available information source for monitoring. Pol-InSAR is a novel developed radar remote sensing technique sensible to the vertical structure of forest that allows the estimation and mapping of forest height. In this paper we demonstrate forest height inversion at two frequencies-L band and P band-by means of Pol-InSAR using INDREX-II data and addresses the problem of temporal decorrelation. [C699]

"Bistatic Exploration using Spaceborne and Airborne SAR Sensors: A Close Collaboration Between FGAN, ZESS, and FOMAAS"

Following the goals of our cooperation treaty between FGAN and ZESS (University Siegen), we work closely together on the complex research field of bistatic exploration. Single tasks of the overall topic are for instance experimental missions, processing, image formation, position- and attitude estimation, synchronisation, simulation, parameter estimation, and visualization. This paper presents an overview about the common projects of FGAN, ZESS, and FOMAAS. [C700]

"Spatially Variant Restoration for Polarimetric Synthetic Aperture Radar Imagery"

A. spatially variant speckle filter is proposed for multi-look polarimetric synthetic aperture radar (POLSAR) imagery. The central idea is that the filtering is applied only to homogeneous areas based on the scattering properties, while for detected edges, lines and point-like textural features, the original complex covariance matrix of these features is restored in order to preserve the actual features. The capabilities of the proposed filter were examined using nine-look NASA/JPL POLSAR C-band data. Based on the obtained results, the proposed filter showed a promising performance in speckle removal and radiometric preservation. Moreover, the point-like textural features as well as structural features (i.e. edges and lines) were well-retained in the filtered outputs. [C701]

"Wide-Aperture 2-D HF skywave radar beamforming with unknown phase offset between sub-arrays"

Sensor systems using a distributed aperture with separately calibrated sub-arrays or elements with different angle-dependent complex response require either elaborate calibration or operation with a beamforming algorithm which compensates for the lack of full aperture calibration. An approach using a variant of adaptive subspace detection algorithms which inherently compensate for unknown scalar offsets between sub-arrays is investigated. [C702]

"Time-Frequency Analysis using Particle Filtering: Closed-Form Optimal Importance Function and Sampling Procedure for a Single Time-Varying Harmonic"

We consider the problem of tracking the frequency and complex amplitude of a time-varying (TV) harmonic signal using particle filtering (PF) tools. Similar to previous PF approaches to TV spectral analysis, we assume that the frequency and complex amplitude evolve according to a Gaussian AR(1) model; but we concentrate on the important special case of a single TV harmonic. For this case, we show that the optimal importance function (that minimizes the variance of the particle weights) can be computed in closed form. We also develop a suitable procedure to sample from the optimal importance function. The end result is a custom PF solution that is more efficient than generic ones, and can be used in a broad range of important applications that postulate a single TV harmonic component, e.g., TV Doppler estimation in communications and radar. [C703]

"Grating-Induced Waveguiding of Surface-Skimming Bulk Waves"

There is ever growing interest in faster surface waves for applications in surface acoustic wave (SAW) devices. Faster SAW means higher frequency operation for the same technological difficulty of making metal strips of interdigital transducers (IDTs) of micrometer width and nanometer resolution. The fastest acoustic waves are the bulk waves which cannot propagate at the substrate surface nor yield strong interaction with IDTs over longer propagation distances required in the SAW filters for narrow-band devices; the surface signal of bulk waves quickly vanish due to the wave propagation (and diffraction) into depth of the body. There is however, a remedy for it: the surface grating like periodic grooves or periodic metal strips (being these of the applied IDTs in the device), can help to trap the bulk wave at the surface making it a complex surface wave-guided mode. This phenomena is analyzed in this paper using the earlier developed spectral theory method in contrast to the couple-of-modes method presented afterwards. Here, only mechanical fields are discussed. [C704]

"Design and Simulation of Pulse Antenna for Ultra-Wideband WPAN Communication"

A complex approach to design and investigation of the time-domain and frequency characteristics of the antenna, ultra-wideband signals and properties of the radiated field are presented in the paper. A simple pulse ultra-wideband antenna for use in radiocommunication WPAN systems is proposed. Time-domain and the limitation of UWB signals' spectrum are investigated. The electric field radiated in chosen directions was calculated and the results are discussed in the paper. [C705]

"A Fully-Pipelined Parallel Architecture for Kalman Tracking Filter"

The Kalman filter is a set of mathematical equations that provides an efficient computational (recursive) mean to estimate the state of a process, in a way that minimizes the mean of the squared error. This filter is very powerful in several aspects: it provides estimations of past, present, and future states, and it can do so when the precise nature of the modeled system is unknown, and even with the presence of measurement and process noise. Moreover, Kalman filter for linear estimate is the most complex and precise algorithm used for target tracking. However, using Kalman filter algorithms in software for multi-target tracking (MTT) radar system would result in a very long computational time which may not be suitable for today's warfare constraints, or real-time processing. Consequently, a hardware alternative has to be developed which may result in big area overhead which is not suitable for today's area constraints such as sensor nodes in a sensor network. In this paper, we break the arrays into their scalar forms, and develop fully-pipelined hardware architecture for the radar tracking Kalman filter, with time division multiplex blocks to decrease the silicon area.. The proposed architecture contains 6 multipliers, 2 dividers, 9 adders, 5 subtracters, one control unit, and some registers and multiplexers for pipeline and control. Simulation results show that the loss in accuracy between the exact track and the estimated is found to be only 4.9%. [C706]

"A Multiple Beam Antenna System using Discrete Lens Arrays"

Conventional radar systems are usually based on complex structures employing not only high performance antennas but also baseband or RF processors. The antennas shall scan the space in the search for potential targets. Scanning can be usually made either mechanically or electronically. Mechanical scanning, although trivial in its conception, is usually expensive and not agile enough for some applications. Electronic scanning, a very elegant approach, usually demands the use of phase shifters or complex beam forming architectures, which can also lead to very expensive systems. As an example, Butler Matrixes, which allows the generation of multiple beams, make use of complex structures with vertical transitions, rather cumbersome when dealing with planar circuits. In addition, phase shifters at high frequencies introduce undesirable losses that degrade the radar noise figure. In this paper, a simple solution using lenses is presented, using a planar construction. A discrete lens array (DLA) operating at 8.2GHz, built entirely with conventional planar circuit techniques is designed and measured. The prototype was able to scan the far field region within -40deg and +40deg, both in azimuth and elevation as for a circular lens. RF-MEMS switches can be employed for confiring agility to the system. The optical system proposed here allows a first-order real time determination of the direction of arrival (DOA) for a target, using a DLA as the main element. The DOA accuracy is a function of the array size, as shown in this work. [C707]

"Rapid Small-Antenna Measurements"

We give an overview of research performed during previous years on the development of methods for measuring and determining the radiation patterns of small antennas. The work has focused on developing a spherical multi-probe system for measuring the 3-D complex radiation patterns of small antennas, as e.g. used in mobile terminals, without the need to move the device under test during the measurement. A demonstrator system with 32 dual-polarised field probes has been manufactured and evaluated. The frequency range of the measurement system covers most of the current mobile communications systems, i.e. from 800 MHz to 3 GHz. The radius of the measurement sphere is 1 m. The far field is determined with the spherical-wave expansion-based near-field to far-field transformation from the signals measured at each probe port. Since the system allows measuring a 3-D pattern within seconds, it facilitates specific research that would not be feasible with traditional measurement techniques. Some of these new results are presented. Finally, foreseen future developments of these measurement methods are presented. [C708]

"Multiphase Signals Based on the Recurrent Sequences of Maximum Length"

This paper is concerned with the particularities of the new class of complex (multiphase) signals created based on the maximum length sequences (m-sequences) and investigation of their properties by means of the spectral and correlation analyses. Ambiguity function apparatus will also be used for these signals investigation. [C709]

"A New Measurement Technique to Enable Engineers To Quickly Troubleshoot Radar Design

Problems"

Until recently, analyzing many radar signals was not a straightforward task. Modern radars depend on complex RF signals that vary with time. To truly understand system performance and troubleshoot today's complex radar signals, the time, frequency, and modulation domains all require analysis in a time-correlated fashion. Traditionally, no single test instrument was designed for this breadth of radar pulse analysis capability. Engineers were thus forced to use many different test instruments in custom-built test sets to collect sufficient data for reliable troubleshooting. Using multiple test instruments is costly, time consuming and can introduce measurement uncertainty that can lead to unreliable diagnostics. The latest generation of Real-Time Spectrum Analyzers (RTSA) solves these problems by providing the ability to trigger on an RF pulse, seamlessly capture it into memory and analyze the pulse in several time-correlated domains on a single instrument. This paper examines how the newest generation of RTSA pulse measurement technology can replace many traditional radar test sets for rapid and reliable radar systems diagnostics. [C710]

"The Joint Radar Targets Detecting and Communication System"

The combined radar system architecture for joint radar target detection and communication is considered. In this system we use complex quasi-continuous waveform of the big time-bandwidth product and duration with the combined modulation. This waveform is used in interrupted continuous wave radar technique. With reference to mariner radar [1] for a radar-location and communication it is offered complex coherent radar waveform with phase and linear frequency modulation. Problems of waveform synthesis, performance characteristic of the combined system are discussed. [C711]

"Analysis and Real Time Implementation of a Clutter Map CFAR Detector with Noncoherent Integration"

In this paper, we analysis a CMAP-CFAR (Clutter Map Constant False Alarm Rate) detector with noncoherent integration. The predetector statistics of the complex envelope are assumed Gaussian. A Swerling II target fluctuation model is considered and the incoming pulses are assumed independent. Closed form expressions of the probability of detection and the probability of false alarm are determined. On another hand, we propose a real time implementation of CMAP-CFAR detector with post integration using Texas Instrument DSP TMS320C4x. [C712]

"Project Wise (Integrated Wireless Sensing)"

Specific Targeted Research Project WISE concerns development of new technologies for wireless sensing in aircraft environment. Current aircraft monitoring systems use sensors hard wired to their electronic acquisition unit. (1) It precludes acquisition of major parameters where wires cannot be installed. (2) It results in complex installation. (3) It very often results in increasing weight. The project objectives are to: (i) enhance aircraft system monitoring by developing concepts based on new wireless technologies and integrated sensing solutions: with autonomous sensor powering and low consumption, compatible with the harsh environment of aircraft systems, (ii) allow the monitoring of parameters that are not available or hardly available by physical link such as wiring or fluid connection, (iii) replace or simplify wiring solutions, (iv)continue monitoring or improve redundancy when with the current solutions the link would be stopped (wire cut, fluid line damaged or destroyed) (e.g.: fire event, engine rotor burst event). Consequently, wireless networks and wired networks could then be mixed to achieve essential or critical safety levels. (v) Improve information segregation: wireless technologies allow saving wiring routing space which shall be taken to improve the segregation of other wired power or signal information lines. [C713]

"Intrapulse Analysis of Complex Signals using IFM Receiver"

The multichannel IFM system capabilities for the internal structure analysis of the complex signals have been presented in the paper. Time analysis was used to obtain instantaneous phase for LFM, PSK and FSK signals. Some phenomena have the place for complex signals receiving using IFM systems. For the LFM and FSK signals instantaneous frequency estimation this phenomena have disadvantageous character, but for PSK signal case this effects are helpful for bit code recognition. To estimate the instantaneous frequency for few type complex signals the time analysis for one channel of microwave frequency discriminator have been done. The results of the analysis have been presented, too. [C714]

"Radiometric Complex for Determination Man Temperature Profile"

The article shows the way to decrease temperature measurement error by reduction of influence of reflection coefficient from skin. The scheme of a radiometric receiver with feedback in high frequency section is

represented. This kind of scheme compensates signal decrease due to antenna mismatch. The article provides a description of the radiometric complex structure. [C715]

"Radiometric Space Complex for Research of Spectral Lines of Oxygen"

At present the research in the field of altitude temperature profile and pressure of Earth atmosphere is of considerable importance. One of feasible methods of acquiring results is the interpretation of resonance line of oxygen at frequencies of 50...60 GHz. In the present article the results of creating radiometric complex in the range of 50-60 GHz are considered. The complex has four radiometric channels and joint scanning antenna system. The high sensibility has been achieved due to minimum losses in the antenna and VHF tract. A good stability of the complex parameters has been achieved by the benefit of digital processing of signal and periodic calibration of the radiometer by the spatial noise generator and cold space. The experimental characteristics of the unit are given in the article. [C716]

"Real-Value Space ESPRIT Algorithm and Its Implement"

Real-value space ESPRIT (RVS-ESPRIT) algorithm transforms complex data into real data, via constructing real-value transformation, so as to reduce computation, through rearranging data and forward-backward averaging improves the performance and precision of estimating parameter. This paper analyses the rotational invariance principle of RVS-ESPRIT algorithm, the relationship between RVS-ESPRIT and complex space ESPRIT, and give the implementing algorithm of RVS-ESPRIT. Its performance is compared with other algorithm by simulation [C717]

"Image Rejection Research on Digital IF Quadrature Detector for Complex Band-pass Signal"

Two kinds of definitions of image rejection ratio (IRR) for complex band-pass signal are put forward, and the signal processing flow for digital IF quadrature detector is discussed in this paper. Simulation results of different definitions of ERR for a sort of complex band-pass signal are presented, which employ Bessel interpolation approach, low-pass filtering approach, polyphase filtering approach and frequency domain approach, respectively. The analysis and simulation results indicate that the values of IRR of different definitions for the same IF quadrature detector approach differs from 5 to 15 dB, and excellent IRR can be obtained with frequency domain approach, which is a more ideal IF quadrature detection approaches at present [C718]

"An S-band Direct Radar Frequency Source"

The overall high performance requirements for the modern radar system set higher and higher requirements for the radar frequency source, such as high spectrum purity, low phase noise and wide bandwidth, fast frequency switching speed, and complex signal generation capability, etc. and drive continuously the development of radar frequency source technique. This paper describes the design and implementation of an S-band direct radar frequency source for an ultra-low-altitude target acquisition radar and presents the result of development [C719]

"Joint Angle and Frequency Estimation with Uniform Eigenvalue Weighting"

In this paper, we address the problem of joint angle and frequency estimation based on uniform linear array (ULA). We derive a new version of ESPRIT-type algorithm to solve this problem. The proposed method follows the classic data stacking and real processing techniques for signal subspace estimation. We transform the estimated real signal subspace back to the complex domain. The purpose of this transformation is to avoid a potential bad-conditioned invariance equation and unbalanced weighting for the joint eigenvalue estimation. Then the complex invariance equation is formed and solved. By such a procedure, we show that the simple joint eigenvalue estimation method can still be applied after the complex invariance equation is solved. By the more sophistic and reliable joint eigenvalue estimation technique, we can obtain a uniform weighting for this estimation. Numeral simulations validate the proposed algorithms. [C720]

"An Imaging Simulation Method of SAR for Three-dimensional Targets"

The imaging simulation of SAR (synthetic aperture radar) is very useful for designing and understanding SAR systems. In this paper, a fast image simulating algorithm of SAR for complex three-dimensional ground object targets is presented. The simulation parameters and echo signal expression of SAR system are presented. In the simulation testing, the imaging of a complex three-dimensional ground object target is realized. [C721]

"Integrating LiDAR, Aerial Image and Ground Images for Complete Urban Building Modeling"

This paper presents a hybrid modeling system that fuses LiDAR data, an aerial image and ground view images

for rapid creation of accurate building models. Outlines for complex building shapes are interactively extracted from a high-resolution aerial image, surface information is automatically fit with a primitive based method from LiDAR data, and high-resolution ground view images are integrated into the model to generate fully textured CAD models. Our method benefits from the merit of each dataset, and evaluation results are presented on a university campus-size model. [C722]

"Target Detection Based on The Artificial Neural Network Technology"

As it is difficult to detect small ship targets from complex background in an IR image because of the impact of kinds of noises, complex background and the smallness of the target, this paper puts forward a method of background prediction utilizing the neural network. The method estimates the background of the input image nonlinearly, gains the residual error image, and detects the target. By comparison, NARX whose hidden layer transfer function utilizing L-M algorithm can achieve more excellent target detection than other neural networks like BP in training speed and stability, thus it is research valuable in the field of small target detection in complex background [C723]

"Reasearch on SDR Architecture for Radar Target Signatures Measurement"

According to software defined radio theory, four sections and four layers architectures for radar target signatures measurement are presented and researched, which can be applied to design to get more and more information including RCS or multi-scattering centers distribution etc. Versatile radar signals can be used in the measurement system, and the working frequency band and bandwidth are changeable, therefore, it is necessary for the design to update signal processing algorithms. The tradeoffs will be analyzed for measurements, the SDR measurement platform is designed. In the end, some characteristics of a complex target will be showed by experimental data [C724]

"New Method for the Simulation of Coherent K-distributed Clutter"

In this study, a new method for the simulation of coherent K-distributed clutter is presented. This method is based on the principle of each quadrature component of K-distributed clutter can be modeled, exactly or approximately, by a weighted sum of products of two independent Gaussian variables. This method can generate correlated coherent clutter with arbitrary complex ACF (autocorrelation function). At the same time, compared with the classic methods ZMNL (zero memory nonlinear) and SIRP (spherically invariant random process), it doesn't need solving nonlinear equations, so the algorithm complexity is decreased dramatically [C725]

"Feasibility of Extracting Sea Surface Current by Onboard HF-SAR"

On the requirement of extracting sea surface current information by a single station, we try to apply synthetic aperture technique to HF surface wave radar, present the new concept of HF surface wave SAR (HF-SAR), and consider the feasibility of extracting sea surface current by HF-SAR in this paper. Firstly the composition and implementation aspects are described, then system model and velocity estimation algorithm are designed, and finally simulation model to extract surface current is implemented on a single resolution cell. Additive complex Gaussian noise is included in the model of SAR echo signals. Simulation results show that by properly choosing the size of a resolution cell in azimuth direction, and estimating Doppler centroid and Doppler rate from azimuth echoes, the velocity estimation of surface current is derived, and the precision is enough to meet the requirements. It indicates that HF-SAR is theoretically feasible to be used in sea surface current extraction [C726]

"Ray-based Simulations of Received Signals from Ground Penetrating Radar"

Numerical simulation of ground penetrating radar (GPR) signals is potentially valuable in both survey design and data interpretation. We develop a method for numerically synthesizing GPR received signals using geometrical ray theory. The GPR reflected ray tracing scheme is implemented using wave front expanding method, based on Fermat's principle, reciprocity principle, and Dijkstra's shortest path algorithm. This method is good for complex layered models with inhomogeneous material and undulate interfaces, and can trace all reflected ray paths from one non-planar interface at one time, for a pair of source and receiver. Simulation experiments show it is effective [C727]

"Target Detection in Long Duration Energy Integration by Time-Frequency Distribution and Morphological Filtering"

A new energy integration detection scheme is proposed to detect a nonlinear frequency modulate (FIM) embedded in strong complex additive white Gaussian noise (CAWGN). In this scheme, the optimal kernel of

Cohen's time-frequency distribution (TFD) is designed to realize local coherent integration of a signal. Thresholding and morphological filtering are used to extract the time-frequency (TF) support region of the signal from the TFD of an observation. Simulated results show that in the strong noise background with low ratios of signal to noise (SNR) the proposed method is effective [C728]

"Target Detection with Adaptive Power Regression Thresholding for HF Radar"

High frequency (HF) radars are capable to detect and track targets at extremely long ranges. But the signal environment that includes external noise, different kinds of clutter and interference will significantly limit the detection performance and system capability. This paper considers a new approach to solve the target detection problem in a complex HF radar signal environment. It uses a conventional constant false-alarm-rate (CFAR) detection procedure but the thresholding scheme is based on regression analysis of power spectrum values along range and Doppler cells. The CFAR detection test rule was combined with a local peak determination procedure. The proposed detection scheme has been tested using real HF radar data and gave very promising results [C729]

"Accelerated GRECO based on GPU"

Graphical electromagnetic computing (GRECO) is implemented by programmable pipeline of modern GPU (graphics process unit) to obtain the electromagnetic scattering of complex target. The speed of the simulation is improved up to 20 times compare to the raw GRECO. The ray tracing algorithm based on GPU is applied to obtain the contribution of multiple scattering of target with concave structure [C730]

"A New Approach of Target Identification Using Enhanced Radar Range Profiles"

Due to the aspect dependence of high resolution range profiles (HRRPs), traditional radar HRRPs target identification (ID) methods usually use averaged or weighted HRRPs as an aspect template. A major shortcoming is that HRRPs cannot provide information about target's cross-range. In this study, we present an application of statistics method on complex radar targets. The enhanced HRRPs extracted by this method were used in radar target identification. It is shown from simulation results that identification performance can be improved greatly by using the enhanced HRRPs features combined with a two-stage fuzzy classifier. [C731]

"MAP Filtering for SAR Images Based on Heavy-Tailed Rayleigh Modeling of Speckle"

Traditional Rayleigh distribution cannot accord with the heavy-tailed statistics of speckle because of the use of central limit theorem. In this paper, speckle in synthetic aperture radar (SAR) amplitude image is modeled as heavy-tailed Rayleigh distribution based on the non-Gaussian assumption of complex echo in each resolution cell, and the maximum a posteriori (MAP) filter is presented using gamma prior distribution. Based on Mellin transform, parameters of heavy-tailed Rayleigh distribution are estimated from the observed image. The de-speckling experiments and their quantitative measures demonstrate that the MAP filter based on heavy-tailed Rayleigh modeling of speckle owns higher capability of noise suppression compared to the one using the traditional Rayleigh distribution and the linear minimum mean square error (MMSE) filter. [C732]

"A Novel Sorting Method of Radar Signals Based on Support Vector Clustering and Delaminating Coupling"

Modern electronic warfare faces complex and dense pulses environments, which brings a severe challenge to radar signal sorting. A novel sorting method is presented based on delaminating coupling and support vector clustering (SVC) in this paper. The 3-dimension feature information is composed of direction of arrival, radio frequency and pulse width in this method which sorts radar pulse sequences for the very first time by employing support vector clustering and delaminating coupling. The experiment result shows that the method can sort efficiently radar signals in the complex pulses environment and the performance is superior to that of K-means clustering sorting [C733]

"An Efficient Implementation of the Nearest Neighbor Based Visual Objects Tracking"

An independent visual objects tracking is less reliable than the data association of visual objects tracking. This paper describes a tracking method based on the nearest neighbor (NN) data association, which serves lower computational than do the multiple hypothesis tracking (MHT) or the joint probabilistic data association filter (JPDAF) but gives low reliability, if the number of targets is increased. This reliability can be increased by selecting appropriate visual object model. To obtain low computation while capable of handling non-rigid object, we propose an object model which combines the threshold of accumulated object region and the object bounding box. The elements of the association matrix are the distance function that is proposed as a mixture of object

models of distance function. The combinations of object models of distance function are important mechanism for determining appropriate state of object correspondence which can be divided into six groups: updated track, missing track, newly track, grouped track, merged track and complex track. The missing track is solved by the track life time criterion while the grouping, the merged and the complex track are resolved by using the proposed NN algorithm again. The experimental results are correctly shown on various situations of correspondence problem from surveillance image sequences [C734]

"Single Camera 3D Lane Detection and Tracking Based on EKF for Urban Intelligent Vehicle"

Road boundary detection and tracking is an important and integral function in advanced driver-assistance system. This paper proposes an algorithm, which can follow multi-kinds of lane, straight and curved, quickly and robustly. The algorithm uses several masks to extract blobs of road markings, combining with KNN function to remove the disturbance. Further more, road is modeled as a 3D surface, and some important parameters of current lane are provided on real-time by tracking based on Extended Kalman Filter (EKF). The results of experiments, which have been done in urban road, show that the algorithm is adapted to many road conditions. Even in a complex driving environment, it also has a good performance. [C735]

"Study of the Influence of Vessel Motions and Sea-Ship Interaction on Classification Algorithms Based on Single-Pass Polarimetric SAR Interferometry"

This paper analyzes the worsening effects the sea surface can induce on vessel classification algorithms working with SAR imagery. Two issues will be tackled, the complex motion history of ships and the polarimetric scattering mechanisms generated by the sea-hull interaction. Both can modify the information that allows to infer the geometry of ships dropping the classification capability. The current analysis will introduce a new classification approach based on polarimetric SAR interferometry that presents a low sensitivity respect the main distortions caused by the sea surface. Simulated SAR images obtained from GRECOSAR, a SAR simulator of complex targets, will show trustworthy vessel classification almost independent on the environmental conditions could be possible for incoming system configurations as Tandem TerraSAR-X. [C736]

"The Gradient Structure Tensor as an Efficient Descriptor of Spatial Texture in Polarimetric SAR Data"

In this paper, the analysis of spatially nonstationary texture from polarimetric SAR data is studied. A previously introduced model named Anisotropic Gaussian Kernel (AGK) was shown to be a pertinent descriptor of local orientation and allowed a simple representation of the complex spatial structure in SAR images. Here, two methods for the estimation of the model parameters are proposed. The first one is an enhancement of the previously developed algorithm and the second one is a new approach based on the Gradient Structure Tensor (GST) operator. These two methods are employed to analyse texture in PolSAR intensity channels. [C737]

"Self-organizing Neural Networks for Unsupervised Classification of Polarimetric SAR Data on Complex Landscapes"

This paper refers to a study on the pixel-by-pixel unsupervised classification of a polarimetric SAR image of a Central Italy landscape. The polarimetric data have been processed by self-organizing neural networks to test their performance in classifying a complex landscape. The discrimination accuracy attained by the self-organizing map method is compared both against that of H/A/alpha-Wishart unsupervised procedure and of a supervised scheme. [C738]

"Real-time synthetic aperture imaging: opportunities and challenges"

Synthetic aperture (SA) ultrasound imaging has not been introduced in commercial scanners mainly due to the computational cost associated with the hardware implementation of this imaging modality. SA imaging redefines the term beamformed line. Since the acquired information comes from all points in the region of interest it is possible to beamform the signals along a desired path, thus, improving the estimation of blood flow. The transmission of coded excitations makes it possible to achieve higher contrast and larger penetration depth compared to "conventional" scanners. This paper presents the development and implementation of the signal processing stages employed in SA imaging: compression of received data acquired using codes, and beamforming. The goal was to implement the system using commercially available field programmable gate arrays. The compression filter operates on frequency modulated pulses with duration of up to 50 mus sampled at 70 MHz. The beamformer can process data from 256 channels at a pulse repetition frequency of 5000 Hz and produces 192 lines of 1024 complex samples in real time. The lines are described by their origin, direction, length and distance between two samples in 3D. This parametric description makes it possible to quickly change

the image geometry during scanning, thus enabling adaptive imaging and precise flow estimation. The paper addresses problems such as large bandwidth and computational load and gives the solutions that have been adopted for the implementation. [C739]

"Waveform Design for First Generation CASA Testbed"

The first testbed of X-band radar systems deployed by the Center for Collaborative Adaptive Sensing of the Atmosphere (CASA), in central Oklahoma called IP-1 (Integrated Project 1) will have a low unambiguous velocity due to their short wavelength, and increasing the PRF will result in multiple trip overlays since storms can extend over a large distance. The range-velocity ambiguity is more severe for X-band radars compared to the conventional S-band. However, low cost radars limit the ability to support complex waveforms due to hardware requirements. In addition the radar observations at short ranges are contaminated by ground clutter. This paper describes the waveforms for the individual radar nodes based on operational requirements such as scan speeds, volume coverage pattern and system/hardware limitations to resolve range and velocity ambiguities along with clutter suppression. [C740]

"A Processing Detection Project Research of Weak Targets in the Complex Ground Clutter"

The paper present a project of improving the weak targets detection capability in the complex ground clutter at the same time maintaining the hardware's simplicity for the air-ground millimeter-wave terminal guidance radar. The project use the wide band chirp-subpulse stepped-frequency signal to detect targets, and get the target region's quasi two dimension image by processing the echo signal both in the time and frequency domain, thereby improving the weak target detection capability and providing the real guidance information. The theoretical analysis and computer simulation result proved the project's validity. [C741]

"New Method of Velocity Compensation in a Stepped-Frequency Testing Radar"

A solution on velocity compensation for a dual-channel stepped-frequency testing radar is presented. The target's radial velocity was estimated real-timely by using high resolution range profiles of the target from two bands respectively, and then compensation was carried out to get the target's real location for automatic target range tracking. An effective method to calculate target's real location avoiding complex computation in direct compensation procedure is discussed. Experimental results are also given and analyzed in this paper. [C742]

"Optimization in the Complex Domain for Nonlinear Adaptive Filtering"

We present a framework that greatly simplifies the evaluations and analyses for optimization in the complex plane through the use of a generalized definition of analyticity. We derive the gradient, the relative (natural) gradient, Newton, and Newton variation updates by using this result and demonstrate its application in system identification using linear and multi-layer perceptron filters. [C743]

"Maximum Likelihood Estimation of Range of Polynomial Amplitude Modulated Complex Scatterers"

We analyze the maximum likelihood estimator (MLE) of range from frequency samples of a radar return consisting of a superposition of complex scatterers whose amplitude have a polynomial amplitude dependence in frequency. Such scatterers arise from target components that contain edges, like flat plates, dihedral and trihedral reflectors, cones, cylinders and other basic geometric shapes. When the MLE of the linear prediction coefficients is used to estimate the scatterer's range, assuming constant amplitude, very closely spaced roots arise from the linear prediction polynomial. The mean square error (MSE) of the multiple root, corresponding to polynomial amplitude dependence, is computed in closed form in the presence of noise. A better approach is to constrain the linear prediction coefficients to account for the multiple roots while doing maximum likelihood estimation of these coefficients. Its mean square error performance is given by the corresponding Cramer-Rao bound (CRB), is computed for the repeated root sinusoids and is shown to be significantly more accurate than the MSE of the distinct(non-repeated) roots model. [C744]

"Precipitation Spectral Moments Estimation and Clutter Mitigation using Parametric Time Domain Model"

In this study the problem of precipitation signal spectral moments estimation in case of clutter contamination is considered. It is proposed to use a parametric model to estimate spectral moments of precipitation echoes and clutter. To estimate these spectral moments the maximum likelihood estimator based on the properties of Gaussian joint distribution of complex time series is used. The main advantage of this approach is that it does not suppress any part of the signal and the properties of weather echoes and clutter are estimated

simultaneously. The performance of the proposed method is evaluated based on simulations of radar signals and compared to the performance of GMAP (Gaussian model adaptive processing). The proposed procedure is also applied to measurements collected by CSU- CHILL radar collected during summer 2004. [C745]

"The lower characteristic ELF altitude of the Earth-ionosphere waveguide: Schumann resonance observations and aeronomical estimates"

Propagation of ELF fields in the Earth-ionosphere waveguide is treated in terms of a two-dimensional method with two complex characteristic altitudes as actual propagation parameters. The day-to-night variations of the lower characteristic altitude are estimated in two different ways: theoretically, on the basis of the parameter's physical model and representative day- and night-time conductivity profiles for the lower ionospheric D-region, and experimentally, from systematic observations of the background electromagnetic signal in the Schumann resonance (SR) frequency range. A simple technique for considerably eliminating undetectable factors (the average current moment, the ionospheric properties over sources, etc.) and smoothing resonance effects in experimental data is applied. It is found that theoretical-aeronomical and experimental estimates are in a reasonable agreement, showing an approx. 20 to 25% day-to-night increase in the lower characteristic altitude within the lower SR frequency range (SR I to III). [C746]

"Evaluation of the ESPRIT approach in polarimetric interferometric SAR"

This paper presents a first evaluation of the ESPRIT approach in polarimetric interferometric SAR. This evaluation is carried out by using 3D images obtained by SAR tomographic like an alternative to the acquisition of ground-truth data, which is an extremely complex task in the case of volume areas. All parameters over a volumetric area are directly visible in a tomographic image and can, therefore, be employed to validate the ESPRIT approach by comparing parameters generated by ESPRIT and the SAR tomography approach. This allows to identify the principal deficiencies of the ESPRIT method, which occur over high vegetation areas, where there is a misinterpretation of the ESPRIT results. Whereas, the ESPRIT approach is useful for building characterisation, identifying a good applicability area. Airborne L-band repeat-pass interferometric data of the German Aerospace Center (DLR) experimental airborne SAR are used to perform this evaluation. [C747]

"Combining capon and APES noise covariance estimates for spectral estimation for ISAR applications"

Techniques concerned with the problem of complex spectral estimation are of great importance to many modern applications, one of which is the inverse synthetic aperture radar (ISAR) imaging, In this paper we study a variation of the non-parametric Amplitude and Phase Estimation of a sinusoid (APES) method that is produced by a parameterization of its noise covariance matrix Q. Computer code using the MATLAB software was produced for the study of the modified estimator and numerical examples using 1-D synthetic data are presented to demonstrate several of its properties. [C748]

"Validation of complex naval target models using superresolution imagery methods"

The main purpose of the paper is to propose a framework for validating radar target models using superresolution imagery methods. The need for realistic target models becomes more and more imperative as the radar technological capabilities and the signal processing techniques are continually improved. Simple scattering configurations, such as a set of well resolved scattering centers, where no geometrical visibility or secondary reflections are taken into account, are going to become completely inappropriate. A complex target model is considered in the paper, the simulated backscattered signal being obtained via the "simplest component method". The target's body is described by a set of elementary geometrical surfaces, whose reflection characteristics are known. Superposing partially scattered signals provides the global echoed signal. This way, a direct and natural link with ship's physical structure is implemented. Geometrical visibility but also interferences between components are also considered. A superresolution technique (MUSIC-2D) is then used, in order to validate the proposed model. [C749]

"Three-dimensional ISAR image reconstruction technique with multiple receivers"

In this work a new three-dimensional (3-D) model of deterministic components of ISAR trajectory signals with linear frequency modulation is suggested. 3-D ISAR geometry is described based on the analytical geometrical approach. The geometry and kinematics of the object and ISAR observation system are described in separate 3-D Cartesian coordinate system. The object space, moving rectilinearly, is presented as a 3-D regular grid of isotropic point scatterers. The analytical expressions for computing the range distance to point scatterers of the object space are derived. The complex ISAR signal, reflected from the 3-D target is obtained by four receivers,

placed on the axes and origin of the coordinate system of observation. Four 2-D ISAR signals, registered by receivers appear to be four 2-D projections of the 3-D ISAR signal. The 3-D image is considered as a set of 2-D images retrieved from the 2-D ISAR signal projections. The image reconstruction procedure includes both range and azimuth compression. Fast Fourier transforms are applied to each 2-D ISAR signal projection to realize range compression and azimuth compression. A synchronized range alignment and an autofocusing technique are applied to each received ISAR signal projection. To illustrate the capability of the 3-D ISAR signal model numerical experiment is accomplished. [C750]

"Level set curve evolution partitioning of polarimetric images"

We investigate a method of segmentation of multichannel polarimetric images, such as in laser illuminated or synthetic aperture radar, into a given but arbitrary number of regions via curve evolution and level sets. The algorithm consists of evolving closed curve, within an explicit correspondence between the interiors of curves and regions segmentation, to minimize a multivariate criterion corresponding to the complex Gaussian polarimetric model and a term of smoothness of the boundaries of regions. Results are shown on a polarimetric image. [C751]

"Improving tracking accuracy using information of dissimilar sensors"

Making use of information acquired from a sensor network to improve the accuracy of target tracking is one of the most important issues in sensor network research. This paper demonstrates this philosophy using a distributed dissimilar sensor fusion scenario, where a tracker was established and maintained by a surface radar sensor and the distributed sensor fusion is performed whenever target measurement from an angle-only sensor is available to the radar sensor. The target state information is extracted from the angle-only sensor measurement so that the distributed track fusion at radar sensor can be performed. The extended Kalman filters (EKF) have been used to implement all tracking functions due to the nonlinearity between target state and the associated sensor observations. The scenario is conveniently implemented using advanced radar tracking system (ARTS) toolbox in Matlab Simulink environment. Our simulation results have shown the improvement of the (racking accuracy bv applying distributed track fusion. The convenience of using ARTS toolbox for complex algorithm implementation and testing are also clear from the context. [C752]

"Coherence estimation from complex coherence map using second kind statistics"

The sample coherence magnitude estimation, computed on a window basis, depends on the number of independent samples and theoretical coherence. Classical methods for sample coherence computation are based on probability density function (pdf) model for estimating regular moments (first kind statistics) defined with the Fourier transform. The proposed approach is based on the same pdf model but for computing "second kind statistics" defined with the Mellin-transform. The result performances of this new log-moment (based on the Mellin-Transform) estimator was presented by the authors in R. Abdelfattah and K.M. Nicolas (2003). This paper presents a generalization of the second kind statistics coherence magnitude estimation approach from a complex coherence maps such as interferometric synthetic aperture radar (InSAR) data. The new developed algorithm is much more less biased than existing ones. [C753]

"Performance comparison of indoor positioning techniques based on location fingerprinting in wireless networks"

Appropriate and correct indoor positioning in wireless networks could provide interesting services and applications in many domains. There are time of arrival (TOA), time difference of arrival (TDOA), angle of arrival (AOA), and location fingerprinting schemes that can he used for positioning. We focus on location fingerprinting in this paper since it is more applicable to complex indoor environments than other schemes. Location fingerprinting uses received signal strength to estimate locations of mobile nodes or users. Probabilistic method, k-nearest-neighbor, and neural networks are previously proposed positioning techniques based on location fingerprinting. However, most of these previous works only concentrate on accuracy, which means the average distance error. Actually, it is not enough to measure the performance of a positioning technique by the accuracy only. A comprehensive performance comparison is also critical and helpful in order to choose the most fitting algorithm in real environments. In this paper, we compare comprehensively various performance metrics including accuracy, precision, complexity, robustness, and scalability. Through our analysis and experiment results, k-nearest-neighbor reports the best overall performance for the indoor positioning purpose. [C754]

"ICA by Maximization of Nongaussianity using Complex Functions"

We use complex, hence analytic, functions to achieve independent component analysis (ICA) by maximization of nonGaussianity and introduce the complex maximization of nonGaussianity (CMN) algorithm. We show that CMN

converges to the principal component of the source distribution and that the algorithm provides robust performance for both circular and non-circular sources [C755]

"One-dimensional model-based approach for ISAR imaging"

In this paper, we extend the estimation of scattering centre parameters to the case of ISAR imaging. The representation of a target by a set of individual scattering centres has shown promising results for applications where high resolution is needed (high-resolution imaging, classification, NCTR). In practice, methods extract time-delay and amplitude parameters associated with strong scattering sources from complex-valued reflectivity samples in the frequency domain. The principle has been successfully applied with samples from one or several segments. We show that a one-dimensional model can be used to create a two-dimensional ISAR image. After presenting the principle of ISAR matrix data collection and processing, we propose two methods for building the ISAR model matrix. We show that the technique processing the Doppler information first is more suitable for building ISAR-Model. As an example, we consider the case of a corrupted data matrix, which can be restored by coherently processing sparse sub-bands. Samples from a simulated Mig25 are used to illustrate the technique. [C756]

"Synthetic aperture radar (SAR)-based mapping of wildfire burn severity and recovery"

New radar based techniques for efficient identification of forest damage caused by wildfire and subsequent recovery are applied to data acquired over the 2002 Rodeo-Chediski, Arizona and 1988 Yellowstone National Park wildfire complexes. Fully polarimetric C-, L- and P-band airborne synthetic aperture radar data were acquired in approximately east-west and north-south swaths over the northern half of the Rodeo-Chediski wildfire scar on August 1, 2002, 25 days after the last active fire was contained. The AIRSAR instrument also acquired fully polarimetric data in C-, L- and P-band over Yellowstone on October 11, 1994, approximately 6 years after the event. We combine single frequency polarimetric parameters in composite images for optimal identification of fire-induced damage to the forests. For the Rodeo-Chediski fire, we demonstrate that polarimetric parameters-such as average scattering mechanism-readily identify bare surfaces, pine trees with intact needles, trees with exposed branches, and trees with residual burned trunks. In particular, a single-pass of polarimetric SAR provides identification of the perimeters and within-burn variability. This work shows that fully polarimetric SAR is sensitive to scattering changes wrought by wildfire in two types of predominantly coniferous forests. By extension, this technique should help quantify different degrees of burn severity in ecosystems where the canopy is altered. We anticipate that these results will provide a new method of responding to wildfires, perhaps even at the tactical fire-fighting level. [C757]

"Complex object's ISAR image simulation"

{no data available} [C758]

"A complex of polarimetric, combined, short pulse radar-radiometers of S-, Ku, and Ka -band of frequencies for platform and vessel application"

{no data available} [C759]

"Analysis of the unbiased complex coherence estimation using varying ERS interferometric data"

{no data available} [C760]

"Multidimensional superresolution ISAR reconstruction techniques in sea-cluttered environnement"

For high-resolution radars (as the ones used for radar imagery tasks are), sea clutter is difficult to characterize, especially for low grazing angles. According to the physical model of sea surface, the echo signal is best described as the product of a Gaussian process, with rapid variation (the speckle component), and of a slow varying component (the underlying component). The K-compound distribution is used for the statistical characterization of the clutter echo. Standard target complex signature simulations techniques (based on the well-known scattering center model or using geometric primitives) are combined with synthetic sea clutter, allowing us to generate realistic signals. The MUSIC 2D super-resolution reconstruction method, presented in the paper, is used to generate ISAR target images. A comparative study of robustness of MUSIC and Fourier type images is then performed. The obtained results show the validity of both clutter simulation engine and super-resolution reconstruction methods. The problem of naval targets, subject to particular simulation conditions, is also discussed in detail. [C761]

"Hidden Markov models for radar pulse train analysis in electronic warfare"

We present a new approach to radar pulse train analysis in electronic warfare. We consider an alternative to the classical time-of-arrival (TOA) histogram technique commonly used for extraction of complex pulse patterns. We derive a hidden Markov model for the radar word templates, and develop a modified version of the Viterbi algorithm to extract radar words from noisy and corrupted pulse sequences. We argue the advantages of this approach compared to the standard TOA histogram technique, and illustrate operation of the algorithm with computer simulation results. [C762]

"Scattering centre extraction for extended targets"

In this paper, we consider the estimation of scattering centre parameters for the case of extended targets. In general, models are tested on synthetic targets made up of few scatterers. This choice is imposed by the maximum model-order assumed by the method. It is limited by the rank of the observation matrix and by the noise which corrupts the signal subspace. However real-world systems have to deal with complex targets such as aircrafts. For this reason, we revisit the theory for the case of targets made up of a large number of scatterers. We present a novel method for selecting poles corresponding to true physical scatterers. Finally, we propose a technique for reducing the model order based on a modification to the ISAR technique. The resulting 2D-model results in lower noise compared to traditional techniques and can be used for pole selection, data compression, image enhancement and high resolution ISAR-imaging. [C763]

"Estimation of range-dependent clutter covariance by configuration system parameter estimation"

The range-dependent nature of the surface clutter power spectrum observed in monostatic or bistatic airborne radar systems results in a mismatch of the clutter covariance matrix (computed from a secondary set of range-cell data) relative to that of a possible target test cell, with attendant degradation of space-time adaptive processing (STAP) performance. In this paper, we develop a new method for predicting the test cell clutter covariance matrix by estimating the configuration system parameters that directly influence the clutter power spectrum. The method uses a multiple complex sinusoid model whose parameters are related to the configuration system parameters, which are then optimized to match the radar return pulse-train data in a least-squares sense. The estimated configuration parameters are then used to predict the clutter covariance matrix in the test cell, which is then used with traditional STAP methods. Computer simulation results are presented that demonstrate the significantly improved STAP performance obtained by the method developed here compared to the conventional method of using the sample covariance matrix estimated from secondary data. [C764]

"Cramer'r-Rao bounds for compound-Gaussian clutter and target parameters"

We compute Cramer'r-Rao bounds (CRBs) for the target and compound-Gaussian clutter parameters using radar array measurements. In particular, we compute CRBs for (i) complex target amplitudes, (ii) the spatial covariance matrix of the speckle component, (iii) texture distribution parameters. We first derive general CRB expressions under an arbitrary texture model and simplify them for gamma and inverse gamma texture distributions. We use the generalized Gauss-Laguerre quadrature to compute the CRBs for gamma texture, whereas the CRBs for inverse-gamma texture do not require numerical integration. We use numerical simulations to validate our results. [C765]

"A novel framework for quality-aware resource management in phased array radar systems"

This paper addresses the problem of operating parameter assignment to multiple real-time tasks in a phased array radar system. The objective is to maximize the resulting system utility while ensuring the schedulability of all tasks with the assigned operating parameters. For this, we propose a novel framework by integrating the existing resource management framework called QRAM (QoS-based resource allocation model) with the notion of schedulability envelope. The schedulability envelope designed offline hides the complex details of phased array antenna scheduling and provides a linear formula as its quantitative abstraction. This abstraction allows QRAM to find the optimal resource assignment without concerning the details of complex scheduling. Our experimental results show that the proposed framework can achieve significantly improved system utility compared to the existing techniques. [C766]

"Fast statistically efficient algorithms for single frequency estimation"

In this article three new estimators of the frequency of a single complex sinusoid are presented. The "rotate-add-decimate" (RAD) method of Crozier is first modified to more closely approach the Cramer-Rao bound, with the same computation. A second estimator almost achieves the CRB above an SNR threshold approximately 1dB above that of RAD. It can be shown to achieve the CRB for high SNR using log2N arctangents and 2N MAC. A

third method matches the SNR threshold of RAD and achieves the CRB at high SNR with log2N arctangents and 3N MAC. [C767]

"Two-dimensional closely spaced frequency estimation using decimation technique"

Based on the two-dimensional harmonic model, this paper studies the problem of estimating the frequencies of closely spaced complex exponentials in the presence of colored noise, and presents a new estimation approach using the two-dimensional decimation technique. By using the capability of decimation in the time domain to increase the frequency intervals, the proposed method separates the frequencies in the frequency domain, and gives the exact frequency estimation by using the cumulant based matrix pencil method. The proposed method is easy to realize and has successfully improved the performance of the existing two-dimensional frequency estimation methods in the case of closely spaced frequencies. Simulations are provided to show its performance. [C768]

"Non-self-embedding context-free grammars for multi-function radar modeling-electronic warfare application"

Multi-function radars (MFRs) exploit flexible and sophisticated software control algorithms that enable them to perform multiple functions (tracking, acquisition, range resolution and search) virtually simultaneously. They can engage multiple targets at once, and employ complex hierarchical signal waveforms to achieve these goals. From the standpoint of the field of electronic warfare (EW), MFRs present a very serious threat. Traditional EW radar signal processing algorithms are not well suited for the level of structure and complexity found in MFR signals. In this paper, we present a new MFR modeling methodology. We consider the signals from an MFR to be strings from some formal language that can be modeled by a compact syntactic representation called the non-self-embedding context-free grammar (NSE CFG). We then describe a procedure that allows conversion of such an NSE CFG model of the radar into a finite state machine. Thus, the rich and well-established theory of finite-state automata can be directly applied to the EW signal processing of MFRs. [C769]

"Netted radar and the ambiguity function"

In this paper, the key performance parameters of multistatic radar are investigated, via the netted version of the ambiguity function. A new tool has been developed for assessing the resolution and ambiguity properties for topologies assuming a radar network consisting of N transmitters and one common receiver, operating in a fully coherent or partially coherent mode. Combinations of monostatic and bistatic geometries are also considered. Simulation results outline the dependence of the multistatic ambiguity function on the relative positions of the nodes in the network and on the position of the target, but more importantly it shows the potential for enhancements in resolution and resolving ambiguities. Finally, the more complex case of N receivers and M transmitters is also developed, presenting two possible approaches for determining the overall ambiguity diagram of such a system. [C770]

"The autopolyploidy enhanced evolution of large-N fractal-random arrays"

This paper introduces a novel approach for the optimization of large-N fractal random antenna arrays using genetic algorithms. Genetic algorithms often become overwhelmed by large numbers of input parameters, leading to an inefficient optimization processes. Fractal-random geometries lend themselves well to genetic algorithm optimization through the ability to describe their complex array structures with only a small number of input parameters. In addition, the recursive properties of fractal-random arrays allow for the rapid calculation of the array factor, which can be exploited to significantly speed up the convergence of the GA. This paper describes a method that increases the number of generators used to construct the array as the optimization progresses, maximizing the benefit of using fractal-random geometries to describe large-N arrays. Several optimized solutions are discussed, the largest being a 1650 element linear fractal-random array with a -23.57 dB side-lobe level and a beamwidth of 0.05°. [C771]

"Complex spatial/temporal CFAR"

The conventional cell averaging constant false alarm rate (CFAR) criterion and its variations work well only in strictly spatially stationary environments. In non-homogeneous environments, clutter map (scan-by-scan) processing is deployed. The performance of this method degrades in the presence of slow targets. In this paper, a hybrid procedure for CFAR is proposed, which combines the advantages of both spatial and time averaging. The detection probability is derived and the related plots are given for different values of L, the number of persistence scans. A method is presented to choose the parameter of the hybrid CFAR to have the lowest self-masking effect. [C772]

"MTD detector using convolutional neural networks"

A detector based on joint time-frequency signal analysis and convolutional neural networks is proposed for radar detection in highly complex and nonstationary cluttered environments. This detector is coherent and monocell, i.e. it works with the complex envelope of the echoes from the same range cell, and exhibits joint CFAR and MTD characteristics. It includes a pre-processing time-frequency block which provides a constant false alarm rate (CFAR) behaviour regarding the clutter power when normalization is utilized. Multiple targets can be also resolved in the same resolution cell (MTD) if the neural network presents multiple outputs. [C773]

"A time domain beamforming method of UWB pulse array"

The principle of space-time processing is discussed here after a realistic UWB pulse model introduced in the paper. The problem of realization of variable delay circuits is addressed. Delay line is not enough for accurately beam steering. A digital filter method by compensating channel dispersed delay for time domain beamforming is presented here. An ideal system with fractional sample delay hat occurs in insufficient sample of UWB pulse signal is not realizable. The two filter approaches involving FIR and allpass filter are given to approximate casual and stable system with the fractional delay. The Lagrange interpolation for FIR filter and complex cepstral computation for allpass filter are examined. A comparison of UWB pulse array directivity versus conventional phased array directivity has been done. The effect of different sampling rate and noise level is discussed. In the experiment, the FIR and allpass filter with a capability of accurate propagation delay compensation improved the beamforming performance remarkably. The results indicate the feasibility and effectiveness of the method. [C774]

"Improved detection of strong nonhomogeneities for STAP via projection statistics"

In this paper, a robust statistical method called projection statistics (PS) is developed into an TV-dimensional complex form required to detect strong nonhomogeneities, or TV-dimensional outlier vectors (i.e., outliers), in space-time adaptive processing (STAP) radar training data, where N is the number of degrees of freedom (DOF) associated with the STAP scenario. The PS technique does not require the estimation of a covariance matrix, as is the case with the generalized inner product (GIP) test. Rather, it uses robust estimators of location (the median) and scale (the median absolute deviation from the median (MAD)) to identify and then excise strong nonhomogeneities in STAP training data that are capable of rendering traditional nonhomogeneity detection (NHD) techniques, such as the GIP, ineffective. Shown in the results section of this paper is sample matrix inversion (SMI) STAP performance using three separate NHD techniques: 1) a power test for high power outlier snapshots, 2) a GIP test, and 3) a PS-based test. The performance when not using any form of NHD is shown for comparison. It is clear from the results that the PS NHD method provides an SMI-STAP processor the best training data selection in the multi channel airborne radar measurements (MCARM) [B.N.S Babu et al., 1996] based radar data scenario studied here, and does so across all range cells of the scenario. [C775]

"On the use of Gedae for the implementation of multifunction RADAR applications"

The difficulty of developing multifunction radar systems is compounded by development of complex software applications. Simplifying the development of software can go a long way toward decreasing the long development schedules and latency between the availability of new hardware and the transition of that hardware to production systems. This paper discusses the features of Gedae that facilitate developing sensor systems, specifically multifunction radar systems. In the paper we show that a small number of concepts (families, data flow, segmentation, exclusion and state) provide a powerful language for expressing the functional behavior of multi-function radars. We also show that it is possible to algorithmically create an efficient implementation of the functionality on a multiprocessor system. [C776]

"Shadow boundary and truncated wedge ILDCs in Xpatch [Cradar applications]"

Recent electromagnetic formulation efforts related to the shooting and bouncing ray tracing code suite Xpatch have concentrated upon higher order diffractive phenomena such as creeping waves and the truncation effects due to diffraction from finite sized wedge faces. These classes of diffraction are essential components of the radar returns at large bistatic angles from complex, low observable targets composed of smooth, rounded surfaces. This paper explains that during 2002-2004 the shadow boundary incremental length diffraction coefficients (ILDCs) and truncated wedge ILDC formulations were implemented in Xpatch. In addition, the supporting Xpatch geometry tools were modified to support these new ILDC capabilities. [C777]

"Adaptive Radar Detection of Distributed Targets in Homogeneous Noise plus Subspace Interference"

This paper addresses adaptive radar detection of distributed targets embedded in homogeneous Gaussian noise

and interference which is assumed to belong to an either known or unknown subspace of the observables. At the design stage we resort to either the GLRT or the so-called two-step GLRT-based design procedure and assume that a set of noise-only data is available (the so-called secondary data). Detection algorithms have been derived modeling noise vectors, corresponding to different range cells, as zero-mean, complex normal ones, sharing the same covariance matrix. The common covariance matrix is unknown at the receiver. The performance assessment, carried out by Monte Carlo simulation, confirms the effectiveness of previously-proposed ones [C778]

"Coherent Change Detection for Multi-Polarization SAR"

This paper presents a solution to the coherent change detection (CCD) problem using multi-polarization synthetic aperture radar (SAR) imagery. The multi-polarization SAR imagery (i.e., the day-1 reference and day-2 test images) are modeled as jointly correlated complex Gaussian vectors with unknown correlation, rho = gammaejPhi . Maximum likelihood estimates of the unknown phase and coherence parameters (Phi,gamma) are derived. Accuracy of the MLE estimates is evaluated; and the benefit of using multi-polarization data versus single-polarization data is quantified [C779]

"UWB radar for human being detection"

UWB radar for detection and positioning of human beings in complex environment has been developed and manufactured. Novelty of the radar lies in its large operational bandwidth (11.7 GHz at -10 dB level) combined with high time stability. Detection of respiratory movement of a person in laboratory conditions has been demonstrated. Based on experimental results human being radar return has been analysed in the frequency band from 1 GHz till 12 GHz. Novel principle of human being detection is considered and verified experimentally [C780]

"Imaging of stepped frequency continuous wave GPR data using the Yule-Walker parametric method"

Ground penetrating radar for humanitarian demining has a large bandwidth. It should discriminate small objects against a complex background. The stepped frequency continuous wave radar of IRCTR has a synthesized bandwidth of 4.5 GHz. Classical methods for generating an image of the subsurface include synthetic aperture processing for cross-range resolution and inverse Fourier transform to generate the range profile. This paper presents a novel scheme, based on Yule-Walker auto regression. This method is widely known as an estimator of the power spectral density based on time domain signals. But here it is interpreted as an estimator of the range profile based on frequency domain signals. The result is a significantly improved detectability and range-resolution if the signal is not too weak. The paper presents some results on the effect of the order of the Yule Walker model and a comparison with the MUSIC method [C781]

"SAR image processing algorithms based on the ambiguity function"

This work focuses on hardware implementations of the ambiguity function defined in terms of signal operators for synthetic aperture radar (SAR) sensor image formation applications. Due to the large quantity of data associated with SAR imaging, basic SAR operations demand high computational cost and are difficult to readily implement on existing commercial digital signal processing (DSP) units. In order to contribute to resolve this problem a search for new efficient algorithm variants in under way compute operations such as discrete Fourier transforms, discrete convolutions, discrete correlations, and Hadamard products of complex signals. These operations are commonly used in the computation of the discrete ambiguity function. Time-frequency tools have been the object of many different studies in SAR image formation operations. The principle behind SAR image formation is recovering a desired reflectivity density function through an inverse convolution process on the raw data generation. It is this particular fact that makes the ambiguity function so important in SAR image formation since it serves to model the impulse response function or point spread function of the SAR system itself. Algorithms for computing the ambiguity designed for this work are being developed in MATLAB and implemented the TMS320C6713 digital signal processor (DSP) unit. The implementation methodology is based on hardware/software algorithm co-design techniques, taking into consideration software and hardware characteristics such as memory cache overflows, twiddle or phase factor pre-computations, extended memory addressing schemes, stride permutation implementations, pipelining schemes, multiply-add DSP architectures, multiple concurrent memory accessing schemes, and overall latency response. [C782]

"A risk-based object-oriented approach to sensor management"

Sensor systems play a critical role in providing situational awareness and threat assessment. Management of adaptive multifunction radars and sensor suites in today's combat systems is mostly based on an operator-

defined set of priorities. Such a set can be very complex and requires a thorough understanding of the sensor capabilities and performance and of the operational needs. Changing such a set in strongly varying scenarios is prone to creation of sub-optimal system performance. In this paper a novel approach to assigning priorities to individual objects in the environment of a naval vessel is presented. This priority assignment is accomplished by means of dynamic evaluation of the risk imposed by each object with respect to the completion of the mission. More in particular a three-stage sensor management system is proposed that first uses the uncertainty related to each object's attributes, such as the state vector, classification and identification to determine the allocation of surveillance, track or recognition tasks. The sensor manager then selects the most appropriate sensor for the task and finally distributes the available time budget based on priorities in case of multiple tasks. The risk is estimated by a dynamic Bayesian network modeling relevant operational knowledge. The nodes in this DBN represent the different object states in time and the events leading to them. A computer simulation was developed to prove the viability of this concept. [C783]

"The impact of tropospheric propagation on data fusion from multiple radars"

Data fusion from spatially separated radars is increasingly being considered within network centric warfare to mitigate complex threats. Propagation of signals from spatially separated radars through differing atmospheric environments, however, can introduce significant errors in target positioning and ranging. For example, simulations illustrate that two radars separated by 100 km viewing the same single target through different tropospheres could place the single target in positions separated by over 200 m. Attempts at fusing the data and resolving the information into a single object could result in operational deficiencies due to classification and discrimination errors. Additionally, anomalous propagation conditions such as tropospheric ducting can lead to radar coverage holes and hence the perception of faulty radars and system level fusion errors. These errors must be characterized and, as far as possible, eliminated if the operational effectiveness of cooperative radar engagements and capabilities are to be optimized. This paper illustrates the type and magnitude of these errors, and their likely impact on system level fusion. The architecture of a potential correction system is outlined. [C784]

"Context fusion for driveability analysis"

Driveability analysis is a quite complex problem that for its solution depends on several factors. One of these factors concerns the type of vehicle for which a drive-way should be determined. Besides this, the terrain structure, the type of vegetation but also the ground type and its conditions play important roles. Driveability analysis will consequently include analysis of primarily geographical information and the outcome of this analysis can be used to support decision making in command and control systems. However, quite often the required geographical information is represented in a resolution that is either too low and/or is represented with a high degree of uncertainty that cannot be neglected. In this work, an approach to driveability analysis is presented in which geographical information is regarded as context information that eventually is fused to generate paths, that may be drivable for certain types of vehicles. This information is fused by means of a knowledge-based technique that determines the driveability from a set of qualitative driveability impact factors. [C785]

"Surveillance by means of a random sensor network: a heterogeneous sensor approach"

A distributed approach to the surveillance is presented. A clustering architecture is modelled and the behavior of the corresponding heterogeneous random network with self-organizing capability is investigated. Two types of sensors, simple and complex, spread out over the surveillance area. Simple sensors can only compute binary information (yes or no detection); complex sensors, instead, are able to form a target track. A two-way efficient local communication among sensors is hypothesized. From it, a global coherent behaviour of the network emerges, and the resulting network is able to track the moving objects. Benefits and drawbacks of our solution are analysed by means of Monte Carlo simulations. [C786]

"A measuring complex of polarimetric, combined radar-radiometers of S-, and Ku-band of frequencies for vessel and airborne application"

A complex of polarimetric (dual polarization), combined active-passive devices of S (3 GHz), and Ku-band (20 GHz) of frequencies for sea surface microwave reflective and emissive characteristics simultaneous and coincident measurements is presented. The complex is dedicated to solve the problem applied to near sea surface wind and surface wave fields' parameters precise and unambiguous retrieval, as well as for sea surface signatures detection and identification. Developed systems are set on a mobile bogie moving on the height of 6.5 m along a stationary platform of 26 m of length. The measuring platform allows carry out polarimetric (vv, vh, hh, hv), multifrequency, simultaneous and coincident measurements of pool water surface microwave reflective and emissive parameters at the same or at various angles of incidence from the while of 0-60°. This paper has an

aim to attract attention of researchers interested in measurements by such kind sensors and to invite them to perform their own or joint measurements using available microwave devices and in-situ and calibration facilities. [C787]

"Analysis of instability of compressed signals parameters in radar systems"

The main tactic-technical characteristics of the radar are defined to a considerable extent by parameters of sounding signal and by their processing system. Realization of potential tactic-technical characteristics of the radar with chosen signal parameters and processing system depends in the first place on stability of signals. In this case, it is expediently to take into account the following signals instability sources: former of sounding signals, sounding signals power amplifier, amplifying-converting section of receiving device, optimal filter (filter of compression) of a complex signal. [C788]

"Height estimation on wideband synthetic aperture sonar: experimental results from InSAS -2000"

This paper presents an improved method of performing relative height estimation using sidescan sonar images collected from two vertically separated receiver arrays. Delay estimation on image sub-swaths by utilising the phase of the complex cross-correlation function is described. We suggest to beamform the images in ground range to reduce baseline decorrelation and footprint shift effect. The authors have also developed a new geometrical description for the height estimation. The improved height estimation technique is tested on experimental data from a wideband interferometric synthetic aperture sonar, operated in a rail experiment at Elba Island, Italy. [C789]

"Bathymetry of shallow coastal regions derived from space-borne hyperspectral sensor"

Hyperion is a hyperspectral sensor on board NASA's EO-1 satellite. Its spatial resolution is about 30 meters with a swath of 7 Km. Though Hyperion was not designed for ocean studies, its unique spectral configuration (430 nm-2400 nm with a 10 nm step) makes it especially attractive to study the effectiveness of such kind of sensor for observing complex coastal waters. In this study, Hyperion data over two sites of the Florida coasts were acquired, with one focused on the clear Key West waters, and the other focused on the relatively turbid Tampa Bay waters. From both data sets, water properties and bottom bathymetry were simultaneously derived from atmosphere-corrected Hyperion data using a spectral matching technique. More importantly, in the top-to-bottom processing of Hyperion data, there was no use of any a prior or ground truth information. For the Key West site, derived bathymetry and water properties were validated with NAVOCEANO CHARTS (active bathymetric LIDAR system) and field measurements, respectively. It is found that the retrieved depths (in a range of 1-20 m) match LIDAR depths very well (15% average error), indicating significant potential of using hyperspectral satellite sensor for efficient and repetitive observation of shallow coastal regions. [C790]

"Adaptive algorithms for Doppler weather radar"

New complex adaptive algorithms of detection and measurement of turbulence intensity in weather formations are proposed. Algorithms are based on calculation of spectrum estimations by using the signals reflected from the adjacent range bins. Statistical hypothesis about the difference between the adjacent or next spectra are checked. The decision-making on distinction of spectra is done by the estimation of RMS velocities of Doppler spectra. Serviceability and efficiency of new algorithms proves to be true by using statistical modeling as well as by processing real signals of weather radar. [C791]

"Enhanced C2 functionality in urban and other complex terrain"

The army's network centric warfare concept is focused on enhancing the army's capabilities in information dominance. Network centric warfare is realized through command and control (C2) systems such as the army battle command systems (ABCS) supported by developing tenet technologies, such as networking, communications and positioning. Fundamental to successful C2 systems is the ability to maintain current situation awareness (SA) information through the tenet technologies. Maintaining current SA information, for enhanced C2 functionality, requires continuous and timely position information from all relevant platforms on the battlefield. The accuracy and availability of position information directly affects operational effectiveness. The traditional role of positioning was for "own ship " pilotage. That is, "can I get from point A to point B? " It is important to note that utilization of position information, as a shared resource is an evolving role from the traditional role of positioning systems, which increases the utility and importance on position information quality and availability derived. The predominate source of that position data is the NA VSTAR global positioning system (GPS). GPS provides a common consistent coordinate reference. GPS accuracy does not degrade with time or distance traveled as self-contained navigation units e.g. inertial navigation units (INU) or Doppler radar navigation sets. In addition, GPS receivers are significantly less expensive to integrate, operate and maintain

than INU's or Doppler's. However, GPS has vulnerabilities to electromagnetic interference (EMI) and satellite signal blockage in urban and complex terrain. Technology initiatives are being concentrated to investigate sophisticated integration techniques of combining externally aided and self-contained navigation systems. This paper addresses urban navigation requirements, urban navigation challenges and recent/new technology initiatives to improve the robustness of p--osition information for the dismounted warfighter [C792]

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"Sampling in three-dimension microwave near-field imaging"

Three-dimension imaging is a hot topic. And the near-field imaging is a new kind of measurement technique, which has been widely used in radar measurement. Based on Nyquist criterion, the spatial and frequency sampling criterion is established in near-field microwave imaging. First, the principle of the experiment was introduced, particular analyses on simple point-target were given, and the method to improve working frequency had been received, through changing the geometry relation of the sampling spatial. A statistics on one typical experiment condition was presented, and an analysis of multi-target and three-dimension target was implemented, compared with point-target, and get the method to predigest the complex target to the point-target by changing the geometry. This will make the experiment easier and more efficient. [C794]

"Angle estimation for two closely spaced targets with polarization monopulse radar"

The measurements of the two-closely spaced targets are merged when the target echoes are not resolved in angle or radial velocity. Conventional monopulse radar will only obtain single DOA measurement of the centroid. The paper provides an approach to extract direction-of-arrival (DOA) of the target. This method is simple and effective, though it requires complex measurements of signal and a priori knowledge of the polarization scattering characteristics of interference. [C795]

"ISAR image reconstruction technique with stepped frequency modulation and multiple receivers"

In this work, a new 3D model of deterministic components of ISAR trajectory signals with stepped frequency modulation is suggested. 3D ISAR geometry is described by means of analytical geometry. The geometry and kinematics of the object and ISAR observation system are described in separate 3D Cartesian coordinate system. The object space, moving rectilinearly, is presented as a 3D regular grid of isotropic point scatterers. The analytical expressions for computing the range distance to point scatterers of the object space are derived. The complex ISAR signal, reflected from the 3D target is obtained by four receivers, placed on the axes and origin of the coordinate system of observation. Four 2D ISAR signals, registered by receivers appear to be four 2D projections of the 3D ISAR signal. The 3D image is considered as a set of 2D images retrieved from the 2D ISAR signal projections. The image reconstruction procedure includes both range and azimuth compression. Fast Fourier transforms are applied to each 2D ISAR signal projection to realize range compression and azimuth compression. A synchronized range alignment and an autofocusing technique are applied to each received ISAR signal projection. To illustrate the capability of the 3D ISAR signal model numerical experiment is accomplished. [C796]

"An alternative approach to multichannel radar detection and location"

Space based radar (SBR) surveillance concepts have been investigated for decades and have once again made an appearance as a viable means of performing the ground moving target indication (GMTI) mission. From the signal processing perspective, a number of unique technical challenges must be addressed. These include a larger Doppler clutter spread, which will cause moving targets to be more likely in the endoclutter region, larger target densities, and nonhomogeneity and/or nonstationarity of the collected data. These and other phenomenology impact the ability of algorithms implemented by the system to perform target detection and parameter estimation. Various adaptations of space-time adaptive processing (STAP) have been put forward as the primary, if not only, solution to detect and locate ground moving targets (GMTI) in complex clutter environments from airborne and/or space based radar platforms. Most, if not all, of the proposed variations can be optimized to work in specific environments but suffer degradation when called upon to perform in a different setting. The reason for this appears to be inherent to the process itself. In order to overcome the difficulties

described above, an alternative approach to the current STAP paradigm has been developed and studied for target detection and location in multichannel radar systems. The new technique is based on an adaptation of a previously developed technique, used in passive arrays for angle of arrival (AOA) estimation, in conjunction with a knowledge based array calibration technique. When combined together, these two algorithms provide a powerful new tool for the detection and location of moving targets in complex clutter environments [C797]

"Two-dimensional harmonic retrieval in Gaussian noise based on hypercomplex"

The complex signal of two dimensional harmonics is common. The pairing steps are always needed when we estimated the frequency pairs of harmonics which is described by complex signals. First we construct the quaternion signal model through the separated signal and its Hilbert transform. Then we define the corresponding four-order cumulant to restrain the additive Gauss noise and extract the frequency. Some simulations prove the correctness of the algorithm in this paper. [C798]

"An improved pedestrian detection approach for cluttered background in nighttime"

Pedestrian detection is one of the most interesting topics in driver assistant systems. In a normal two-step detection framework: image segmentation (thresholding) and recognition, the pedestrian areas usually connect with other objects after segmentation, especially in cluttered nighttime images. The bad segmentation result causes the recognition module not to identify the pedestrians. This paper presents a fast template matching approach to locate the most pedestrian-like areas (candidates) in the complex background. At most of the time, the template matching method produces too many non-human candidates. However, our approach employs a set of efficient and simple filters to reject most of unwished candidates to reduce false alarm rate. Experiments show that the proposed method can segment the pedestrian areas well and promote the ability of the pedestrian detection system. [C799]

"MBE grown mid-infrared HgCdTe avalanche photodiodes on Si substrates"

Modern weapon systems need to detect, recognize, and track a variety of targets under a wide spectrum of atmospheric conditions. They include stationary and mobile targets against complex backgrounds and landmines. A number of active systems like hybrid LIDAR-RADAR systems, heterodyne detection as well as passive systems like thermal imagers have been proposed and developed to meet this objective. Most ground-based and air-based systems would operate at long distances. The return laser signal from the target is not only attenuated by absorption, reflection and scattering by air-borne gas, dust and liquid particles, but also by the emissivity and reflectivity variations of the target surface. High bandwidth detectors with internal gain are required. Avalanche photodetectors (APDs) are best suited for this purpose due to their high gain-bandwidth characteristics. Robust silicon-APDs are limited to visible and very near infrared region, while InGaAs works well up to certain wavelengths. On the other hand, it is important to realize that the atmospheric attenuation is wavelength dependent. Local changes in the air density yield random fluctuations in the refractive index, diverging the laser signal. Consequently, longer wavelength (MWIR: 3-5mum and LWIR: 8 -12mu m) source-detector systems are required to overcome the practical and seasonal conditions of the atmosphere. Previous efforts on HgCdTe APDs has been based on expensive CdZnTe substrates . The paper reports on the first HgCdTe based MWIR (3-5mum) APD grown on Si substrates by molecular beam epitaxy(MBE) [C800]

"Synthesis of a polarization-controlled pattern for a wideband array by solving a second-order cone program"

Jointly optimizing complex baseband FIR filters as element weights using second-order cone programming (SOCP) can synthesize a wideband array pattern having an arbitrarily polarized main beam with, in terms of L1, L2, L∞, or other norms, its frequency response flattened and cross-polarization components strictly limited across the entire beam. Sidelobes and SNR measures can be just as flexibly controlled. A high-level interface to a fast solver minimizes the required programming. [C801]

"Low-angle reflectivity modeling of sea clutter using LS method"

Radar sea clutter (SC) reflectivity is important for predicting the performance of radar engaged against a low-angle target at sea. Existing techniques to resolve the reflectivity estimate are mainly based on radar clutter theory and the LS approximation method. A more practical reflectivity model for SC is presented through data (Nathanson, F.E. et al., "Radar design principles: signal processing and the environment", McGraw-Hill, 1991). Throughout the reflectivity modeling, the idea of inductive reasoning is used. By using it, the functional relations between radar parameters and radar surface clutter backscattering are analyzed. In calculating the unknown parameters in the presented models, simplification of limit conditions are used so properly that the LS method can be employed. From the comparisons analysis, we can obtain that, generally, the presented SC model

approximates that of Nathanson et al. better than others. Considering the accuracy and complexity for a more complex prediction of radar performance, the presented SC reflectivity model is preferable. [C802]

"A new stable hybrid three-dimensional generalized finite difference time domain algorithm for analyzing complex structures"

In many practical situations it is necessary to hybridize two algorithms, e.g., the FDTD and FETD, to improve the accuracy of the solution without placing an inordinately heavy burden on the CPU. In order to accomplish this task without having to use a very small time step throughout the computational domain to satisfy the Courant condition (Taflove, A. and Hagness, S.C., 2000), we have proposed a stable hybridized 3D FDTD algorithm (Marrone, M. and Mittra, R., IEEE Trans. Antennas Propag., to be published). This algorithm has been developed using the cell method that enabled us to address the problems of both instability and connectivity. We present the results of some numerical tests, which serve to compare the accuracy and the computational complexity of the proposed algorithm with the same for the classical FDTD method. [C803]

"Simulation of chaff cloud radar cross section"

Chaff finds its main applications in electromagnetic countermeasures. A cloud of chaff is a diffuse artificial target made up of half-wave resonant dipoles. The study of electromagnetic scattering by a chaff cloud is so complex that no exact theory is currently available for describing well all the phenomena observed. A chaff cloud simulation developed by LACROIX/CESTA for the French Ministry of Defence (DGA) is presented. It shows how the authors have overcome the difficulties of modelling chaff clouds to reproduce realistic scattered signals in all polarisation states, taking into account chaff fluctuations and multipaths on the sea surface. The software is able to characterize battle ship autoprotection systems under operational configurations. Such a modelling can now be used to evaluate the performance of seekers jamming. [C804]

"2D indoor mapping and location-sensing using an impulse radio network"

This paper describes a location-sensing technique suitable for impulse radio ad-hoc networks operating indoors. This technique has similarities to hyperbolic navigation and bistatic radar, but it does not use any fixed references. Given the channel impulse responses (CIRs) of transmitter/receiver pairs communicated around the network, we show that this technique can successfully map typical indoor environments comprising two and four walls in relation to communicating radios. The technique can be extended to solve more complex scenarios. [C805]

"Re-entry vehicle tracking observability and theoretical bound"

This article deals with theoretical bounds and observability in ballistic re-entry vehicle tracking; theoretical and simulation results are presented. One essential characteristic of this trajectory is the deceleration of the vehicle when it reaches dense atmospheric layers. The intensity of the phenomenon is proportional to a scalar, called the ballistic coefficient. This leads to highly non-linear dynamics. We have compared tracking data processing techniques like extended Kalman filter (EKF) and particle filter to the posterior Cramer-Rao bound (PCRB) in order to confirm the exactness of this very bound and to evaluate at the same time the filters' performance. The observability problem of the trajectory is mostly the observability of the ballistic coefficient during the re-entry phase. Thus we have gradually studied its observability using a simple a priori random walk model, from a constant to a complex Allen oscillatory ballistic profile for the trajectory simulation. The accuracy of the particle filter and the exactness of the bound have been confirmed. In order to understand the important parameters of the bound, we explain the evolution of the observability during the re-entry phase using the Fisher information matrix, the inverse of the Cramer-Rao bound (CRB). We give an analytical expression of the CRB versus time for simple observation cases, using Cauchy-Binet formula for matrix determinants. [C806]

"Joint target tracking and identification-Part I: sequential Monte Carlo model-based approaches"

This paper deals with model-based approaches for joint target tracking and identification. In a Bayesian framework, parametric state-space model classes are introduced as a generalization of the widespread state-space models. In addition to the dynamic state, they include a hyper-parameter, which takes into account target features or behaviors. For such model classes, sequential Monte Carlo approaches, also known as particle filtering, provide a powerful tool to perform sequentially on-line estimation and model selection. The paper focuses on the ergodicity concern of fixed hyper-parameter estimation and model selection. Indeed, the infinite memory of such a system may lead to the particle filter degeneracy or divergence. It reviews various methods to solve this problem, from the common and basic trick of adding an artificial noise to more complex methods, such as the introduction of reversible jump Markov chain Monte Carlo moves. [C807]

"Estimation of parameters of a polynomial phase model using the warped complex time distributions"

{no data available} [C808]

"Non parametric target tracking in non uniform clutter"

Target tracking algorithms have to operate in an environment of uncertain measurement origin, in the presence of randomly detected target measurements as well as clutter measurements from unwanted random scatterers. Most data association target tracking algorithms incorporate a measure of clutter density. Quite often the clutter density is non-uniform, especially in ground target tracking, or when the radar beam "touches" the ground. Non-parametric target tracking assume a priori unknown clutter density, however the assumption is that it is uniform within the selection gate. Complex selection gates, which are created for a number of multi-scan and/or multi target tracking algorithms, can encompass a large volume where the clutter density will vary widely. We propose an alternative clutter density estimation scheme for non-parametric target tracking, which does not assume uniform clutter within the selection gate. Instead, clutter density is estimated on a measurement by measurement basis, prior to a posteriori target track update. The scheme is adaptive and has no bias in estimated inverse of clutter density at the measurements coordinates. A simulation study shows the benefits of adaptive clutter estimation based on single target tracking algorithms in an environment of heavy and non-uniform clutter. [C809]

"Unified Bayesian-experiment design regularization technique for high-resolution reconstruction of the remote sensing imagery"

In this paper, the problem of estimating from a finite set of measurements of the radar remotely sensed complex data signals, the power spatial spectrum pattern (SSP) of the wavefield sources distributed in the environment is cast in the framework of Bayesian minimum risk (MR) paradigm unified with the experiment design (ED) regularization technique. The fused MR-ED regularization of the ill-posed nonlinear inverse problem of the SSP reconstruction is performed via incorporating into the MR estimation strategy the projection-regularization ED constraints. The simulation examples are incorporated to illustrate the efficiency of the proposed unified MR-ED technique [C810]

"Evolution of the radar target tracking algorithms: a move towards knowledge based multi-sensor adaptive processing"

Though there are a no. of methods for target tracking described in literature like Kalman filtering, extended Kalman filtering, Bayesian approach, IMM-PDA, ML-PDA, particle filters, random set theory, covariance intersection, neuro-fuzzy methods, tracking through genetic algorithms and so on, the goal has always been to bring adaptivity to tackle the changing situations. Since, no one sensor can perform well in all the conditions, Multi-sensor adaptive processing has been the inherent focus. This paper presents a brief account of the target tracking algorithms developed till date and to be developed in future and brings out the main development trends. As a novel way of presentation, a Boston Consulting Group (BCG) matrix analysis has been performed and the algorithms have been classified in four classes i.e. Question marks, stars, cash cows and dogs. It has been applied to the radar target tracking algorithms. The evolution and further discussion about future trends clearly show a shift towards knowledge based adaptivity and sensor fusion. Though a number of papers have come out bringing complete account of target tracking algorithms but their presentation format does not provide a way of their practical utilization in the system development. The mathematical formulations are complex and mixing is too much for a non-expert or even a system manager to take decisions. Thus a need was felt to provide a suitable format to the decision makers and provide the non-expert a balanced simple account of the algorithms. Further, a knowledge based perspective has been brought out well in this paper. Knowledge based theme though shown in target tracking here is not limited but applies to other areas of radar, ATR, air traffic control & collision avoidance, network centric warfare etc. also. Latest knowledge based research has been incorporated in a broader sense to cover ANNs, CI, fuzzy etc. also. [C811]

"Robust subspace technique for joint angle/Doppler estimation in /spl alpha/-stable clutter using phased fractional lower-order moments"

We consider the problem of joint angle and Doppler estimation for space-time adaptive processing (STAP) airborne radar in non Gaussian clutter modeled as a complex symmetric alpha stable (SaS) process. We introduce a new robust MUSIC algorithm named PFLOM-MUSIC which is obtained using a new class of covariance matrix estimate based on the phased fractional lower-order moment(PFLOM). Such matrix and the subspaces spanned by its eigenvectors serve as a basis for a high-resolution angle/Doppler estimation method. The performance of the PFLOM-MUSIC is examined by comparing the estimation results with those of the sign

covariance matrix estimate SCM-MUSIC (T. Liu and J. M. Mendel, Aug. 2001). Extensive Simulations demonstrate that our proposed algorithm outperforms the previously reported estimators [C812]

"DSP and CPLD based field oriented control of PMSM using application specific IPM"

This paper proposes a highly-integrated and digitized servo control system for permanent magnet synchronous machine (PMSM) used in radar-driven system, which is based on application specific intelligent power module (ASIPM), digital signal processor (DSP) and complex programmable logic device (CPLD). The field oriented control (FOC) algorithm and space vector pulse width modulation (SVPWM) technique are implemented in the system. The new generation of power module ASIPM is adopted to achieve high integration, small size and low cost of the system. The DSP completes all the real-time signal sampling, processing, transformation and computation. The CPLD is utilized as a complement to DSP to address the functionality of logic signal processing like signal conditioning and fault detection. The performance of the system is verified experimentally. [C813]

"The representation of radar objects polarization properties on the complex plane and polarization proximity of these objects"

The definition of the radar objects polarization remoteness introduces the notion of polarization contrast in connection with the possibility of radar object discrimination of the radar's polarization properties. The direct use of the distance between two radar objects represented on the radar object complex plane (i.e. Euclidean metric) prevents the establishment of an acceptable measurement of these object polarization property distinctions. In this paper, the author considers the notion of radar object polarization state proximity by presenting a full description of the polarization properties using the specific invariant parameter, termed as the "complex degree of the polarization anisotropy" (CDPA). Using this algorithm, the CDPA notion allows the presentation of the object's complex plane polarization properties. [C814]

"Technique of ultra wideband radar target discrimination using natural frequencies"

An aspect independent radar target discrimination method based on the natural frequencies of ultra wideband radar targets is introduced. The sets of points in a multi-dimensional space corresponding to the poles on a complex plane (natural resonances) were offered as signatures of radar targets. This approach allows performing the automated discrimination algorithm of radar targets. The results of experimental research of the signals scattered by scaled aircraft models using the signatures algorithm and cumulant preprocessing are presented. [C815]

"The complex signals instantaneous frequency measurement using multichannel IFM systems"

The capabilities of a multichannel IFM system for instantaneous frequency measurement of complex pulse signals are presented. The frequency characteristics of the IFM systems are correct for CW and long pulse signals. For complex short pulse signals with a wide spectrum, the IFM's frequency characteristics can be changed depending on the signal structure. Pulse signals with LFM (linear frequency modulation), NLFM (nonlinear frequency modulation) and FSK (frequency shift keying) have been used for the analysis. The results for time-domain and frequency-domain analysis methods are presented. [C816]

"Atomic functions in the two-stage digital signal processing scheme of SAR"

Two-stage signal processing method in SAR is used for frequency matching at the input and the output of digital system. In that case, digital synthesizing process pass with low sampling frequency, that reduce requirement for digital processing system. In the process of forming radar image for decreasing the sidelobe level weighting functions are used. In the report, a new class of weighting windows, based on the theory of atomic functions, offered for use. Numerical experiment results are presented. Efficiency of the new method is shown. [C817]

"The instantaneous frequency measurement receiver in the complex electromagnetic environment"

Real-time measurement of the carrier frequency of radar signals is an essential part of electronic-reconnaissance systems. The wideband instantaneous frequency measurement (IFM) receiver offers a high intercept probability over wide instantaneous RF bandwidths, high dynamic ranges, good sensitivity and high frequency measurement accuracy. The ability to process economically wide instantaneous RF bandwidths, while making this type of receiver attractive to the system designer, intensifies the problem of measurement correctness in the complex electromagnetic environment. The problem of linear detection in instantaneous frequency measurement systems is presented. Measurement data are shown and compared to theoretical analysis. Methods of minimizing the linear detection error are proposed. [C818]

"SAR interferometer optimal processing algorithms for the stochastic surface models"

This work discusses about the SAR interferometer optimal processing algorithms for the stochastic surface models. One of the main algorithm in the InSAR is the phase algorithm or complex scattering coefficient estimation. Structure of such algorithm depends on surface model used to denote input process in the antennas. In fact, scattered from the real surface signal represents a stochastic process (Gaussian), usually nonstationary in the time domain. Stochastic character are taken in to account while estimating altitude or absolute phase difference in the SAR (Synthetic Aperture Radar) interferometer. [C819]

"Estimation of Doppler-polarimetric spectrum of signals reflected from distributed radar objects"

Polarization parameters and their Doppler spectrum of reflections characteristics coming from volumetric distributed radar objects are estimated for Doppler-polarimetric radar using complex modulations signal transmission the case of complex signals using. The influence of the sounding signal's ambiguity function on the possible joint estimation of the velocity spectra and separate backscattering matrix elements of objects is shown. Simulation results of our algorithms estimating the matrix Doppler spectrum are presented for the case of PCM and LFM transmissions. [C820]

"Synthetic aperture radar and high-resolution MM5 simulations of barrier jets in coastal Alaska"

The mesoscale atmospheric flow near coastlines with prominent terrain lias a tremendous impact on those who live and work in the coastal environment. One of the most common of these terrain-induced flows, the barrier jet, creates especially dangerous weather conditions, particularly in southeast Alaska and the Pacific Northwest. The resulting severe winds pose a threat to life, property and economic activities. They play a major role in safety at sea for the fishery and oil industries. Barrier jets occur when stable onshore flow interacts with a mountain barrier. In classical barrier jet theory, the barrier normal flow is blocked when the Froude number is much less than 1. In these situations, the onshore flow is too stable to rise over the barrier. The dynamic response is for the ascending air to cool and generate a hydrostatic positive pressure perturbation which forces a turning of the wind to the left along the barrier in the Northern Hemisphere. The Gulf of Alaska is uniquely suited to studying barrier jets of both the classical and hybrid types. This is because of the frequency of onshore flow events associated with landfalling synoptic cyclones, the mountain ranges with complex dimensional terrain (including gaps) that occur along large sections of the coast, and the orientation of the coast line (particularly along the SE coast of the Gulf). In addition, the fact that much of the Gulf lies at high latitudes ensures excellent coverage from polar orbiting satellites such as the scatterometer aboard QuikSCAT and the synthetic aperture radars aboard the ENVISAT and RADARSAT-1 satellites. [C821]

"Correlation time analysis of delay-Doppler waveforms generated from ocean-scattered GPS signals"

The ocean-scattered Global Positioning System (GPS) signal can be used, in a bistatic radar configuration, for estimating the ocean surface roughness. This requires fitting a scattering model to the distribution of reflected power in delay and Doppler. The delay-Doppler map, or waveform, is generated through the cross-correlation of a local copy of the pseudorandom noise (PRN) code assigned to each GPS satellite with the reflected signal over increments in Doppler frequency equal to the pre-detection bandwidth. The correlation time of the reflected signal voltage sets an upper limit on the pre-detection integration time. Correlation time was estimated from experimental data through fitting a model Gaussian function to the magnitude of the complex autocorrelation of the time series of the waveform. Range bins were taken 1.1 chips prior to the averaged waveform peak in the leading edge and 2.5 chips after the averaged waveform peak in the trailing edge. Doppler bins were set at -500, 0, and +500 Hz relative to the Doppler frequency of the corresponding direct GPS signal. The direct GPS signal was tracked using a frequency locked loop (FLL). Results showed that maximum correlation time occurs approximately 0.72 code chips prior to the averaged waveform peak. The correlation time was found to vary with the elevation angle of the satellite, with lower elevation satellites showing longer correlation time. Some experimental results were compared with model predictions. A good comparison was usually found for delay bins near the specular point and both the model and experiment showed a decrease in the correlation time for longer delays. In the higher range bins the model tended to predict longer correlation times than those observed in the experimental data [C822]

"SAR interferometric baseline calibration without need of phase unwrapping"

Baseline calibration is a needed step in all applications of SAR interferometry and differential interferometry. A new approach for baseline calibration is proposed, based on the idea of maximizing the correlation between the original complex interferogram and reference values of it obtained from ground control points. The main

advantage with respect to traditional techniques is that the method does not require the phase to be unwrapped in advance, and therefore the results are not affected by possible unwrap errors. In addition, successive phase unwrap is facilitated by the better phase flattening possible after baseline calibration. The method is computationally more demanding than traditional techniques, though the requested computational time is comparable with that of other processing steps of SAR interferometry. Tests performed on real ERS SAR images confirm the validity of the proposed approach [C823]

"Techniques for seismic damages assessment by using remotely sensed images"

This paper discusses the methods of seismic damages assessment by utilizing remotely sensed data. Classical Change Detection (CD) algorithms are effective when the author can acquire both pre and post-event images in a very short period of time. For images those have large temporal difference, edge detection and neighborhood operations and occurrence calculations are used to enhance the texture information and detect the displacement of outlines of ground objects. When there is only post-quake image, the Direct Recognition from Single Image (DRSI) method is used. But automated DRSI is difficult because the pattern of houses is very complex and varies greatly in different geographical areas. Experiments were carried out for 2003 Jiashi-Bachu Ms 6.8, 1999 Taiwan Jiji Ms 7.2 and 1998 Zhangbei Ms 6.2 quakes. SPOT, ERS-2 SAR and airborne images were obtained. The results were in agreement with field surveys. [C824]

"Vegetation effects on soil moisture estimation"

Several successful algorithms have been developed to estimate soil moisture of bare surfaces. We previously reported a new algorithm using the tilted Bragg approximation. However, these algorithms are only applicable to bare surfaces. When vegetation is present, soil moisture is typically underestimated by bare surface algorithms. In order to derive soil moisture under vegetation, we have to understand the complex scattering process due to vegetation. Our main interest is to retrieve the global soil moisture information using Hydros L-band polarimetric radar data. The Hydros mission will provide the first global view of land soil moisture using L-band radar and radiometer. The unique characteristics of the Hydros data are the availability of the low resolution soil moisture information from radiometer data and the continuous time series radar data collected at the same incidence angle. In this paper, we will examine a potential inversion algorithm to retrieve soil moisture under vegetation canopies using Hydros L-band polarimetric radar data [C825]

"Swiss alpine airborne sar experiment (SASARE) part I: multi-baseline polarimetric SAR interferometry studies at L- and P-band"

In the frame of the Swiss Alpine Airborne SAR Experiment 2003 (SASARE) multitemporal/-baseline Pol-InSAR (polarimetric SAR interferometry) data sets were acquired with the German E-SAR (Experimental SAR) platform at L- (1.3 GHz) and P-band (350 MHz) in the region of the Great Aletsch glacier in Switzerland. For SASARE, several sub test sites had been selected below and significantly above the equilibrium line. One of the two campaigns was designed as a joint venture experiment and therefore also includes measurements of the Swedish CARABAS UWB (Coherent All Radio Band Sensing, ultra wide-band) sensor operating in the VHF frequency range (20-90 MHz). We provide first results from analysis of multitemporal/-baseline Pol-InSAR Land P-band measurements of the polarisation-dependent complex interferometric coherence of different glaciological surface types of an Alpine glacier [C826]

"Pol-InSAR for agricultural vegetation parameter estimation"

The quantitative bio/geo physical agricultural and land-use parameter estimation has attained significant prominence as it is a challenge to quantify complex and fast changing media in terms of geometry and material properties. In this work the behavior of agricultural vegetation in terms of polarimetric interferometric SAR (Pol-InSAR) observables is investigated. For this a two layer model, the Oriented Volume over Ground (OVoG) model, is discussed and validated against experimental data [C827]

"Passive multichannels millimeter-waves imaging system"

32-channels passive imaging system is developed in the frequency range 33...38 GHz. The system contains multibeams quasi-optical scanning antenna with an array of low noise direct detection receivers. New type of scanning mechanism on the base of asynchronous three-phase motor is used. The software-hardware complex has been created to control scanning mechanism and to process the receiving information. Simultaneous receiving of signals from different parts of scene allows to form a good quality image on the monitor screen in 3 seconds. The developed imaging system can be used to provide navigation on the ground or at sea, especially at short distances where surface radar clutter is high, for remote sensing in space and air investigations, for all-weather surveillance, for objects discovering, and many other commercial applications. [C828]

"Adaptive pulse compression"

Pulse compression is essentially an estimation procedure in which the complex amplitude for a given range cell is to be estimated while mitigating the interference from neighboring range cells that results from the convolution of the transmitted waveform with the range swath of interest. Traditionally, matched filtering is employed to estimate the range returns whereby the neighboring range cells are suppressed by a fixed amount that is dictated by the range sidelobes of the matched filter. However, matched filtering is a misnomer in that the receive filter is matched only to the transmitted waveform and not to the actual received signal. The paper extends the previously proposed reiterative minimum mean-square error (RMMSE) algorithm for adaptive pulse compression whereby the true matched filter for each individual range cell is estimated based upon the actual received signal resulting in range sidelobes that are adaptively suppressed to the level of the noise floor. The convergence of the RMMSE algorithm is addressed along with the Doppler tolerance. [C829]

"Enhanced maneuvering targets detection via polynomial phase modeling in over-the-horizon radars"

This paper describes a processing algorithm based on polynomial phase modeling scheme that increases visibility of maneuvering targets in HF over-the-horizon radar (OTHR). For the presence of the echo backscattered by the target that has significantly varying radial velocity within a coherent integration time (CIT), it is difficult for traditional coherent processing to centralize energy and peak in Doppler spectrum. Due to the polynomial property of the phase of maneuvering target radar echo, a polynomial phase signal (PPS) is introduced to model the complex Doppler variation of maneuvering targets. As an effective method to estimate the parameters of PPS, a high-order ambiguity function (HAF) based algorithm is applied. And a compensation process follows to eliminate the coherent processing loss (CIL) caused by irregular motion of targets. The experimental results are given to illustrate the validity and efficiency of the proposed method. [C830]

"MATLAB-based ERS SAR data acquisition and processing software for classroom use"

The paper provides a review into the steps involved in acquiring and processing synthetic aperture radar (SAR) data transmitted by the European remote sensing (ERS) satellites. The paper reports on a simple MATLAB-based SAR processing system, that reads the image out of the complex SAR data files and that is suitable for use in the classroom to demonstrate one of the procedures used in SAR data processing. The paper can also help a beginner in the field of SAR signal processing to get information and understand the basics that are necessary to acquire and process a SAR image. The data, provided by the Alaskan Satellite Facility (ASF), is categorized into different levels and the paper describes the process of obtaining the level-1 basic image from the level-0 raw data file provided by ASF. [C831]

"Analysis of advanced data association techniques for ASDE radar"

The paper analyses and evaluates the application of different techniques to the data association problem for ASDE (airport surface detection equipment) radar. Data association for this sensor requires the removal of the classical one-to-one constraints and should allow tracks to be updated by sets of blobs. Different innovative alternatives, based on recent advanced techniques, have been formulated and tried to solve this problem in complex scenarios. Simulation results show the capabilities achieved in terms of tracking robustness, accuracy and required computation. [C832]

"Application of neural networks to radar signal detection in K-distributed clutter"

The radar signal detection is a very complex task, which is generally based on conventional statistical methods. These methods require a lot of computing and they are optimal only for one type of clutter distribution. Recently, artificial neural networks (ANN) have been used as a means of signal detection. In this paper, we consider the problem of radar signal detection using ANN in a K-distributed environment. Two training algorithms are tested; namely, the back propagation (BP) and genetic algorithms (AG) for a MLP architecture. The simulation results have shown that the MLP architecture outperforms the classical CA-CFAR detector. [C833]

"A new implementation of complex number multiplier using RB representations"

Redundant binary (RB) representation is one of the signed-digit number systems originally introduced by Avizienis, which provides carry-propagation-free addition. Since the multiplication of two numbers is generally performed by the addition of partial products, the carry-propagation-free feature of the RB arithmetic can be used to design high-speed multipliers and multiply-and-accumulate units. Complex number arithmetic computations are one of the key arithmetic components in modern digital communication and optical systems.

Complex number multiplication plays a unique role in these applications. In this paper, a new implementation of the complex-number multiplier based on a Redundant Binary (RB) representation is presented. With the proposed algorithms, the complex number multiplication is reduced to parallel RB multiplications. The implementation result on Xilinx FPGAs is presented in the paper compared to other methods. The proposed complex number multiplier is used in our proposed high-performance Complex Arithmetic Signal Processor. [C834]

"Acquisition of topological action maps through teleoperation"

It has been demonstrated that a robot can learn to interact purposefully with its environment through a developmental acquisition of sensory-motor coordination. Teleoperation can bootstrap the process by enabling the robot to observe its own sensory responses to actions that lead to specific outcomes within an environment. This paper reports the results of learning to navigate an indoor environment by a simple mobile platform using only LIDAR and odometry. Descriptors of sensory-motor coordination in the form of LIDAR scan images coupled to concurrent motor activity are extracted from five teleoperated trials of driving the robot through the environment. From these a topological action map of the environment is constructed. A hierarchical discrete event dynamical system is defined wherein higher levels encompass increasing time intervals, longer sensory and motor histories, more complex behaviors, and higher degrees of abstraction. An event that cannot be handled at the current level precipitates a jump to the next higher level for processing. The sensory-motor associations learned and encoded in the action-map enable autonomous navigation while avoiding localization errors. Test results are given that demonstrate the robustness of autonomous navigation through the learned environment in the face of both stationary and moving obstacles. [C835]

"Independent component analysis by complex nonlinearities"

A number of complex nonlinear functions are proposed for the independent component analysis (ICA) of complex-valued data. We discuss the properties of these nonlinearities and show their efficiency in generating the higher order statistics needed for ICA. [C836]

"A super-resolution method for extraction of modal responses in wideband data"

The paper presents a spectral estimation method to process coherently the wideband frequency domain field data of any object, and extract specific modal responses associated with wave propagation along the object. The problem is formulated in terms of well-known range processing used in radar waveform analysis. Thus, the data is modeled in terms of complex sinusoids, whose phase yields the decay/growth constants and the range associated with discrete scattering centers. Unlike previous approaches, the resulting amplitude and decay/growth constants are made frequency-dependent to capture the dynamic wideband behavior of the scattering mechanism. The method is illustrated by application to mode extraction for a cylindrically stratified scatterer. [C837]

"A tomographic SAR image formation based on 3D target"

A method is developed for the 3D image reconstruction of synthetic aperture radar based on a tomographic model. In this model, the demodulated radar return signal could be seen as a set of sampled 3D Fourier transform of the reflectivity density of the target, and a 2D image of projection corresponding to reflectivity in the 3D scene can be reconstructed. Besides, a half-quadratic regularization is developed to deal with the complex valued, random-phased nature of the SAR target reflectivity. [C838]

"A novel spread clutter suppression algorithm based on multiple-dimension matched field processing technique [Cover-the-horizon radar]"

High-frequency skywave over-the-horizon radar (OTHR) can provide a wide coverage over the horizon by means of the refraction within the ionosphere. However due to the complex propagation conditions of electromagnetic waves in the HF band, many disadvantageous effects, such as phase path contamination and multimode propagation, cause the target to be submerged by the neighboring spread clutter. In this paper, the spread effect of identical clutter, backscattered from the adjacent dwell illumination region (DIR), has been discussed. On the basis of the existing matched field processing (MFP) method developed for this problem, the multiple-dimension cross-relation method, using the multiple channel signals, has been proposed and used for the temporal data directly. Experimental simulations are given to demonstrate that the improved method is effective in suppressing the spread clutter. [C839]

"Algorithms to separate overlapping secondary surveillance radar replies"

We investigate the separation of a linear mixture of secondary surveillance radar (SSR) replies impinging on an M-element antenna array. At base-band, a received SSR signal consists of a binary sequence with alphabet {0, 1}, modulated by a complex exponential due to the residual carrier frequency. We present two algebraic algorithms to compute the separating beamformers by taking into account the particular modulation format of the received signal. [C840]

"Estimating frequencies of two dimensional harmonics with hypercomplex"

The complex signal of two dimensional harmonics is common. Pairing steps are always needed when we estimate the frequency pairs of harmonics which are described by complex signals. We introduce the hypercomplex signal, and use it to study two dimensional harmonics. First, we construct the hypercomplex signal using the signal's original two dimensional harmonics and its Hilbert transform. Then, we present our algorithm for estimating the frequencies of the hypercomplex signal through taking advantage of the properties of Hamilton's quaternion. Some simulations illustrate the prospect of using hypercomplex signals in estimating the parameters of two dimensional harmonics without pairing steps. [C841]

"Polynomial phase signal modeling using warping-based order reduction"

The high-order ambiguity function (HAF) was introduced for the estimation of polynomial-phase signals (PPS). Currently the HAF suffers from noise-masking effects and from the appearance of undesired cross terms in the presence of multi-components PPS. The multi-lag product HAF concept was then proposed as a way to improve the performance of the HAF. Nevertheless, the performance of the new methods are affected by the error propagation. This effect is due to the technique used for polynomial order reduction, common for current approaches: signal multiplication with the complex exponentials formed with the estimated coefficients. In this paper, we introduce an alternative method to reduce the polynomial order, based on the successive unitary signal transformation, according to each polynomial order. We prove that this method considerably reduces the effect of error propagation. [C842]

"The eigenvector-based identification of shallow buried targets in ground penetrating radar"

A new approach to the super-resolution eigenvector method implementation, in step-frequency ground penetrating radar (GPR), is proposed. The pseudospectrum determination, fulfilled by the eigenvector algorithm, is followed by a procedure of more precise signal parameter estimation. Accordingly, the distance to the object obtained by the eigenvector algorithm is considered more reliable. Then, complex amplitudes of the determined signal components are calculated, which allows distinguishing different types of buried objects. [C843]

"Finding organized structures in 3-D ladar data"

In this paper, we address the problem of finding organized thin structures in three-dimensional (3-D) data. Linear and planar structures segmentation received much attention but thin structures organized in complex patterns remain a challenge for segmentation algorithms. We are interested especially in the problems posed by repetitive and symmetric structures acquired with a laser range finder. The method relies on 3-D data projections along specific directions and 2-D histograms comparison. The sensitivity of the classification algorithm to the parameter settings is evaluated and a segmentation method proposed. We illustrate our approach with data from a concertina wire in terrain with vegetation. [C844]

"Recent nonlinear inversion methods and measurement system for microwave imaging"

The paper reviews different inversion methods in connection with different measurement systems to solve nonlinear inverse scattering problems for various applications where the discrepancy between the measured and computed scattered field is minimized at each step of an iterative procedure. First, the reconstruction of the complex permittivity profile (permittivity and conductivity profiles) of inhomogeneous buried objects using polarization diversity (TM, TE and cascaded TE-TM polarizations) is considered for nondestructive testing, geophysical, civil engineering, or humanitarian applications. Second, a boundary-oriented method based on contour deformations is exposed for reconstructing the shape of metallic objects for radar imaging purposes. [C845]

"Vital-an advanced time-based tool for the future 4D ATM environment"

The number of aircrafts will increase in the future. It is commonly agreed that in several high density traffic areas like central Europe the capacity limits are nearly reached. A solution can be seen in 4-dimensional (4D-x, y, z-coordinates, time) air traffic management (ATM). As no revolution in ATC will take place, the close future 4D ATM system will be human centred. The human controller will still have to construct a mental picture of the air

traffic for his own understanding. This mental picture is required for anticipating and predicting the movement of the aircrafts. The quality and speed of the construction of the mental picture depends largely how on the information is presented. Today, the presentation of the information is well adapted to the current working methods. A future 4D ATM system requires more complex information. Presenting this information with current methods, will increase the mental load for controllers to create their mental traffic picture. Further mental demand for the controller will either decrease his quality and/or his speed and therefore the working capacity. To overcome these constraints for a future 4D ATM the EUROCONTROL Experimental Centre (EEC) searched a new method to present this information to the en-route controller. Therefore information from radar and flight plans are correlated on the common time base and presented in a time-line. The concept, called 'Vital' represents the information in form of a table, the en-route MONitor (EMON). Each row of the EMON represents the artefact of an aircraft path related to the sector. The controller may place this artefact freely at any line of the EMON to support his mental representation of the sector. The innovation of this representation is the combination of digital and analogue information in the same artefact. The analogue information is presented on a time-line which is progressing in real-time. The size of the time-line window is common to all artefacts. The time-line information represents the past, actual and extrapolated future positions of an aircraft in the route network of the sector. The digital part of the artefact contains fix information from the flight plan and updated flight parameters. Future 4D concepts will include new features like route offsets, 4D-rendezvous points, station keeping of two or more aircrafts, delayed or locally fixed climb/descend orders, including uncertainty. Furthermore displaying an envelope for possible speed variations are included in the analogue timeline representation without overloading the display and increasing the complexity significantly. [C846]

"Recognition of objects on their complex natural resonance at ultra wideband sounding"

In this report, the RSO (radar subsurface objects) complex resonance frequencies are used as features of their recognition proposed. From these features the basis of the prior information about identifiable object scattering characteristics is described. However, for practical implementation of described algorithm of RSO recognition it is necessary to explore and to take into account effect of some complicating factors such as deformation of observed data. Thus from this report the algorithm of recognition of RSO is designed. [C847]

"Signal processing techniques at radar measurement of the UWB polarization characteristics"

In the report the principles of processing of the UWB signals for an estimation of frequency responses polarization matrices by results of measurements are discussed. The reviewed methods are introduced in a "TSUNAMI-3" collimating type radar measuring complex. The outcomes of obtaining 2D polarization object radar images on experimental data are resulted. [C848]

"Application of the audio interface for ground penetrating radar data representation and interpretation"

The present article offers a description of software complex, which supports reception and preliminary processing of ground penetrating radar (GPR) information, development of flag description, generation of radar displays and synthesis of their audio representation in the tasks of underground sounding data interpretation. A method of image-to-sound conversion is described, with the storage of image information at the level of attainable resolution. Technical feasibility of the replacement of visual perception with acoustic perception has been substantiated. Practical limitations of the parameters of conversion have been defined, and the conformity of the coded values with the level of perception of audio information has been verified. [C849]

"Scattering pulse signal on layer-uniform half-space"

The problem of a plane pulse wave scattering of on the layer-uniform half-space with arbitrary complex dielectric permittivities of layers is considered. The proposal method bases on the boundary problem solution for the system of stationary Maxwell equations and well adapted to determination of complex amplitudes of the fields at any point of space. [C850]

"A real-time compressing method for complex SAR images"

Complex image compression is widely used in diverse remote sensing applications in order to reduce the costs of data storage and release the burden of data transmission on limited data transmission channels. However, the huge amount of data makes it difficult to compress in real-time. A novel real-time compressing method for complex SAR images is presented in this paper. The system uses a fixed-point DSP of TI SM320c6416 with IGB SDRAM (synchronous dynamic random access memory). After removing the redundancy of complex image in frequency domain, arithmetic codec is applied for statistical redundancy, further. With the least data regress limes, good performance is achieved. The results show that compressing a complex image of 8192*2048 needs

only 4315 ms in an acceptable distortion with compression ratio of 16.214:1. So, the method is highly suitable for real-time (or low delay) applications. [C851]

"Polarization-doppler response function in the inverse synthesis problem"

A possibility of complex radar object polarization Doppler response function is considered for an aperture synthesis. [C852]

"A new performance analysis metric for medical ultrasound"

The resolution of medical ultrasound systems is usually characterized by the width of the mainlobe, typically the full width at half maximum (FWHM), in beamplots. The FWHM has, however, been shown to sometimes provide misleading information about systems. The concept of "cystic resolution" in which performance is quantified as the size of the void that produces a specified contrast, has been previously introduced to medical ultrasound. We extend the concept and develop a general metric to analyze the 3D broadband performance of arbitrary ultrasound systems. We provide an example of application in which we compare the performance of a conventional system using a 1D array and time delay beamforming of radiofrequency (RF) data to that of a system based on a 2D array that focuses solely via phase rotation of complex I/Q data formed by directly sampling the received RF signal. [C853]

"TIME-MUSIC DOA estimation based on the exploitation of an arbitrary-order temporal structure in the data"

This paper presents a unifying method called TIME-MUSIC for high-resolution direction of arrival estimation of statistically independent complex narrowband signals in noise with a planar sensor array of arbitrary geometry. It is based on the exploitation of an arbitrary-order temporal structure in the data by cumulants. A MUSIC-like spatial pseudo-spectrum is computed that exhibits peaks at the source directions of arrival. The theory is unifying in several senses. Firstly, it is general with respect to the order of the exploited temporal structure. Secondly, all types of statistical variability in the data, such as arbitrary-order nonstationarity and n on whiteness, are incorporated into the problem formulation in a unified manner. Finally, the conjugation pattern of the arguments of the involved cumulant functions can be chosen arbitrarily. In practice, this should be done in accordance with the characteristics of the involved signals. Depending on the number of sensors, the order of the exploited temporal structure, and the chosen conjugation pattern, a large number of source directions can be determined that exceeds the number of sensors for orders larger than one. [C854]

"Interferometric three-dimensional imaging on ground moving target"

In this paper, a system of a three-dimensional (3D) interferometric SAR imaging for ground moving targets is analyzed. By using the estimation of angular motion parameters in the cross-range directions, the registration of the respective complex images can be achieved via compensating the respective echoes in the raw data level, and the 3D image can be reconstructed sequentially. Finally, the cross-range resolution of 3D image is analyzed. [C855]

"Compression of tactical real-valued SAR imagery in the complex SAR phase history domain"

This paper introduces a technique that exploits the statistical properties of complex synthetic aperture radar (SAR) data to effectively compress the information required to produce tactical real-valued SAR imagery. Performing the compression on the complex data as opposed to the real-valued image enables the inherent sinusoidal structure of the radar returns to be modeled. The compression technique also takes advantage of the fact that the phase information in the complex SAR data is discarded in the image formation process. This enables a vocoding technique where white noise is passed through the source model to effectively recreate the frequencies required to reconstruct the SAR image. Line spectral pairs are used to quantized the model parameters and a 45:1 compression ratio is achieved with very little loss in perceptual image quality compared to the JPEG standard. [C856]

"Synthetic aperture radar visualization"

We investigate methods for two-dimensional and three-dimensional reconstruction of objects from radar backscatter measurements taken over wide angles. Radar backscattering is characterized by several variables: object location, complex amplitude, polarization and the aspect (azimuth and elevation) of the interrogating sensor. This high-dimensional data is typically projected into a two-dimensional image. As next-generation radar systems become increasingly capable, the assumptions and algorithms for traditional imaging need to be reconsidered. We propose new imaging techniques that accommodate limited persistence scattering on objects

and use these techniques to develop two-dimensional and three-dimensional object reconstructions from wide-aperture radar measurements. Finally, we explore phase and polarization stability of scattering centers at the high resolutions afforded by wide-angle apertures. [C857]

"The chaotic character of ion relaxation oscillation in microwave tubes"

The noise caused by ion relaxation oscillation becomes a research focus in the field of microwave tubes recently because of the improvement of radars and communications requirements. In this paper, electron beam is described by beam envelope equation, and ions generated from ionization of the background gas in microwave tubes are treated as discrete macro-particles. One dimensional particle-in-cell (PIC) simulation code was developed, and time series of ion relaxation oscillation are obtained by the presented method. The ion relaxation oscillation is treated as the response of a complex nonlinear dynamical system, and the time series is analyzed by power spectrum; restructure phase diagram and Lyapunov exponent. From the analysis results, we find that the ion relaxation oscillation has chaotic character at the first time. The reason of chaos was attributed to the dissipative structure of the system. This would be useful for depressing relaxation oscillation and processing signal with relaxation oscillation noise. [C858]

"Power-efficient design of memory-based FFT processor with new addressing scheme"

The paper presents a new memory-addressing scheme for the realization of low power FFT processors. The scheme is based on the minimization of coefficient access and the reduction of switching activity by modifying the butterfly sequence. Therefore, power consumption in the complex multiplier and memory is significantly saved. [C859]

"Optimal siting of hydrological monitoring stations with respect to remote sensing-based geo-environmental patterns"

The management of sustainable and dependable water resources in a semi-arid coastal watershed in South Texas, such as the Choke Canyon Reservoir Watershed (CCRW), is deemed critical because of complex relationships among ecosystems, social development, human health, and economic progress. To retrieve key hydrological information constrained by a limited budget, a set of hydrological monitoring stations in support of investigation of drought and flood impacts in the CCRW were identified by a grey integer programming (GIP) approach under uncertainty. The area of interest is divided into eight hundred cells in GIS for the 15,000-square-kilometer watershed area. Each cell size is 4-by-4 kilometer. The cells are assigned weights that could quantify monitoring values in terms of soil permeability, precipitation rate, evaporation rate, predicted soil moisture, evapotranspiration rate, and the normalized difference vegetation index (NDVI). RADARSAT and LANDSAT satellite images are acquired in support of determination for part of the weighted values, such as soil moisture and vegetation index, in the hydrological cycle. The weights are aggregated as coefficient matrices in a GIP model that help identify the most suitable locations. Fifteen cells are chosen out of eight hundred candidates and are ranked consecutively. Eventually, only five sites were selected after a site investigation based on site accessibility and practical uses of the selected sites. It may help collect a vital database at strategic locations, including wind speed, wind direction, soil moisture, ambient temperature, soil temperature, and relative humidity periodically for drought and flood management in the future [C860]

"The TerraSAR-L basic product tree"

The TerraSAR-L system, currently being designed in a Phase B definition study, provides ESA with its most powerful radar-imaging programme to date. The platform is optimized for and built around the 11 mtimes2.9 m active phased array antenna of the L-band Synthetic Aperture Radar (L-SAR). The L-SAR features, on top of standard Stripmap and ScanSAR operations, full polarimetric capabilities, repeat-pass ScanSAR interferometry and a Wave Mode. Specification of the L-SAR has been guided by a careful analysis of the product requirements resulting in a robust baseline design with considerable margins. Besides, a major contribution to applications in areas of climate change and oceanography, the TerraSAR-L design responds specifically to requirements from interferometric applications. One key element of the TerraSAR-L operations strategy is a long-term systematic and repetitive acquisition scenario to ensure consistent data archives and to maximize the scientific and commercial exploitation of this SAR system. The other important factor is a systematic processing of all acquired data to Single-look Slant-range Complex (SSC) products to facilitate higher level product generation and services based on these products. This paper describes the TerraSAR-L basic product tree and explains the rationale behind. The nominal TerraSAR-L imaging modes are introduced and their performance characteristics are described. The generation concept of multi-look detected products based consistently on complex products-generated either at an intermediate stage during ground segment processing or serving as input product into a stand-alone tool-is introduced. A modular SAR processor design using the same complex

product generation algorithms as far as possible independent of the underlying imaging mode is addressed [C861]

"An experimental complex for multi-frequency, short distance, coincident, microwave active-passive and in-situ combined measurements of soil and snow moistures"

An experimental polygon is represented, equipped by a complex of polarimetric (dual polarization), combined, short pulse scatterometer-radiometer systems of L-, C-, and X-band of frequencies, for bare soil, soil vegetation and land snow cover microwave reflective and emissive characteristics simultaneous and spatially coincident measurements. The polygon equipped as well by facilities for microwave devices absolute calibration, by spatially distributed sensors for in-situ measurements of soil moisture, and has local meaning small weather station. This paper has an aim to attract attentions of researchers engaged in such kind of measurements and to interest them to perform their own or joint measurements using available facilities [C862]

"Measurement and simulation of L-band emission for a larch forest stand"

In this work, there was tested a possibility to establish quantitative relationship between the moisture of forest stand, as a system of the trees, litter, and soil layers, and the radiometer antenna temperature. The radio brightnesses of radiometer antenna at L-band was measured as a function of viewing angle for both the V and H polarizations, with the antenna being directed at the larch forest stand. The radiometer was mounted on the tower at the height of 21.5 m, with the viewing angle being changed from close to the nadir to the horizon. The larch forest stand of 100 Ч 100 m2, used as an object of study, was located 50 km to the north from the city of Krasnoyarsk, Russia, with the average tree height, diameter, and density of trees being of 13.8 m, 0.1 m, and 0.38 trees/m2. All data were recorded in August 2001. In the theoretical model developed for predicting the radiometer antenna temperature, the forest canopy was considered as a three layers medium with each layer having its own complex dielectric permittivity. The latter was calculated using the refractive mixing dielectric model with its parameters being determined experimentally in L-band through the laboratory measurements using the data collected in situ at the site of measurement. As a result, there have been proved the possibility of using comprehensive radiobrightness and dielectric models as a physical basis in developing processing algorithms for radiometric remote sensing of moisture, on the forested territories. [C863]

"Analysis on noise reduction method for interferometric SAR image"

Noise in SAR interferogram brings much trouble in phase unwrapping. It will also influence the accuracy of digital elevation models. Based on realization of complex mean filtering, pivoting mean filtering, pivoting median filtering three noise reduction algorithms, their computations are analyzed and the effect of noise reduction is given out. In order to get the most optimized balance between computation and effect of noise reduction, a new noise reduction idea-second-time or multiple combined noise reduction is proposed. The algorithm can comprehend the merits of several noise reduction methods. It can preserve edge information well and decrease phase noise dramatically at the cost of adding a little computation. Based on computer simulation, certain terrain is set and the effect of noise reduction of new method is verified. The variance of before and after combined noise reduction is given out. The effect of three-time or more combined noise reduction is not obvious because noise has been reduced by second-time noise reduction. We do not recommend 4 or more-time combined noise reduction for its large computation. ERS-frac12 real data are also used to verify the validity of the new algorithm [C864]

"Creating a geographic footprint from LIDAR data in ArcGIS"

LIDAR (Light Detection and Ranging), like radar, is an active remote sensing system. This technology involves the use of pulses of laser light directed toward the ground and measures the time of pulse return. The return time for each pulse, back to the sensor is processed to calculate the variable distance between the sensors and the various surfaces present on the ground. The project is to create a geographic footprint from LIDAR data, using Microsoft Visual Basic for Application (VBA) and ArcGIS. VBA is an across product language that allows users to create complex and fully functional applications. The problem at hand was to find the line beginning and the line end of each scan line and mark those points to extract the polygon outline. The maximum and minimum points, which will declare the left or right outermost points of the sample image, were found. These x and y connecting points cannot have openings or dangling lines when being shaped into a polygon. In order to avoid unwanted shapes, the programs used to arrange points to draw a polygon of the selected data were written. VBA was used to write the program codes and then the codes were integrated with ArcGIS software. This paper demonstrates specific examples regarding the creation of geographic footprint from LIDAR data in ArcGIS. The end product of the project can be useful for anyone working with LIDAR data [C865]

"L-band active-passive and L-C-X-bands passive data for soil moisture retrieval, two different approaches in comparison"

In the context of the project HYDRO-POL, a study was carried out to test the efficiency of two different approaches: the use of L band active and passive data or the use of L-C-X bands passive data to retrieve soil moisture of bare soils. Simulated data are generated implementing classical superficial scattering models: IEM model for active L-band and L-C-band passive data, GO model for X-band passive data. Data are simulated considering different roughness conditions and moisture content. As the inversion problem is very complex, artificial feedforward backpropagation neural networks (NN) were employed. The best performing NNs are chosen to simulate a retrieval with a dataset artificially added with noise. In each case, the best retrieved parameter is the real part of the dielectric constant, while roughness parameters, especially autocorrelation length, is not very well retrieved. In many cases, retrieved values are out of range, so that the simulated values and targets appear unrelated. Applying a very generic filter that eliminates values very far from the proper range, correlation coefficients grow up. This filter cleans up the resulting data removing a small part of them. After this filtration, correlation coefficients relative to the real part of the dielectric constant surpass 0.82. In spite of the filtering process, roughness parameters retrieval is of inferior quality. On smooth soil, the three considered configurations work in an equivalent way, excellently retrieving the real part of the dielectric constant, without a need for filtration. On medium and rough soil, inversion results generally more difficult, so that performance gets worse. Active-passive approach results more efficient than the L-C-X one [C866]

"High resolution radar imaging using GPOF based data extrapolation"

A new data extrapolation technique which utilizes pole extraction based GPOF method is proposed to fit the scattering characteristics of an object. The proposed data extrapolation method is very efficient for data extrapolation when applied to the ISAR data. Modeling the data as the superposition of complex exponential signals, GPOF and Prony methods do not guarantee a stable prediction filter like the MCM method, while Burg ensures. Meanwhile, the performance of GPOF decreases with the increasing number of scattering centers but the radar images obtained using this extrapolated data is still more accurate than those obtained using the extrapolated data generated by other methods [C867]

"Improving coherence estimation for high-resolution polarimetric SAR interferometry"

This work presents a new method for filtering the coherence map issued from Synthetic Aperture Radar (SAR) polarimetric interferometric data. For each pixel of the interferogram, an adaptive neighborhood is determined by a region growing technique driven by the amplitude image information. Then, pixels in the derived adaptive neighborhood are complex averaged to yield the filtered value of the coherence, after performing a phase compensation step. The proposed method has been applied on airborne high-resolution polarimetric interferometric SAR images. Both subjective and objective performance analysis, including coherence edge detection, shows that the proposed method provides better results than the standard phase-compensated fixed multi-look filter and a linear adaptive coherence filter proposed by Lee et al. [C868]

"A novel algorithm for two-dimensional harmonic retrieval"

This paper addresses the 2-D harmonic retrieval problem embedded in complex Gaussian white noise. By use of the biorthogonality of matrices and rotational invariance property, a novel iteration algorithm for 2-D harmonic retrieval is presented, which obtains a single column of the Vandermonde matrix containing 1-D frequencies and the corresponding column of the Vandermonde matrix containing the other 1-D frequencies in each iteration. Thus, this algorithm can automatically pair the 2-D frequencies. Its performance is verified by computer simulation results. [C869]

"Estimating frequencies of two dimensional harmonics Gaussian noise with hypercomplex"

The complex signal of two dimensional harmonics is common. The pairing steps were always needed when we estimated the frequency pairs of harmonics which were described by complex signals. We introduced hypercomplex signal in this paper, and used it to study two dimensional harmonics in additive Gaussian white noise. First, we constructed hypercomplex signal using the original two dimensional harmonics and its Hubert transform. Then, we presented our algorithm of estimating frequencies of hypercomplex signal taking advantage of the properties of Hamilton's quaternion. Some simulations illustrated the prospect of using hypercomplex signal in estimating parameters of two dimensional harmonics in additive Gaussian white noise without pairing steps. [C870]

"Discontinuous Non-Rigid Motion Analysis of Sea Ice using C-Band Synthetic Aperture Radar

Satellite Imagery"

Sea-ice motion consists of complex non-rigid motions involving continuous, piece-wise continuous and discrete particle motion. Techniques for estimating non-rigid motion of sea ice from pairs of satellite images (generally spaced three days apart) are still in the developmental stages. For interior Arctic and Antarctic pack ice, the continuum assumption begins to fail below the 5 km scale with evidence of discontinuities already revealed in models and remote sensing products in the form of abrupt changes in magnitude and direction of the differential velocity. Using a hierarchical multi-scale phase-correlation method and profiting from known limitations of cross correlation methods, we incorporate the identification of discontinuities into our motion estimation algorithm, thereby descending below the continuum threshold to examine the phenomenon of discontinuous non-rigid sea-ice motion. [C871]

"Trends in design of massively parallel coprocessors implemented in digital ASICs"

This paper collects the most recent parallel coprocessors and highlights the recent trends. It is shown that the single chip massively parallel processor implementations seem to disappear from the scientific investigations (with the exception of low-level near-sensor image processing). Meanwhile, the formerly developed architectures have moved inside complex system-on-chips/microprocessors. The common aspect of the recent architectures is the advanced processing element and internal interconnection solutions, and the dominant mid-grain parallelism (i.e. up to a hundred processing element per chip). [C872]

"Analysis of island wakes and katabatic winds imaged by RADARSAT-1 synthetic aperture radar"

In this study, the sea surface imprints of strong mountain katabatic winds and gap winds are observed on RADARSAT-1 synthetic aperture radar (SAR) ScanSAR wide images off the west coast of the U.S. and in the Gulf of Alaska. Two case studies are presented. In the first case study, a RARASAT-1 SAR scene taken at 14:25:30 UTC on January 21, 2003 shows a finger-like wind pattern that mirrors the coastal mountain height. In the second case, the SAR image was taken at 4:41:45 UTC on December 22, 1999. It shows a strong gap wind and vortex streets through the Aleutian Islands. In order to understand the dynamics of these wind patterns observed in the SAR images, we simulated the low level atmospheric circulation using the fifth-generation Pennsylvania State University (PSU)-National Center for Atmospheric Research (NCAR) Mesoscale Model, MM5. A triple nested-grid (9/3/1 km) technique is employed to achieve a multi-scale simulation. In general the MM5 model captures the wind pattern very well and reveals the dynamics of these meso-scale atmospheric phenomena. However, the MM5 did not resolve the vortex shedding due to the model resolution and the complex nature of this phenomenon [C873]

"A new historic ERS wave mode data set for oceanographic applications"

Since 1991, the ERS satellites have collected high resolution SAR data over the oceans on a global and continuous basis. Operating in wave mode the ERS SAR yields a patchy coverage of the oceans with about 1500 images of 10 by 5 km size each day. These data have recently been shown to be able to deliver wind speed and wave spectra as well as information on individual waves. In the scope of the ESA AO WaveAtlas, the ERS-2 raw data acquired in 1999 and 2000 are reprocessed to single look complex imagettes. This paper describes the necessary steps for the reprocessing of historic wave mode data including an assessment of the effort required to reprocess all available ERS wave mode raw data archived at ESA. Furthermore the paper demonstrates the potential of these data for different oceanographic applications. Special emphasize is put on wind, wave and sea ice measurements. In addition atmospheric features can be analyzed. The data in particular enable the estimation of two-dimensional sea surface elevation fields which are of high practical relevance for ship design or offshore operations. Mean wave parameters like the mean period derived from SAR wave mode data can be used for the assimilation of numerical wave models thus helping to improve wave forecast. Global maps of mean and individual wave parameters are presented. The reprocessing of wave mode data is planned to be extended to the full lifetime of ERS-1 and ERS-2, which is at least 1991-2004. This allows the derivation of wave climatologies on a decadal basis in particular enabling the analysis of climate trends. As wave mode data are also available from the ENVISAT mission a consistent update of these climatologies is possible [C874]

"A novel algorithm for FPGA-based SAR Doppler center frequency estimation"

In this paper, a complex sign Doppler estimator (CSDE) is proposed for FPGA-based real-time synthetic aperture radar (SAR) Doppler center frequency estimation. This CSDE reduces the complexity in Doppler center frequency estimation by exploiting the statistical properties of SAR data and applying the complex arcsine law to the correlation coefficient calculation. Simulation results show that with this CSDE, much less computational loads and implementation area can be achieved compared with existing estimators while maintaining comparable performance. [C875]

"A strip adaptive processing approach for the SMOS space mission"

This article is concerned with the apodization windows to be applied to brightness temperature maps reconstructed from complex visibilities provided by the MIRAS (Microwave Imaging Radiometer with Aperture Synthesis) instrument on board the SMOS (Soil Moisture and Ocean Salinity space mission) spacecraft in order to achieve a close to uniform pixel at the Earth's surface level [C876]

"A new method for automatic calibration of 5-port reflectometers"

The five-port reflectometer has been recently applied to demodulators and radars, offering an alternative to classic In-Phase/In-Quadrature (I/Q) discriminators. In these applications, calibration of the reflectometer is an important task. Most of the methods developed are suitable for the instrumentation and measurement field and present a high degree of complexity. We propose in this paper a new method for calibrating six or five-port reflectometers. This procedure is advantageous for its simplicity and is particularly useful for calibration in manufacturing processes. [C877]

"Real time Multi-UAV Simulator"

This paper presents the system architecture of a real time multi-UAV simulator (RMUS). The simulator has been implemented as both a testing and validation mechanism for the real demonstration of multiple UAVs conducting both decentralised data fusion and control. These mechanisms include the off-line simulation of complex scenarios, hardware-in-the-loop tests, validation of real test results, and online mission control system demonstrations. The paper also present CommLibX, a novel communication framework for the system which allows simulation modules to communicate over single or multiple virtual channels. This unique communication system is then easily ported onto the real hardware allowing for maximum reuse of software and integrity. [C878]

"Adaptive real-time publish-subscribe messaging for distributed monitoring systems"

Many complex distributed real-time applications, monitoring and controlling the external environment, require sophisticated processing and sharing of an extensive amount of data under critical timing constraints. We present adaptive real-time publish-subscribe (RTPS) messaging service for distributed real-time applications, and four primitives are defined for expressing the adaptive RTPS. Furthermore, adaptive RTPS is incorporated into an active real-time database (ARTDB) named Agilor by translating RTPS primitives into subscription objects and ECA rules. We also apply real-time scheduling algorithm to protocol processing for improving predictability and minimizing priority inversions during message transmission. The experimental results indicate the idea is feasible, and the current implementation shows better performance [C879]

"Modelling research of complex signal back-scattering from surge sea surface"

Features of radar signals reflection by surge sea surface in decameter range of wavelengths are investigated. As a probe signal is used complex signal, matched with a surface frequency coefficient of reflection. The form of radio echo is analyzed. Simulation of radar signals back-scattering from the marine surge surface is conducted. Differences in outcomes of simulation and analytical solutions are considered. [C880]

"Research of signal processing system based on multi-model adaptive control methods"

Traditional single-model adaptive signal processing system faces many difficulties when it is applied in complex signals processing and different conditions, such as constant frequency wide-band signal, fast-varying signal and changed disturbing conditions. In this paper, multi-model adaptive signal processing systems based on multi-model adaptive control structure is presented. [C881]

"Global numerical optimization using multi-agent genetic algorithm"

A new algorithm, Multi-Agent Genetic Algorithm (MAGA), is proposed. It realizes the complex global numerical optimization via agent-agent interactions. All agents are fixed on a lattice, and they will compete or cooperate with their neighbors to increase their own energy. On the other hand, agents can also increase their energy with knowledge. In experiments, 4 multimodal benchmark functions are used to explore the effect of problem of problem dimension on the performance of MAGA. The results on functions with 20 10,000 dimensions show that MAGA obtains good performance in solving high dimensional functions. Even when dimension is as high as 10,000, MAGA can still find high quality solutions with very low computational cost. [C882]

"An ultra high-speed FFT processor"

This paper presents an implementation of an ultra high-speed FFT processor which can process input data of 800MHz sample rate. In order to meet such an extremely real-time requirement, high-speed differential I/O interfaces (LVDS) and dedicated parallel-pipelined radix-8 architecture are adopted. Implemented in an FPGA device, the processor can operate at 115MHz and compute a 4096-point complex FFT in 5μs. To reduce power consumption, currently, the chip is being migrated to 0.18 μm CMOS technology. [C883]

"Immunity clonal strategies"

Based on the clonal selection theory, the main mechanisms of clone, which will be explored in the field of artificial intelligence, are analyzed in this paper. An improved evolutionary strategy algorithm, immunity clonal strategy algorithm (ICS), which includes immunity monoclonal strategy algorithm (IMSA) and immunity polyclonal strategy algorithm (IPSA), is put forward. Compared with the classical evolutionary strategy algorithm (CES), ICS is shown to be an evolutionary strategy capable of solving complex machine learning tasks, like multi-objective optimization, and the results are better. Using the theories of Markov chain, it is proved that ICS algorithm is convergent. [C884]

"An optimization-based approach for distributed project scheduling"

Pressed by market globalization, a recent trend for manufacturers is to have their design teams at different locations to better serve local markets and reduce design costs. Under the concurrent engineering paradigm, tasks in a design project are required to be performed in parallel, however, are often interdependent in a complex way. As a result, effective communication and coordination among teams become vital for a project to be successful. The complex interdependencies have not been adequately addressed in the literature. This paper presents a novel optimization formulation that explicitly models the interdependencies among tasks and the communication activities required. A solution methodology that combines Lagrangian relaxation and the surrogate subgradient method has been developed to solve the optimization problem that is inseparable. Backward/forward Dynamic programming is used to solve task subproblems. Numerical results demonstrate that complex dependencies among tasks are satisfied via communication activities, and near-optimal schedules are efficiently obtained. [C885]

"Experience of antenna complexes creation for the radars of distant detecting and space area monitoring"

Air defense radars using reflector antennas for area surveying were not found suitable for operating new targets. Antennas with great aperture surface and electrical beam moving were required. Antenna complexes of "Dunay-3" and "Dunay-3U" radars are presented in this paper. It operates in the decimeter wave band and consists of two antenna systems located in two sites-the transmitting one and the receiving one. The antenna is also an active array with linear radiators. The "Dunay-3" radar antenna uses 200 radiators while the "Dunay-3U" consists of 100 linear radiators. The main radar element is an antenna made as a phased antenna array on relatable system for the upper semi-sphere observation. The antenna array is divided at sub arrays with an analogue beam forming way and the full antenna pattern is formed with an adaptive digital way. Another antenna complex presented in this paper is the "Volga" radar. The "Volga" radar is the new generation of distant detection stations operating in continuous radiation regimen: the radar illuminates a target and receives reflected signals simultaneously. [C886]

"Radar the next generation-sensors as robots"

One can easily envisage future military operations and emerging civilian requirements (e.g. intelligent unmanned vehicles for urban warfare, intelligent manufacturing plants) that will be both complex and stressing and will demand innovative sensors and sensor configurations. The goal of our research into sensors as robots is to develop a cost effective and extendable approach for providing surveillance for a variety of applications in dynamically changing military and civilian environments. We discuss the development of a futuristic intelligence, surveillance and reconnaissance concept utilizing the innovative integration of cutting edge technologies such as: knowledge-based signal processing; robotics; wireless networking; waveform diversity; the semantic Web; advanced computer architectures and supporting software languages. This concept is projected as an autonomous constellation of air, space, and ground vehicles that would offer a robust paradigm to build toward future deployments. [C887]

"Tracking radar digital matched-filter ASIC design and its error analysis"

Matched-filter is widely used in real time signal processing, especially in radar signal processing. This paper presents a novel structure of digital tracking radar matched-filter, whose hardware overhead is one third of traditional design but its throughput is doubled. With block-floating-point arithmetic, the precision is high

improved. The whole digital matched-filter is implemented in just one chip of FPGA. This ASIC has two work modes: 512 points pulse compression and 256 points pulse compression. It complements three channels of 512-points complex signal in 102us. The noise-to-signal ratio formula of this matched-filter is deduced at the end of the paper. [C888]

"Ocean imaging using multichannel along track interferometry"

An airborne multichannel along track interferometer (MATI) is described and discussed. This MATI system is based on an X-band SAR installed in a BAE/BAC 1-11 aircraft which can be set up with 2, 3 or 4 beams. It is demonstrated that a MATI can be used to Doppler filter radar signals acquired from a moving platform which are scattered by moving and partially coherent scatterers. Processing techniques are described for the removal of phase errors. These phase errors are caused primarily by the separation of the antennas in range due to the aircraft installation, and by aircraft roll, pitch and yaw motions. The basis of the processing technique is a two stage phase screen which is capable of compensating the differential phase errors between each image in a multichannel set to the precision required for Doppler filtering. It is shown that optimal filtering may be applied to the scattered radar signals by adaptively varying complex weights applied to each channel until an extremum of a selected image measure is obtained. Hence, if a certain type of scatterer is associated with energy located in a particular part of the Doppler spectrum, and an image feature results from the modulation of this type of scatterer, then the visibility of the feature can be maximised using an adaptive MATI. An example is presented showing the technique applied to a sandbank image. [C889]

"The design and development of an experimental netted radar system"

In this paper we report on the development of a low-cost, four-node netted radar system operating at S-band. The system has been designed using 'commercial off the shelf' subsystems and components wherever possible. A detailed computer simulation has been implemented to provide an environment for testing design options and development of a test strategy for the completed network. This has been invaluable as the extra dimensionality of the system, uncertainty in component specification and potential variability in the synchronisation signal make design and performance prediction complex. [C890]

"Multiple reflectivities estimation for multibaseline InSAR imaging of layover extended sources"

In this paper, the problem of retrieving radar reflectivity of natural layover areas is addressed. It is formulated as the problem of estimating a multicomponent sinusoidal spatial signal corrupted by multiplicative complex correlated noise-the speckle in the radar imaging jargon-and by additive white Gaussian noise. Application of nonparametric adaptive and parametric spectral estimators for amplitude estimation is investigated for a multiple looks scenario. Performance analysis is investigated through Cramer-Rao lower bound calculation and Monte Carlo simulation. The method of least squares (LS), coupled with Capon's approach for interferometric phase estimation, multilook-RELAX and multilook-APES outperform conventional beamforming and provide accurate reflectivity estimates for undistorted image formation of layover areas. [C891]

"Ultra wideband radar target discrimination using the signatures algorithm"

An aspect independent radar target discrimination method based on the natural frequencies of ultra wideband radar targets is introduced. The sets of points in multi-dimension space corresponding to the poles on a complex plane (natural resonances) were offered as signatures of radar targets. This approach allows performing an automated discrimination algorithm of radar targets. The results of experimental research of the signals scattered by the scaled aircraft models by using the signatures algorithm are presented. [C892]

"Robust antenna array processing using M-estimators of pseudo-covariance"

This paper addresses the problem of antenna array processing in nonGaussian noise and interference conditions. Such conditions arise due to man-made interference in indoor and outdoor mobile communication channels as well as in military communications. In this paper M-estimators of the array (pseudo-)covariance matrix based upon complex data set are introduced. Estimates of the noise and signal subspaces based on M-estimators are then used to robustify the subspace direction of arrival (DOA) estimation methods. In addition, eigenvalues based on M-estimators are used in MDL criterion, thus yielding a robust signal detection method. The reliable performance of the proposed methods are shown by simulations. [C893]

"A multiple target high precision laser range measurement system based on the FMCW concept"

Optical distance measurement systems are well suited for achieving very high measurement accuracies due to the small measurement spot. Unfortunately most of the existing commercial measurement systems suffer from

their limitation to one target only. In this article an optical measurement system is described that is able to work even in complex multi target environments like in closed vessels where the measurement signal has to pass through a process window. The system is based on the FMCW concept allowing large bandwidths of more than 2 GHz. Another feature is a baseband phase-locked-loop (PLL) linearization of the frequency ramp generated inside a broadband high frequency oscillator. This PLL guarantees for a highly linear and reproducible frequency generation and thus is the basis for stable and precise measurement results. Measurements on a prototype system underline the good functionality of the concept. [C894]

"Ad hoc sensor networks, constraint programming and distributed agreement"

Numerous applications rest on sensor networks. Managing such networks in an efficient manner involves solving complex distributed computing problems, that problems are magnified in ad hoc sensor networks, where a limited knowledge of the topology is available. The two major issues that must be addressed simultaneously are, on the one hand, optimal sensor allocation and, on the other hand, tolerance to sensor and communication failures, which leads to solving dynamic assignment/reconfiguration problems. We describe a class of solutions that combines the problem solving capabilities of constraint programming techniques with the properties of distributed real-time fault-tolerant agreement. With such solutions, those safety, timeliness and dependability properties that define the management problems under consideration. The efficiency of these solutions are illustrated with real world examples. [C895]

"Application of state-space frequency estimation to a 24-GHz FMCW tank level gauging system"

Radar is a well established tank level gauging technique. Today, a shift towards more demanding measurement applications can be observed. As a result, novel radar signal processing algorithms emerge. One of the most challenging tasks for tank level gauging systems is separation of closely spaced targets, especially with the given bandwidth limitations set by both legal means and technical feasibility. Superresolution methods are expected to overcome the inherent resolution limits of Fourier transform based algorithms. However, they are fairly complex, making adaptation to real world radar signals a tedious and complicated task. Furthermore stability problems occur, mainly caused by the necessary a priori model-order estimation. This paper now demonstrates a robust implementation in a commercial 24 GHz radar tank level gauging system, where an adaptive model-order estimation algorithm is used. The measurements in an industrial tank show a threefold increase of the resolution while maintaining stability. Finally a special set of measurements shows that the selected state-space approach is especially well suited for the resolution of small peaks adjacent to larger echoes. [C896]

"Two discrete-time phase delay estimators"

Two simple discrete-time methods for estimating the phase-shift between two real sinusoidal signals in noise are proposed. The first estimator removes the bias of the recently proposed quadrature delay estimator (QDE) by utilizing all in-phase and quadrature-phase components of the received signals. While the phase estimate of the second method is given by the phase difference of the discrete-time Fourier transforms of two complex sinusoids derived from the real signals. The performances of the two estimators are evaluated by comparing with the QDE as well as the performance bound. [C897]

"Phase-based detection of small 3-D dielectric objects beneath rough surfaces"

This paper discusses the detection of small three-dimensional (3-D) dielectric objects with low contrast (relative to their surrounding media) buried near the 3-D rough ground surface by means of stand-off ground penetrating radar. This case scenario was derived from the requirements on detecting small non-metallic anti-personnel (AP) mines in realistic minefields, where AP mines are buried a few centimeters beneath rough ground surfaces. If the dielectric contrast between the objects and their surrounding media is low, and if the objects are small and buried just beneath rough ground surfaces, then scattering from the rough ground surfaces will dominate and hence mask the weaker scattering from these buried objects. Various analyses and numerical simulations have shown the considerable complexity of scattering from rough surfaces and/or the targets buried beneath rough surfaces. In this paper, we present the methodology using measured GPR phase data to deal with this complex problem without using a-priori knowledge about the target and/or ground characteristics. [C898]

"Realistic modeling of surface ground-penetrating radar antenna systems: where do we stand?"

The generation and recording of electromagnetic waves by ground-penetrating radar (GPR) systems are complex phenomena. To investigate the characteristics of typical surface GPR antennas operating in realistic environments, we have developed an antenna simulation tool based on a finite-difference time-domain (FDTD) approximation of Maxwell's equations in 3-D Cartesian coordinates. The accuracy of the algorithm is validated

with respect to laboratory measurements for comparable antenna systems. Numerically efficient and accurate modeling of small antenna structures and high permittivity materials is achieved via subgridding. We simulate the radiation characteristics of a wide range of common surface GPR antenna types ranging from thin-wire antennas to bow tie antennas with arbitrary flare angles. Due to the modular structure of the algorithm, additional planar antenna designs can readily be added. Shielding is achieved by placing a metal box immediately above the antenna. Damping is accounted for by filling the shield with absorbing material, by connecting the antenna to the shield with resistors or by continuous resistive loading of the antenna panels. The effects that these features have on the radiative properties of the tested GPR systems and thus on the illumination of the subsurface are investigated for various half-space models. [C899]

"Applications of GPR for surface mining"

Over the past 25 years, a myriad of applications for GPR technology have evolved ranging from archaeology to subsurface mapping on Mars. However, it is only recently that GPR has been applied on a production basis for surface mining. Due to the generally resistive nature of the media, GPR is an obvious candidate for alluvial gold and diamond resource exploration in aggregate-filled paleochannels. By correlating the radar reflectors to known geological features detected by boreholes or trenches, GPR has been used on a large scale for preliminary exploration, as well as on a local scale for the three-dimensional reconstruction of complex braided paleochannel systems. Although GPR has been attempted historically at a variety of placer sites, newly developed visualization techniques have enabled greater exploitation of the richness GPR data affords. Data are presented which illustrate the utility of GPR in the three-dimensional mapping of various fluvial paleofeatures, to depths frequently exceeding 40 m. A demanding application for GPR is that presented by tropical weathering environments. With the dramatic growth of interest in lateritic and bauxitic resource exploration, fueled by increasing demand and new processing technologies, the need for accurate resource delineation and careful mine planning becomes paramount. The traditional use of borehole grids to calculate ore reserves has proven to be neither sufficiently accurate nor cost-effective at many sites due to the complexity of tropical weathering profiles. Although conventional wisdom dictates that radar surveys are usually unsuccessful in regions with a high clay fraction, GPR has emerged as the most suitable geophysical tool to complement borehole grids in addressing project geology, resource delineation, and mine planning issues in the high clay fraction soil found in most tropical weathering environments. [C900]

"Advances in microwave tomography: phaseless measurements and layered backgrounds"

A new approach for electromagnetic imaging of scatterers enclosed in a stratified media from only intensity data is proposed and discussed. The developed procedure splits the problem in two different steps. In the first one a phase retrieval problem is solved for the total field, thus estimating the scattered field. Then, the complex permittivity profile is reconstructed in the second step by using the estimated scattered field. Numerical examples are provided in order to check the whole chain (which is done in the case of scatterers located in free space) and a specific inverse scattering procedure capable to deal with a three layers background. [C901]

"Electromagnetic field and material properties in ground penetrating radar"

Electric, magnetic and electromagnetic fields are consequences of the existence, motion and acceleration of electric charge. Complex coupled vector field distributions in space and time result. Most material properties are consequences of EM field interactions between adjacent matter particles at atomic scales. Velocity, attenuation, wavelength, polarization, scattering, relaxation, and resonance are some of the properties and processes important to electromagnetic wave propagation in ground penetrating radar. Such properties and processes determine the performance limitations of ground penetrating radar systems, and they are also what are measured by ground penetrating radar to describe ground and things buried within the subsurface. Space and time distributions of material properties are described in terms of complex dielectric permittivity and complex magnetic permeability. "Complex" means there are parts describing both energy dissipation and storage, with consequential frequency dependent properties. Dielectric properties are dominantly controlled by the distribution and properties of water in the ground. Magnetic properties are dominantly controlled by the distribution and properties of iron in the ground. Field polarization and scattering processes are dominantly controlled by the geometric orientation and spatial distribution of contrasts in material properties at wavelength scales. Measurement of field properties and processes allows GPR to determine material properties. [C902]

"Application of State-Space Frequency Estimation to a 24-GHz FMCW Tank Level Gauging System"

Radar is a well established tank level gauging technique. Today, a shift towards more demanding measurement applications can be observed. As a result, novel radar signal processing algorithms emerge. One of the most

challenging tasks for tank level gauging systems is separation of closely spaced targets, especially with the given bandwidth limitations set by both legal means and technical feasibility. Superresolution methods are expected to overcome the inherent resolution limits of Fourier transform based algorithms. However, they are fairly complex, making adaptation to real world radar signals a tedious and complicated task. Furthermore stability problems occur, mainly caused by the necessary a priori model-order estimation. This paper now demonstrates a robust implementation in a commercial 24 GHz radar tank level gauging system, where an adaptive model-order estimation algorithm is used. The measurements in an industrial tank show a threefold increase of the resolution while maintaining stability. Finally a special set of measurements shows that the selected state-space approach is especially well suited for the resolution of small peaks adjacent to larger echoes. [C903]

"Ultra Wideband Radar Target Discrimination Using the Signatures Algorithm"

An aspect independent radar target discrimination method based on the natural frequencies of ultra wideband radar targets is introduced. The sets of points in multi-dimension space corresponding to the poles on a complex plane (natural resonances) were offered as signatures of radar targets. This approach allows performing an automated discrimination algorithm of radar targets. The results of experimental research of the signals scattered by the scaled aircraft models by using the signatures algorithm are presented. [C904]

"Asymptotic maximum likelihood estimation of multiple radar targets"

This work deals with the problem of jointly estimating complex amplitudes, directions of arrival (DOAs) and Doppler frequencies of multiple radar targets present in the same range-azimuth resolution cell. We derive the conditional maximum likelihood (CML) and the asymptotic (large sample size) ML (AML) estimators. We propose as well an efficient way to implement the AML algorithm based on a RELAXation method. RELAX allows us to decouple the problem of jointly estimating the parameters of the signal components into a sequence of simpler problems, in which we estimate separately and iteratively the parameters of each component. Performance of the AML estimator is investigated through Monte Carlo simulation and compared with the Cramer-Rao lower bound in the case of target model mismatch. The AML estimator has been derived, in fact, in the case of deterministic amplitude, but here, the performance of the estimator is evaluated in the case of random target amplitudes. [C905]

"EDGE data receiver design"

Data receiver design is one of the most challenging tasks in EDGE terminal implementation. We outline critical design considerations for data receiver and describe their impact on the receiver performance. Sensitivity of the design to specific receiver parameters is illustrated, showing that overall solution requires complex balance between channel estimation, synchronization, equalization and soft bit information for channel decoding. [C906]

"Target detection in sea clutter using convolutional neural networks"

A detector based on convolutional neural networks is proposed for radar detection of floating targets in highly complex and nonstationary cluttered environments. This detector is coherent and monocell, i.e. it works with the complex envelope of the echoes from the same range cell. It includes a pre-processing time-frequency block implemented by the Wigner-Ville distribution, which provides a constant false alarm rate (CFAR) behavior regarding the clutter power when normalization is utilized. Simple theoretical models for the clutter and targets were allowed to study the impact of the correlation and Doppler of both target and clutter on its performance. This detector has also been tested with real-life sea clutter with an improved performance compared to classic detectors. [C907]

"A new method for detectability of signals in K-distributed clutter"

In this paper, we introduce a new method to analyze the detection performance of radar systems, operating in K-distributed clutter and thermal noise. A parametric approximation of cumulative distribution function (CDF), and probability density function (PDF) in terms of weighted sum of exponentials for detection probabilities are obtained, using a finite amount of sample random variables in the environment. The method proposed here is based on approximating CDF of the sample variates by a linear combinations of complex weighted exponentials. This method simplifies the detection problem and is directly applicable to many problems in the simulation of communication systems to determine density functions. [C908]

"Denoising radar signals using complex wavelet"

In this paper, an extended SURE procedure is proposed to denoise radar I/Q orthogonal complex signals with

Doppler phase shift using complex wavelet. Waveshrink has proven to be a powerful tool for the problem of signal extraction from noisy data. A key step of the procedure is the selection of the threshold parameter. Donoho and Johnstone propose of the threshold based on a SURE procedure for real signals. In this paper, we first review the minimax threshold selection procedure and then propose to extend the use of SURE procedure for denoising radar signals with complex-valued discrete wavelet transforms. At last, an example is used to show that the extended SURE procedure is an effective method for denoising radar signals. [C909]

"Signal waveform reconstruction from noisy bispectrum estimations pre-processed by vector filters"

The reconstruction of 1-D signal waveform from noisy bispectrum estimations in case of a limited ensemble realization number and low input SNRs leads to considerable output errors. In order to improve the signal bispectrum estimations we propose to smooth the obtained bispectrum estimations. The methods based on vector filter application to 2-D complex valued bispectrum processing are considered in this paper. The influence of input SNR, the filter type and the used norm selection on signal reconstruction system performance is analyzed using computer simulations. It is shown that the proposed methods decreases both fluctuation error and bias of reconstructed signal. [C910]

"Maximum likelihood angle-frequency parameter estimation in unknown noise fields for low-elevation target tracking"

In radar applications, the received echo signals reach the array elements via a multiplicity of paths even though there exist only one target. So, it is often relevant to estimate the direction and the Doppler frequency of each path ray. We apply in this paper a 2D extension of the approximate maximum likelihood (AML) algorithm to estimate these parameters using a sensor array in an unknown additive noise field. We consider the case where the complex fading factor fluctuates from one pulse repetition interval (PRI) to another one. Numerical simulations are provided to assess the performance of the approach, which is compared to the standard stochastic maximum likelihood derived for a white Gaussian noise. [C911]

"Designing the fast filter bank with a minimum complexity criterion"

The fast filter bank (FFB) is an extremely efficient single-rate filter bank due to the sparse population of non-zero coefficients in the subfilters. Its subfilters are designed and operated based on the frequency response masking (FRM) technique. The node-modulated fast filter bank (nm-FFB) was proposed as a modification to the fast filter bank to further reduce its complexity when processing real-input, real output signals. An optimal implementation of the nm-FFB can be achieved by shifting the terminal stage at which node-modulation is performed. Such an implementation is extended to the complex signal case and found to provide a lower complexity when compared to the original FFB implementation. [C912]

"Wavelet-based impulse reconstruction in UWB-radar"

In this paper we present a technique for evaluating shape and position of an ultra wideband pulse in noisy data, based on the continuous wavelet transformation. By using a complex extension for both the signal and the mother wavelet, the received impulse can be completely characterized by only four parameters, without the necessity of exact knowledge of the pulse shape. With this novel approach, the impulse shape is characterized by the angle information of the complex wavelet transform. This allows e.g. the reduction of the amount of data for further processing. [C913]

"Subsurface imaging using measured antenna footprints"

For the detection of landmines, images of the subsurface are made using a bistatic stepped frequency continuous wave radar system. During the measurements, the system moves along the surface and due to the presence of objects in the subsurface changes in measured voltages are observed. These changes are formulated as a convolution of a complex contrast function with a sensitivity function. In fact, this sensitivity function is the vectorial inner product of the incident and the total electric wavefield. Using the Born approximation, the sensitivity function is obtained as the inner product of the field emitted by the transmitter and the field from the receiver operating in transmitting mode. For imaging purposes, knowledge of the wavefields in the subsurface is needed. Since it is difficult to model the radiation characteristics very accurately, we measure the footprints of the antennas at one level and propagate the emitted wavefields using Huygen's principle. After we verify the usability of this principle, we create synthetic data using measured patterns and apply back-propagation on the data to localize objects. [C914]

"An ultra-wideband microwave radar sensor for characterizing pavement subsurface"

A new ultra-wideband (UWB) stepped-frequency radar sensor operating from 0.6 to 5.6 GHz has been developed using microwave integrated circuits for pavement subsurface characterization. UWB microstrip quasi-horn antennas have also been designed and tested for use in the sensor. A new simple yet effective, accurate procedure was developed to compensate the amplitude deviations and non-linear phase errors of the complex I/Q vectors due to the inherent imperfection of the system. The system has been used to assess a pavement sample with good accuracy. [C915]

"On the unitary equivalence application in the polynomial phase signal processing"

The high-order ambiguity function (HAF) was introduced for the estimation of polynomial-phase signals (PPS) embedded in noise. Since the HAF is a nonlinear operator, it suffers from noise-masking effects and from the appearance of undesired cross terms in the presence of multicomponents PPS. The multilag HAF concept was then proposed as a way to improve the performances of the HAF. Nevertheless, performances of the new methods are affected by the error propagation effect which drastically limits the order of the polynomial approximation. This effect is due to the technique used for polynomial order reduction, common for actual approaches: signal multiplication with the complex exponentials formed with the estimated coefficients. In this paper, we introduce an alternative method to reduce the polynomial order, based on the successive unitary signal transformation, according to each polynomial order. We will prove that this method considerably reduces the effect of error propagation. [C916]

"Investigation of side looking EM field scattering from a buried metallic object to support UXO discrimination"

Detection and identification of buried unexploded ordinance (UXO) remains a challenging problem. Despite limitations due to clutter and ground coupling, ground penetrating radar has shown considerable virtues for UXO discrimination. Recent UWB field tests between 10's of MHz and 100's of MHz have demonstrated that certain of the target's dimensions can be estimated from analysis of complex natural resonances in the signal. The problem becomes much more complicated when objects are placed in layered ground and oriented vertical to the antenna, so the incident field cannot excite currents along the major axes and the scattered field from the object cannot easily be separated from the layer interface response. To investigate this, we pursue simulations here designed to test side looking EM field scattering from a buried object placed in layered ground. The numerical calculation is done using the finite difference time domain (FDTD) method in conjunction with the generalized perfectly matched layer GPML. The results are analyzed for a cylinder placed in a uniform and layered earth. [C917]

"Real-time complex signal processing in a SAW broad-band convolver"

The result of theoretical and experimental studies of a broad-band convolver in piezoelectric-semiconductor configuration (Bi12GeO20-Si) are presented. Dispersive excitation transducers were used to improve the matching of the convolver inputs to the external sources of the signals in the passband. A new measurement system for the amplitude characteristics of the convolver output has been proposed. Experimental analysis of the convolver for compression of a signal with linear frequency modulation have been reported. [C918]

"Complex impedance mapping using GPR survey methods"

GPR surveys are normally processed to provide reflection images free of static offsets and long period drift. However in many surveys the raw data is observed to contain systematic decays consistent with Cole-Cole models of complex impedance. The resulting time-constants can be used to provide additional constraints for geotechnical investigations of moisture content and plasticity in soils. [C919]

"Multi-resolution imaging spectroscopy resolving the structure of heterogeneous canopies for forest fire fuel properties mapping"

Coniferous forests represent canopies with a high heterogeneity in the horizontal and as well in the vertical dimension. Consequently the interaction of incident radiation is dominated by the complex 3-D canopy structure and architecture. Radiative transfer approaches based on coupled leaf and canopy radiative transfer models still allow the simulation of the canopy reflectance as a function of leaf optical properties, canopy structure and viewing geometry as well as the retrieval of biophysical and biochemical canopy variables. High resolution imaging spectrometry supported by LIDAR data and radiative transfer models of different levels of complexities (SAIL, GeoSAIL) are employed to assess the influence of canopy heterogeneity and structure at different spatial scales. We discuss the relevance of single scene components and canopy structure to the recorded canopy reflectance and present a strategy to support radiative transfer models for biophysical and biochemical

parameter retrieval relevant for forest fires. [C920]

"Towards a quantitative understanding of the effects of wind motion on airborne and satellite SAR imagery of vegetation"

The monitoring of environmental land resources with airborne and satellite Synthetic Aperture Radar (SAR) is time-critical and relies on the availability of good quality images often acquired within specific time windows when there are marked differences in backscatter between and among vegetation. Wind disturbance can differentially alter the backscatter and image statistics of different vegetation types in a scene, and cause rapid temporal decorrelation between images. Recently, this temporal behavior has been utilized as a discriminant between vegetation types. However, to date, almost all this work has been based on empirical inspection and supposition, with little or no validation by field observation or modeling. In this paper we present results from a model developed to provide realistic wind-induced motions based on extensive field observations. The results allow us to make a quantitative assessment of the behavior and quality of SAR imagery according to wind conditions, vegetation response, and imaging scheme. We also look at ways of alleviating wind effects by use of appropriate data collection and processing schemes. It is found that the effect of the motion on the imagery is a complex interaction between the motion that describes the characteristic period of oscillation of the target and the way the imaging process samples that motion. There are also critical dependencies on radar frequency, range and resolution. With consideration of the latter dependency we look to likely future SAR platforms which promise markedly increased spatial resolution, but for which motion effects will become more acute. [C921]

"Classification of polarimetric synthetic aperture radar images using fuzzy clustering"

Clustering is a well known technique for classification in polarimetric synthetic aperture radar (POLSAR) images. Pixels are represented as complex covariance matrices, which demand dissimilarity measures that can capture the phase relationships between the polar components of the returns. Four dissimilarity measures are compared to judge their efficacy to separate complex covariances within the fuzzy clustering process. When these four measures are used to classify, a POLSAR image, the measures that are based upon the Wishart distribution outperform the standard metrics because they better represent the total information contained in the polarimetric data. The Expectation Maximization (EM) algorithm is applied to a mixture of complex Wishart distributions to classify the image. Its performance matches the FCM clustering results yielding a tentative conclusion that the Wishart distribution model is more important than the clustering mechanism itself. [C922]

"Hierarchical decision tree classification of SAR data with feature extraction method based on spatial variations"

The binary decision tree classification and feature extraction method based on texture features is applied to SAR data. In order to achieve more complex analysis it is advantageous to use binary decision trees, in which the decision between only two classes must be assigned at each node . Pixel based feature extraction methods reduce classification performance because of the speckle and also conventional texture analysis is not applicable to every part of an image. Therefore, a decision-making process, which can be applied to every pixel of an image, is required. The results show that computation time and accuracy of classification process are improved. [C923]

"Effect of dielectric properties of moist salinized soils on backscattering coefficients extracted from RADARSAT image"

This paper presents the experimental results regarding changes in the dielectric properties of artificially moistened and salinized soils and on soil samples taken from a salt lake. The complex dielectric constants of soil samples were measured using a microwave network analyzer. We evaluated the real and imaginary parts of dielectric constants of artificially moistened and salinized soil samples prepared in the laboratory as a function of microwave frequency, salinity, and water content The frequency and the salinity of soils have little influence on the real part of dielectric constant ε'. The results show that, in the frequency range of 1-6 GHz, the imaginary part ε" has greater sensitivity to soil salinity. The dielectric constant measurements for soil samples collected in Jilantai Salt Lake are in agreement with the results of the artificially moistened and salinized laboratory soil samples. These dielectric measurements were subsequently compared with the backscattering coefficients extracted from a RADARSAT image (C-HH) that was acquired at same time with the soil sampling at the Jilantai Salt Lake area. We discovered that the correlation coefficient between σ0extracted from the RADARSAT image and ε" measured in the soil sample is 0.70. The correlation coefficient between σ0and the soil sample salinity is 0.69. This suggests that soil salinity has a significant contribution to the backscattering coefficient, σ0recorded in a SAR image. Consequently, a SAR image can be a useful tool for monitoring soil salinity. [C924]

"A new wind sea /swell classification method for complex ENVISAT ASAR wave mode data"

First Page of the Article [C925]

"Characterization of shallow underground targets using wideband microwave reflectometry"

In this paper, the use of a combined signal processing technique of target discrimination for the step-frequency ground penetrating radar is investigated. To construct the radar range profile from the backscattered signal, a real part of the inverse discrete Fourier transform is multiplied by the pseudospectrum obtained from the same data via eigenvector method. The signatures of small underground objects can be subdivided in four categories designated conditionally as front wall; back wall; inclusion of high density; inclusion of low density. Experimental studies have shown that the technique is valid for both strong and weak scatterers. The approach can be extended to the discrimination of complex targets such as landmines by creating a set of templates. [C926]

"Investigations in radar rainfall estimation using neural networks"

Rainfall on the ground is dependent on the four dimensional distribution of precipitation aloft. In principle one can obtain a functional relation between the rain rate on the ground and the four-dimensional radar observations aloft. However it is difficult to express this in a useful form. Neural networks provide a mechanism to solve this complex problem. Using ground measurements of rain rate as the target output neural networks have been developed in the past that use the radar measurements as input and produce rainfall rates on the ground. Several topics related to neural network based radar rainfall estimates are addressed in this paper. This paper investigates the input vector types and sizes that are useful in a radar rainfall estimation context. Similarly, the neural network is trained with an initial data set, but updated adaptively. Various updating mechanisms are investigated with respect to accuracy of rainfall estimation. Two years of data from the Weather Surveillance Radar-1988 Doppler (WSR-88D) radar and a network of gages from Melbourne, Florida are used to evaluate the topics listed here. [C927]

"An empirical model to retrieving ocean wave period from nadir altimeter data"

Accurate measurement of the ocean wave period is of much scientific interest both operationally and for research. Shipping and offshore industries are keen to obtain real-time and climatological information on wave period in the open ocean to assist the design of sea-going structures and maximise safety at sea. Similarly, wave period is relevant for short-to-medium term ocean and weather forecasting, and more broadly, to ocean circulation and climate research, given the reported dependence of atmosphere-ocean momentum transfer on some measure of sea state development. In principle, full ocean wave spectra can be obtained from satellite synthetic aperture radars (SAR), yet the systematic extraction of wave period information from SAR has so far not been pursued. Hence, global wave period information is presently available only through numerical wave models, and there remain concerns about the lack of large scale validation of the geographical distribution and temporal variability of the modelled ocean waves. Here, we propose that ocean wave period information can be retrieved with adequate accuracy using satellite altimeters. There is evidence that satellite altimeter data contain wave period information, in addition to that on wave height. The existence of sea state development effects on the retrieval of altimeter wind speed is well documented and a few earlier studies have already considered the development of altimeter wave period models. However, the sea state dependence in these semi-empirical models is complex, and in both cases, the datasets of collocated altimeter/buoy measurements used to develop the models spanned only a small range of environmental conditions. In this paper, we present preliminary results of a new, purely empirical, wave period algorithm developed on the basis of the largest to-date dataset of collocated altimeter/buoy spectra measurements. The empirical wave period model is validated using independent collocated altimeter/buoy data, and by computing global monthly wave climatology. These are compared with existing wave period climatologies derived from numerical wave models. [C928]

"Analysis of two dimensional sea surface elevation fields using spaceborne SAR"

Space borne synthetic aperture radar are able to provide high resolution measurements of ocean waves on a global scale. The present study uses a reprocessed data set of complex SAR images acquired by the European Remote Sensing satellite ERS-2 to estimate different wave parameters relevant for ship security. In addition, a new method is presented to derive two dimensional sea surface elevation fields from complex SAR data. The method permits to analyze wave fields in more detail than conventional SAR wave measurement techniques, which only estimate the wave spectrum. The technique provides parameters like maximum to significant wave height ratios, wave steepness, or the probability of wave breaking. Global maps and statistics of the new parameters are presented. [C929]

"Retrieval of multi-scale roughness parameters and soil moisture by numerical inversion"

The aim of this present work is to find an inverse model to retrieve roughness geometric and dielectric parameters of natural rough surfaces from radar backscattering data. The bi-dimensional surfaces are described by means of the fractional Brownian motion random process, using the bi-dimensional wavelet transform. Multi-scale roughness is characterized by two parameters, the first one proportional to the standard deviation and the other one related to the fractal dimension. Soil moisture is related to the complex dielectric constant. To simulate radar backscattering we used the small perturbation model in which the radar backscattering coefficient can be expressed as the product of two factors, the first dependent on polarisation but independent of surface roughness and vice versa the second dependent on roughness but independent of polarisation. Thus, this model simplifies the procedure of inversion and the co-polarised ratio between hh and vv polarisation is independent of roughness and a minimisation over only two parameters is performed to retrieve the complex dielectric constant independently of the employed geometric surface description. Once the dielectric constant is known, the retrieval of multi-scale surface roughness parameters is performed in a successive step by using multi-frequency and multi-incident angle data. [C930]

"Nonlinear adaptive prediction using a complex-valued PRNN"

A computationally efficient architecture for nonlinear adaptive prediction of complex-valued nonlinear and non-stationary signals is presented. The adaptive predictor is based upon a complex-valued pipelined recurrent neural network (CPRNN) trained by the complex-valued real-time recurrent learning (CRTRL) algorithm. A variable forgetting factor (VFF) is introduced to improve the performance of CPRNN in the non-stationary environment. The analysis is undertaken with respect to the number of the nested modules, forgetting factor, and input memory of the CPRNN. Simulations on real and synthetic complex data support the proposed architecture and algorithms. [C931]

"Fully polarimetric classification accuracy"

Assuming that polarimetric data is entirely described by the underlying complex covariance matrix, this paper gives expressions for the maximum likelihood classification accuracy, and applies these to real data. This assumes negligible interclass environmental variation and a homogeneous image structure which is overly simplistic. By including a model of environmental variation, more realistic results may be possible. [C932]

"Measurements of the delay, Doppler and directional characteristics of obliquely propagating HF signals over several northerly paths and a comparison with vertical ionosonde and HF radar observations"

The high latitude ionosphere is a very dynamic and disturbed region containing irregularities which, on scales much greater than a wavelength, may be considered as providing a rough reflecting surface for obliquely propagating HF radiowaves. To improve our knowledge and understanding of the complex propagation mechanisms prevalent in the high latitude region, an experimental campaign is currently being conducted with a receiver system capable of measuring the delay and Doppler spread characteristics and the directional structure of the received signals at Kiruna in northern Sweden. [C933]

"Melting layer model evaluation in Singapore"

Propagation characteristics in the melting layer are not only relevant to slant path attenuation predictions for satellite links but also for spaceborne radar remote sensing of rainfall. In the latter case, the radar retrieval algorithms rely heavily on accurate estimates of the melting layer attenuation, since the radar signal traverses this region twice, both in the forward direction and in the return direction. Several models have been proposed for predicting the attenuation in the melting layer. One such method is the non-coalescence-non-break up (N-N) model based on spherical melting particles made of dielectric composites, Nishitsuji and Hirayama (1971). The model assumes the melting particles to be composed of a homogenous mixture of water, ice and air, and calculates the complex permittivity from Wiener's theory. The calculation includes the parameter "form factor", U, as well as the volume content of water, ice and air. The height variation of these parameters has been inferred fairly accurately in the past from satellite propagation data, Awaka et al. (1985). This paper compares the N-N model predictions with Doppler radar measurements taken in Singapore. Comparisons are presented in terms of the radar reflectivity (dBZ) as well as the mean fall speed (View) and the Doppler width (w). [C934]

"The choice of operating frequency in HF surface wave radar design"

Radars operating in the HF band (3-30 MHz) are primarily of interest because of their ability to provide an over-the-horizon (OTH) surveillance capability. There are two types of such OTH radars-skywave (typically capable of

detecting. targets at ranges of thousands of kilometres) and surface wave (typical detection ranges of hundreds of kilometres). Skywave radars, which are generally large, complex and expensive, rely on the ionosphere to refract signals beyond the horizon. The dynamic nature of the ionosphere places considerable demands on the radar, one of them being a very wide operating bandwidth (e.g., several octaves). Surface wave radars, on the other hand, are generally less expensive and complex, and can operate robustly over a somewhat narrower band, easing the constraints on RF and antenna design. This leaves the radar designer with an interesting choice with regards to the system operating frequency and bandwidth. The paper discusses the various factors that influence that choice and highlights some of the difficulties of selection. [C935]

"Wavelet-based system for classification of airborne laser scanner data"

A new semi-automatic processing system for classification of airborne laser scanner cloud points is developed. To mitigate the difficulty caused by the complex distribution of objects on Earth's surface, wavelet was adopted in size-based clustering of laser points. A hybrid method of processing laser scanner data in both grid and raw formats was also adopted to speed up the processing time and adjust the smoothing effect of interpolation. The processing focused on processing the data acquired over urban area. This paper presents and explains the components of the system using the test data acquired over Shinjuku area, Tokyo, Japan. [C936]

"Stochastic modelling for structure reconstruction from high-resolution SAR data"

The exploitation of metric resolution SAR data for the reconstruction of the structure of the observed scenes poses specific problems related both to the complexity of acquired scene details and to the peculiarities of the SAR acquisition system. On the one hand, much more complexity is transferred through the system from the scene into the data: new kinds of complex man-made scene objects are acquired. Layover and shadowing and responses from single scatterers tend to dominate the data. On the other hand, multiple signal reflections, sidelobe effects, radiometric pollution and many other effects related to the increased resolution of the system have to be taken into account. We show how, by properly modelling in stochastic terms the peculiarities of both the acquisition system and of the scene and by composing them in a Bayesian framework, new methods are developed that allow the reconstruction of the imaged structures from SAR data. Particular interest is devoted to the application of the developed algorithms in urban environments on data resolutions ranging from a few metres to fifty centimetres. [C937]

"Unsupervised Bayesian reconstruction of microwave images from real data"

We address the problem of non-linear microwave imaging for the reconstruction of dielectric profiles. We propose a statistical based inversion algorithm, adopting the Bayesian (MAP) framework and a complex Gaussian MRF model for the image. The use of statistical algorithms for the estimation of the complex MRF parameter leads to a robust and effective non-linear inversion method. Some experiments on real data are able to show the good performance of the method. [C938]

"Combining GPR and EMI data for discrimination of multiple subsurface metallic objects"

Cleanup of subsurface metallic objects such as unexploded ordnance (UXO) constitutes an urgent problem worldwide. The heart of the problem is discrimination, as opposed to detection. Ultra-wideband electromagnetic induction sensors (UWB EMI), operating from a few Hz up to 100s of kHz, have shown considerable promise in subsurface discrimination of metallic objects. Unfortunately, a great many objects, including widespread clutter items, produce very broad, smooth EMI signal patterns, over a number of decades of frequency. Shape identification is complicated by the sensitivity of EMI fields to metal type. UWB ground penetrating radar (GPR) has also shown definite discrimination capability for characterizing subsurface metallic targets. Uninfluenced by metal type, GPR is capable of registering complex natural resonances from which target length can be estimated. Further, examination of the spatial patterns of GPR signals can indicate the (X,Y,Z) locations of targets, even of multiple targets present simultaneously in the incident beam. In this paper we consider potential collaborative roles of UWB GPR and UWB EMI for discrimination of multiple subsurface metallic objects. Rigorous 3-D FDTD models demonstrate GPR's ability to estimate target positions, orientations, and length even when reflections overlap. These data can then be used to constrain inversion of UWB EMI patterns. Processing of EMI measurements based on prior estimates of object location and orientation successfully extracts distinct frequency response signatures for two very closely spaced objects. [C939]

"Frozen soil dielectric model using unfrozen water spectroscopic parameters"

In this paper, the generalized refractive mixing dielectric model (GRMDM) introduced in was extended over freezing temperatures. Two types of unfrozen soil water, bound either by hydrophilic soil particle or ice crystal surfaces, have been identified. With this approach, the soil unfrozen water spectroscopic parameters in the

microwave band were retrieved using the bentonite soil dielectric data measured at 0.6, 1.11, and 1.43 GHz, and 25°C down to -30°C. Based on these results, a dielectric model for frozen soil was proposed which allows for predicting complex dielectric constant as a function of frequency and temperature. [C940]

"Analysis of GPR scattering by multiple subsurface metallic objects to improve UXO discrimination"

Detection and identification of buried unexploded ordinance (UXO) is an emerging problem worldwide. Recent ultra wideband (UWB) field tests between 10s of MHz and 100s of MHz have demonstrated that certain of the target's dimensions can be estimated from analysis of complex natural resonances in the scattered signal. However, the problem becomes much more complicated at highly contaminated UXO sites where clutter items, from which subsurface UXO must be distinguished, appear simultaneously within the field of view of the sensor. This often occurs in realistic field conditions, where GPR discrimination capabilities are typically limited by ground clutter, coupling between antenna and ground, and limited view of the target due to innocuous items. Under extreme shielding by clutter, the incident field cannot excite strong currents on the target and in turn the scattered field from the object cannot easily be separated from the responses of the clutter. To investigate this, we pursue simulations here designed to test subsurface side-looking EM field scattering from multiple buried objects placed in a uniform ground. The numerical calculation is performed using the finite difference time domain (FDTD) method in conjunction with generalized perfectly matched layer GPML. The results are analyzed for a cylinder and plate placed in a uniform ground. [C941]

"Registration of range data from unmanned aerial and ground vehicles"

In the research reported in this paper, we propose to overcome the unavailability of Global Positioning System (GPS) using combined information obtained from a scanning LADAR rangefinder on an Unmanned Ground Vehicle (UGV) and a LADAR mounted on an Unmanned Aerial Vehicle (UAV) that flies over the terrain being traversed. The approach to estimate and update the position of the UGV involves registering range data from the two LADARs using a combination of a feature-based registration method and a modified version of the well-known Iterative Closest Point (ICP) algorithm. Registration of range data thus guarantees an estimate of the vehicle's position even when only one of the vehicles has GPS information. Additionally, such registration over time (i.e., from sample to sample), enables position information to be maintained even when both vehicles can no longer maintain GPS contact. The approach has been validated by conducting systematic experiments on complex real-world data. [C942]

"A new temporal interpolation method for high-frequency vector wind fields"

A new technique for the time interpolation of the forcing fields that recovers the movement of propagating features is introduced and applied to vector wind fields. The method involves the decomposition of the fields into their complex empirical orthogonal functions, and the interpolation of the temporal functions for the significant modes. The technique is tested using atmospheric model vector wind fields sampled at coarse temporal resolution to demonstrate the recovery of the wind fields at the intermediate times. The technique is also applied to a gridded vector wind product from satellite scatterometer data. [C943]

"High speed data acquisition systems for ISRO's airborne and spaceborne radars"

During 1990's, high speed data handling and control unit (DHCU) was developed for Indian Space Research Organisation's (ISRO) C-band airborne synthetic aperture radar (ASAR) at Space Applications Centre (SAC), ISRO, India. It has been extensively utilised to acquire high bandwidth radar signal during ASAR flights aboard Beechcraft-200 aircraft, conducted regularly since 1997. DHCU supports ASAR data acquisition, formatting and storage. It carries out high speed 6-bit I/Q digitisation (30.814 MHz sampling) of the complex baseband signal (25 MHz bandwidth) received from the ASAR receiver. The digitized data are multiplexed with other auxiliary data before being stored on a redundant array of independent disks (RAID) based recorder through high speed ECL parallel interface. Subsequently, since 2000 A.D., ISRO has embarked upon a very ambitious spaceborne SAR mission, called radar imaging satellite (RISAT). The onboard digital subsystem for this high resolution spaceborne SAR has to cater to data acquisition, control and timing, data compression, buffer storage and formatting requirements. The ultra-high speed data acquisition units of this spaceborne radar consist of dual chains of ultra-high speed 8-bit ECL A-to-D converters based I/Q digitisers. These units perform digitisation of the received complex radar echo signals and calibration signals at more than 200 MHz sampling rate and demultiplexing of ultra-high speed digitised signal into multiple channels. It also implements radar data compression, variable data rate formatting and high speed LVDS interface with satellite. In view of the high bandwidth signals and high sampling rates (200 MHz), signal integrity, EMI/EMC and thermal issues assume great importance and pose a great challenge in the PCB and package layout, design and fabrication. This paper describes the high speed design requirements and configuration details for the ultra-high speed data acquisition

units of spaceborne SAR as well as for high speed acquisition unit of airborne SAR. It also addresses the signal integrity, EMI/EMC and thermal related issues for these systems. [C944]

"Multiresolution GMTI radar"

The detection and tracking of ground moving vehicles from airborne radar can be challenging at slow target velocities due to the close space-time (angle-Doppler) proximity of strong competing mainbeam clutter. Moreover, in complex non-stationary clutter environments, conventional space-time adaptive processing (STAP) cannot be relied upon to provide precision ing. In this paper, we re-examine GMTI radar from a multiresolution perspective resulting in a hybrid radar mode combining elements of synthetic aperture radar (SAR) with STAP GMTI. In particular, acute sources of clutter interference are resolved via quasi-SAR processing, and then combined with STAP GMTI to significantly reduce minimum detectable velocities, reduce the required DOFs, increase available training set size, and lower SINR loss and false alarms. [C945]

"Bayesian computer-intensive methods for statistical signal processing"

Summary form only given. The talk discusses various computational techniques for solving complex inference problems in signal processing. The focus of the talk would be Monte Carlo methods, and in particular the sequential Monte Carlo methods which are currently proving extremely powerful for non-linear/non-Gaussian sequential environments. The author review the basic formulation of the sequential Monte Carlo framework, or particle filter, from the perspective of sequential updating of a general probability distribution, such as the posterior distribution of a hidden state or signal parameter. These methods, in their most basic forms, have proved very powerful for solving of non-linear problems in radar tracking, financial time series, communications, robotics and computer vision. In recent years increases in available computer power and memory have facilitated substantial algorithmic advances in these methods, allowing for more accurate inference and solution of more complex problems. In the second part of the talk the author describe some of these recent advances in sequential Monte Carlo, including Monte Carlo smoothers and trans-dimensional filters, which allow for on-line model selection. The methods described would be illustrated with examples from radar tracking, audio signal extraction and inference of musical beat from an audio waveform. [C946]

"NEOS: the North East Ocean Observing System by: Scott Glenn & NEOS partners"

Ocean.US is coordinating the development of a National Federation of Regional Associations of Coastal Ocean Observing Systems. It is anticipated that on the order of ten regional associations will evolve. These associations will coordinate regional enhancements of the existing and expanding national backbone of coastal ocean observations. [C947]

"Superresolution ISAR imaging of maneuvering targets via subspace tracking"

For the problem of ISAR imaging of maneuvering targets, the Doppler frequency shifts are time-varying and range migration may still happen even after the motion compensation due to the complex motion of targets. Sliding window MUSIC algorithm based on a computationally efficient subspace updating method which takes advantage of the URV decomposition is applied to solve this problem. The effectiveness of this algorithm is shown by presenting and discussing some simulation results. [C948]

"Singular signal detection with fractal"

Singularities and irregular structures often carry the most important information in signals. The method of singular signal detection based on fractal technique is presented at the beginning of this paper. Mathematics model of singular signal is expressed with local Lipschitz exponent. The characteristics of singular signal and the principle of this detection method are introduced; and the algorithm of this detection method is discussed in detail. According to short-duration grille fractal dimension of signal, information like the start-time and end-time of singular signal can be obtained. The experimental results verify that the method can detect singular signals in the electrical power system accurately. Finally this detection method with fractal is no more complex and can be implemented easily. [C949]

"Results of a multi-static synthetic aperture sonar experiment"

It has long been recognized that point targets in synthetic aperture sonar (or radar) imagery could be used to calculate the beamformer coefficients and the motion compensation functions for the system. One difficulty with this approach arises when no point targets are available. Another problem exists in the initial recognition of true point targets, or rather, the automatic separation of point targets from complex targets in the raw data. A multi-static synthetic aperture sonar (MSSAS) laboratory experiment, instructive to practical field applications, was

conducted at Naval Surface Warfare Center, Dahlgren Division, Coastal Systems Station (CSS) Acoustic Test Facility (ATF) in December 2000. The experimental method and three dimensional imagery results are described. Practical field system designs suggested by this experiment are explored. Hyperbolic Frequency Modulation (HFM) transmissions in the 5-17 KHz band were sent to a vertical array that was four wavelengths high at 10 KHz. A horizontal aperture of 40 wavelengths (at 10 KHz) was synthesized. A bullet shaped shell, approximately 32 inches long, was used as the target. A simplified self-calibration technique is harnessed to simultaneously form the basic multi-static beamformer kernel, remove motion effects, and resolve the unknown distances among transmitter, receivers, and target. [C950]

"High frequency triply resonant broadband transducer array development at NUWC"

Summary form only given. With the Navy's current emphasis on detection in littoral environments requires the use of broadband sonar signal processing and frequency agility. This has prompted the need for new classes of broadband sonar transducers that can transmit and receive these complex signals. NUWC has developed and built a new class of novel high-frequency (HF) broadband (electro-acoustic) transducers and arrays that can be configured into conformal arrays for use on the bow or sail of present and future classes of submarines, unmanned undersea vehicles (UUVs), and on torpedo homing sonar systems. This transducer design, the Triply Resonant Tonpilz (TRT), is a mechanical series arrangement of a piezoelectric ceramic stack, two center masses, two compliant springs, and a tail and head mass, all together generating three resonances. The design produces a flat transmitting response of two octaves when in an array-loaded configuration. The increase in operating bandwidth is achieved without the use of exotic and expensive transduction materials. This triply resonant transducer is a very cost competitive approach to introducing broadband into the Fleet. It provides a 5 kHz to 10 kHz increase in bandwidth at the low end of the band over a traditional tonpilz transducer. A traditional tonpilz designed to encompass this lower frequency would be at least 50% to 75% longer, which is unsatisfactory in these applications that require minimal impact on the submarine. The results of two 36 element planar HF arrays that are currently being designed, fabricated, and tested NUWC is presented, modeled results of a more compacted (22% smaller) Triply Resonant Tonpilz using PMN-PT single crystal as the active driver is also presented. A smaller 9 element VHF array design that is three times smaller than the HF design is also presented. [C951]

"A complex of polarimetric, combined active-passive sensors of L-, C-, and X-band of frequencies for vessel and airborne application"

Summary form only given. A complex of polarimetric (dual polarization), combined active-passive devices of L-, C-, and X-band of frequencies for land and sea surface microwave reflective and emissive characteristics simultaneous and coincident measurements is presented. The complex is dedicated to solve the problem applied to near sea surface wind and surface wave fields' parameters precise and unambiguous retrieval, as well as for sea surface signatures detection and identification. The methodology of experiments' performance and field calibration will be discussed. The results of preliminary measurements of sea surface radar backscattering coefficients and brightness temperatures under various conditions of observation (angle of incident, location and polarization), air-water temperatures, wind and wave parameters will be presented. Relationships between sea surface radar backscattering coefficients, brightness temperatures, statistical characteristics of radar signal frequency's distributions and the parameters of observed media will be built. As well as correlative properties between fluctuations of sea radar backscattering coefficients, radar signal frequency distribution characteristics and brightness temperatures due to the change of sea surface principal parameters air-water temperatures, wind speed and direction, sea wave force and swell condition will be presented. Vessel and airborne application properties of such a complex application for sea surface mapping will be discussed. [C952]

"Conversion of PDF documents into HTML: a case study of document image analysis"

Portable document format (PDF) has become the de facto standard in many fields because of its independence of local formatting restrictions and its accurate reproducibility. On the other hand, HTML documents are becoming an integral form of our lives by being the dominant form for information exchange within the World Wide Web environment. This paper discusses how image-processing techniques can be used to perform document layout analysis of complex multiple-column PDF documents. This analysis allows the conversion of these documents into the HTML format keeping the logical and physical layout intact. [C953]

"Soil dielectric spectroscopic parameters dependence on humus content"

The purpose of this paper is to apply generalized refractive mixing dielectric model (GRMDM) based on the Debye relaxation formula to soils with various humus contents. With this approach, the soil types containing 6.6% and 0.6% of natural humus. Complex dielectric constant or complex refractive index were measured as a

function of moisture at the frequencies of 0.55; 1.1; 1.8, 3.0, 11.5, 13.5 and 16.3 GHz with the temperature being of 20-24 °C. Using measured data only at 1.8, 3.0, 4.3 GHz, the GRMDM parameters-relaxation time, static dielectric constant, and conductivity for both types of water in soil were attained for both types of soil. Though variation in the relaxation parameters with humus content is moderate, this factor has to be taken into account when soil moisture remote sensing algorithms are being designed for agricultural areas. For this purpose, the GRMDM can be applied, with a soil humus content being one of its physical parameters. [C954]

"SMOS: analysis of perturbing effects over land surfaces"

Surface soil moisture is a key variable of water and energy exchanges at the land surface/atmosphere interface. But currently there are no means to assess it on a global and timely fashion. The ESA Earth Explorer Opportunity mission Soil Moisture and Ocean Salinity (SMOS) is the first attempt to fill such a gap. SMOS is based upon an L-band 2-D interferometer, an innovative concept of bi-dimensional aperture synthesis method to obtain surface measurement with an appropriate resolution from a tractable (in terms of dimensions) space-borne instrument. Moreover, the sensor has new and very significant capabilities especially in terms of multi-angular view configuration. However as for most of space borne instrument, retrieval of surface parameters/variables will be hampered by several factors. This fact is enhanced for sensors having a coarse spatial resolution. In the specific case of SMOS the ground resolution of 40 km means that the influence of different contributors to the signal has to be accurately assessed and eventually corrected. Finally many pixels will be affected by topography effects. It is thus important to assess exactly which level of topography distorts significantly the brightness temperatures and to which extend so as to be able to either correct soil moisture retrieval for topography effects or flag the data. The goal of this paper is to present the topography effects. The latter has been analyzed in depth by modeling the signal issued from mountainous terrain including moisture and vegetation gradient. The adjacency and shadowing effects were in particular addressed. The second step was to develop a simplified characterization of the topography through a statistical description which is then used to assess exactly the level of topography which has an influence of the signal and from which one has to take it into account in the retrieval process. The potential of SMOS, depending on the view angle configuration and the use of the sole 1.4 GHz is thus investigated over complex targets. These questions are key issues to define the exact range of configurations where SMOS meets the scientific requirements of the mission. [C955]

"Geometric performance of ENVISAT ASAR products"

We describe validation measurements of the geometric accuracy of ASAR images, measured redundantly via independent methods. Our tests include image (IM), alternating polarization (AP), and wide swath (WS) mode acquisitions over a variety of test sites. ASAR's slant range products (IMS/APS) require a slightly different validation methodology than ground range precision (IMP, APP) and medium resolution products (IMM, APM, WSM). A third approach is required for ellipsoid-geocoded products (IMG, APG). The most highly accurate validation is possible with single look complex (SLC) data (IMS and APS products), as all other product types lose resolution during multilooking. For a library of ground control points (GCPs) including map features such as bridges or road intersections, as well as (where available) transponders and corner reflectors, we use surveyed or map-measured position information (together with the delay value in the case of transponders) to solve the zero-Doppler iteration and predict the position of the GCP as an azimuth and slant range coordinate in the radar image. In the case of ground range products (e.g. IMP, APP, IMM, APM, WSM) the predicted slant range value is additionally transformed by a slant to ground range transformation tro determine the predicted image coordinate. The GCP feature is then either measured by inspection of a detected image, or localized automatically within the neighborhood of the prediction. GCPs are measured within the radar geometry image products, derivative geocoded products, and topographic maps, providing their measured map, radar geometry, and nominally geocoded GTC locations. Radar image locations are compared to map reference values and statistics of differences are tabulated. We compare the accuracies of the estimates achievable using transponders and map GCPs. Based on the suite of products (and accompanying orbit information) available to us, we establish a methodology for estimating a preliminary sampling window start time bias. The multiple validation and estimation techniques used ensure robust determination of ASAR geolocation accuracy. [C956]

"Clutter effects on ground moving target velocity estimation with SAR along-track interferometry"

The SAR interferogram, defined as the product of the first channel and the complex conjugate of the second, is one way of comparing two SAR channels. When the two sub-apertures are aligned along the flight path, targets with non-zero radial velocities can be detected by exploiting the phase information of the interferogram. This paper examines the effect of clutter interference on the interferometric phase and provides a simple method for mitigating the clutter contamination by using time-frequency (TF) analysis techniques and a velocity-offset matched filter (VOMF). Both simulated and airborne results are presented. [C957]

"Campaign mode observation of tropical convection using ground-based radar systems"

Tropical convection plays an important role in enhancing rainfall and also creates uncertainty in the model-based predictions of weather in tropics due to the latent heat released into the troposphere. Ground-based radar systems are important tools available for the effective characterization of convective events. Availability of different radar systems ideally suited to study tropical convection in an area popularly known as the Golden triangle for weather observations in southern part of India, led to the organization of an interagency program for a campaign mode of observations using the different radar systems and associated rain gauges etc. to observe tropical convection during the period Oct-Dec, on a few days when the north east monsoon was prevalent over the east coast of peninsular India. The Golden triangle consists of Sriharikota Island where the Space Launch Complex of ISRO is located at the Satish Dhavan Space Center, the Cyclone Detection Radar site of IMD at Chennai and the National MST Radar Facility (NMRF) at Gadanki in close proximity to the temple city of Tirupati. An indigenously developed S band Doppler weather radar is commissioned at Sriharikota Island on the east coast of India in December 2002, as an interagency program between India Meteorological Department and Indian Space Research Organization. A siphoning type fast response rain gauge and a tipping bucket rain gauge are located within 10 km from the radar. Another S band DWR is located in Chennai, India by IMD. These radars have the capability to measure precipitation and Doppler velocity and provide in real time the 3 base products viz., reflectivity, velocity, and spectral width of the hydrometeors within radar sample volume with good accuracy up to 250 km. From these base products, other meteorological products like rainfall rate, rainfall accumulation, Cappi, echotop etc. are derived. Indian MST radar, a VHF profiler (at 53 MHz) normally used for estimating the winds and turbulence and an L band lower atmospheric wind profiler operating at 1357.5 MHz for estimating the winds, turbulence, and precipitating weather systems in tropical latitudes are operating at NMRF since 1990. Apart from these radar systems, a disdrometer and an optical rain gauge are also located at this faci- lity as collocated instrumentations for the measurement of rainfall rate and rainfall accumulation. All these three locations are geographically located within 80-100 km from each other and form a triangle. These instrumentation systems provide an excellent ground-based network for the characterization of tropical convection. The paper describes the campaign details including the detailed characteristics of the radar systems used and provide intercomparison of the data obtained as the convective systems transited over the terrain which is essentially coastal for Chennai and SHAR and mountainous for Gadanki. [C958]

"Buried land mine detection using complex natural resonances on GPR data"

In this paper, we discuss a modified Prony's algorithm for use in buried land mine detection from ground penetrating radar (GPR) data. The algorithm finds the dominant complex natural resonances (CNRs) for vectors of time-domain GPR data. We consider the identification of objects present in two-dimensional images. The CNR features of an unknown image are processed through distance-based detectors with the CNR features of known objects from an object library. We analyze our algorithm performance versus SNR and also analyze performance for different distance detectors. [C959]

"Segmentation of textured scenes using polarimetric SARs"

The methods currently used for classification or segmentation of polarimetric SAR images are based on the multivariate complex Gaussian model. This should limit the application of these methods to "homogeneous" Gaussian areas, since their performances are significantly degraded in the presence of spatial texture. We show that image segmentation can be viewed as a likelihood approximation problem. The optimum criterion is derived for segmentation of K-distributed textured polarimetric SAR images. The product model is assessed and applied only within areas in which the model is valid. The new method is validated for ice type segmentation using Convair-580 SAR data collected in 1993 over Cornwallis Island in Canada. [C960]

"A cardioid model for multi-angular radiometric observations"

L-band passive microwave remote sensing sensors are able to provide estimates of surface soil moisture, on both spatial and temporal scales compatible with applications in the fields of meteorology and hydrology. A radiometric system using a 2-D interferometric design with multi-angular viewing capabilities will be borne by the Soil Moisture and Ocean Salinity (SMOS) space mission. The basic rationale for retrieving soil moisture from radiometric measurements is the assumption that the surface layer can be modeled as a dielectric medium. Its dielectric constant then depends on several physical parameters, including soil moisture; emissivities for various incidence angles are computed using Fresnel's formulas. Many controlled field experiments have demonstrated the validity of this approach. Scenes exist however (e.g. ice covered or frozen surfaces, complete desert areas) where surface soil moisture is not a relevant concept. For such scenes, information should however be available on the complex dielectric constant itself. This communication describes a methodology which aims at retrieving in an optimized way the dielectric constant information available from multiangular radiometric data. [C961]

"The determination of surface salinity with SMOS-recent results and main issues"

The European Space Agency SMOS (Soil Moisture and Ocean Salinity) mission aims at obtaining global maps of both variables from space for large scale climatic studies. In uses an L-band microwave interferometric radiometer with aperture synthesis (MIRAS) to measure brightness temperature (TB) emitted by the Earth surface and then compute from it the two geophysical parameters. The retrieval of salinity is a complex process that requires the knowledge of other environmental information and an accurate processing of the radiometer measurements. Here we present the recent results obtained from different studies and campaigns as part of the SMOS mission and highlight the different issues still to be solved. [C962]

"Evaluation of the Wishart test statistics for polarimetric SAR data"

A test statistic for equality of two covariance matrices following the complex Wishart distribution has previously been used in new algorithms for change detection, edge detection and segmentation in polarimetric SAR images. Previously, the results for change detection and edge detection have been quantitatively evaluated. This paper deals with the evaluation of segmentation. A segmentation performance measure originally developed for single-channel SAR images has been extended to polarimetric SAR images, and used to evaluate segmentation for a merge-using-moment algorithm for polarimetric SAR data. [C963]

"Polarimetric optimisation applied to permanent scatterers identification"

In this work, the potential of full-polarimetric SAR data to enhance the performance of permanent scatterers candidates (PSC) detection is investigated. In particular, the problem of finding the polarisation states that maximise the signal amplitude inverse coefficient of variation (ICV) is analyzed. Under the hypotheses of Rice statistics and high signal to clutter ratio (SCR), the problem can be cast into a form equivalent to the optimisation of the ratio between PS (target) and clutter backscatter. Then, solution can be derived for the optimal transmit and receive polarisation states. In the paper, selected typologies of PS and clutter are investigated. The approach is validated through Monte Carlo simulation of the multitemporal polarimetric response of PS-like SAR pixels. Results indicate that optimal ICV values of polarimetrically complex PSC pixels are higher than in the ERS case of the single VV channel, thus leading to increased stability of the subsequent parameter retrieval. Moreover, simulation of ICV vs. SCR suggest that a higher number of PSC may be detected by using optimal polarisation states than in the conventional VV channel alone. [C964]

"Results of processing and analysis of large volumes of repeat-pass InSAR data of Vancouver and Mount Meager (B.C.)"

A large quantity of ERS InSAR data and several scenes of Radarsat InSAR data were used to study historical deformation at Mount Meager in Northern B.C. The Mount Meager Volcanic Complex is a hazardous area showing an anomalously high frequency of catastrophic slope failures. It is also the location of Canada's most recent explosive volcanic eruption (2350 YBP). The primary objective of processing and analysis of the SAR data was to detect and measure small deformation events on the slopes of the mountain. A similarly large number of repeated ERS SAR scenes collected over the urban area of Vancouver between 1992 and 2000 was selected for InSAR processing. The objective of the project was to investigate the potential of detecting and measuring very small deformation rates (better than 1 mm/yr) and deformation events while taking advantage of the large volume of SAR datasets. The following types of deformation were of specific interest: 1. Stability of the Fraser River Delta 2. Tidal loading 3. Subsidence patterns in urban areas 4. Deformation of individual buildings, bridges and infrastructure. This paper provides some information on the processing methodologies that were employed as well as results and interpretation of the results. [C965]

"A multi-sensor remote sensing approach for monitoring large wetland complexes in northern Canada"

The Peace-Athabasca Delta is a 3900 km2freshwater wetland complex, located in north-eastern Alberta, Canada. The intricate channel system, the numerous smaller wetland basins and the large shallow lakes of the delta are important habitats for a large number of migrating waterfowl, mammals and insects. The hydrological regime in this remote area is unique as many of the productive wetland are isolated from the channels and require overland floods to be replenished. Recent studies have shown that the delta has experienced a reduced frequency of these large overland floods. Attribution of these changes is complex, however, remote sensing provides a unique opportunity to characterise the spatio-temporal distribution of these changes and to collect important baseline hydrological information that is too difficult to obtain using traditional methods. This paper focuses on a development of a multi-sensor remote sensing strategy to assess hydrological change in this wetland environment. This includes the use of Radarsat, Landsat, IKONOS and lidar data to derive year to year

changes and assist in predicting future outcomes and risks for this ecosystem. [C966]

"Extracting sea ice parameters from SAR imagettes"

From raw ERS wavemode data, complex SAR images of size 5 km Ч 10 km-so called imagettes-were computed using the BSAR processor at the German Aerospace Center (DLR). Being collected every 200 km along the orbit, imagettes provide a relatively dense coverage especially over polar oceans up to 84 degrees North. Several statistical measures have been introduced for analysis of imagettes classifying ice free and ice contaminated imagettes as well as deriving sea ice parameters such as ice concentration, deformation energy, and ridge frequency. The results are compared to SSM/I data and sea ice model results. In addition, a wavelet-based edge detector is used to examine the ice surface structure. Using the imagettes in an automatic extraction system can provide global statistics of sea state and sea ice parameters from both upcoming ENVISAT and historic ERS data providing a 10 year dataset. [C967]

"Differential SAR interferometry using corner reflectors"

The differential InSAR technique has the potential for monitoring centimetre-scale ground motion in an accurate and cost-effective manner. Probably the most important limiting factor in the application of InSAR is temporal change in the complex reflectivity of the ground surface during the period between radar acquisitions. This can be due to changes in such parameters as moisture content or vegetation. The stable artificial corner reflectors can be identified from long temporal series of interferometric SAR images even with large baselines and therefore decrease the risk of image decorrelation. In this paper we will discuss the following questions: (1) how to get the true phase of a corner reflector in a SAR complex image; (2) how to co-register the corner reflector pixels, if the coherence of its surrounding area is extremely low; (3) how to computer the interferometric phase of two co-registered corner reflectors without flat Earth term and corners' height contribution. In order to demonstrate the results some practical examples Bonn-Experiment and landslide monitoring in Three Gorges area in China are given. [C968]

"Polarimetric segmentation using Wishart test statistic"

A newly developed test statistic for equality of two complex covariance matrices following the complex Wishart distribution and an associated asymptotic probability for the test statistic has been used in a segmentation algorithm. The segmentation algorithm is based on the MUM (merge using moments) approach, which is a merging algorithm for single channel SAR images. The polarimetric version described in this paper uses the above-mentioned test statistic for merging. The segmentation algorithm has been applied to polarimetric SAR data from the Danish dual-frequency, airborne polarimetric SAR, EMISAR. The results show clearly an improved segmentation performance for the full polarimetric algorithm compared to single channel approaches. [C969]

"Forward and inverse modelling of multi-baseline L-band Pol-InSAR E-SAR data"

The objective of this paper is the analysis of forward and inverse modelling of multi-baseline L-band polarimetric SAR interferometry (Pol-InSAR) data. The first part of this study deals with an analysis of the differential phase between interferograms in different polarisation states. It is shown that conventional polarisations in the (h, v)- or Pauli-polarisation basis, while identifying different scattering mechanisms, cannot provide unambiguous interferometric phase centres in vegetation volumes at L-band. On the other hand, the Pol-InSAR optimised singular polarisations provide the largest vertical separability of interferometric phase centres within volume scatterers. The representation of the interferometric coherence in the complex unitary circle as a function of polarisation complements these observations. The second part of the paper concentrates on the forward modelling of Pol-InSAR measurables using a well-known coherent scattering model. The behaviour of the coherence is simulated to provide a more detailed interpretation of the physical meaning of the singular polarisations than was possible in the first part of the paper. Physical parameter ambiguities are emphasised and analysed. In the third part of the paper, Pol-InSAR observables are obtained through inversion of the model mentioned above. The analyses make use of multi-baseline airborne L-band E-SAR data. [C970]

"Polarimetry based on one transmitting and two receiving polarizations: the pi/4 mode"

The purpose of this study is to assess what can be learnt from polarization duality in reception for a SAR which transmits only one polarization. We focus here on a configuration where the two linear receiving polarizations are oriented at pi/4 of each side of the unique transmitted linear polarization. A procedure to estimate a full polarimetric (fp) information over extended targets from this design (hereafter called the pi/4 mode) is proposed, when the ity of complex correlation between co- and x-polarized terms is assumed. The behavior of point targets is subsequently considered. The performance assessment (based on SIR-C L band image analysis) relates to the level of information preserved comparatively to fp, but also to the concurrent space segment complexity, in

terms of working pulse repetition frequency (PRF), processed swath and down link features. [C971]

"Global analysis of ocean wave systems from SAR wave mode data"

One of the major goals of the European Remote Sensing Satellites ERS-1 and ERS-2 were applications in ocean wave research and wave forecasting. For the first time, two-dimensional spectral information on the sea state globally, continuously, and in quasi real time are provided in the so-called SAR wave mode. To use not only the spectral but also the image information of these data, a global set of single look complex (SLC) synthetic aperture radar (SAR) images (imagettes) was processed from ERS-2 wave mode raw data, using the BSAR processor developed at DLR. SAR imagettes are used to analyze recently developed algorithms for wind and wave measurements. As the new European Satellite ENVISAT will provide cross spectra on a global and continuous basis, interest in the described techniques is growing. Two-dimensional ocean wave spectra are derived from SAR imagettes by quasi-linear inversion of the SAR imaging mechanism. Individual wave systems are detected by a so-called partitioning algorithm. The resulting wave parameters are analyzed and compared to model data. To take into account the complete nonlinear SAR imaging mechanisms, wave model spectra are simulated forward into cross spectra and compared to observations. Using this approach cases of significant inconsistencies between SAR and model data can be detected. With our 3 week data base in 1996 (about 30,000 imagettes) statistics are calculated. Finally, we derive daily maps showing areas with significant deviations between simulated and observed cross spectra. [C972]

"Ocean wave groupiness from ERS-1/2 and ENVISAT imagettes"

In this study a global data set of reprocessed synthetic aperture radar (SAR) data acquired by the European Remote Sensing satellite ERS-2 is used to study ocean wave grouping using wavelet based methods. For more than a decade the ERS-1/2 satellites have continuously recorded SAR images of the ocean surface. Operating in wave mode both instruments have acquired about 1400 imagettes of 10Ч5 km. size (every 200 km along the orbit) each day, which allows to study ocean waves on a global basis. Only coarsely gridded SAR image spectra are available as official wave mode products from the European Space Agency (ESA). As the full image information is required for the present study about 3 weeks of ERS-2 SAR wave mode raw data were reprocessed to 34000 complex SAR images using the BSAR processor from the German Aerospace Center (DLR). ENVISAT satellite, which was successfully launched on February 28, 2002, will provide almost 3000 imagettes a day due to its higher sampling rate (every 100 km). Applying a wavelet edge detection method on the SAR-amplitude-density image and using a region growing approach for the edgefree areas allows examinations of the wave groupiness on a single image. These examinations include group size and number of large groups. The wavelet coefficient as a measure for edge strength is correlated to both wave height and steepness. The wavelet method is compared with an alternative approach, which is based on the classical Hilbert-transform technique. For the latter method the actual sea surface elevation field has to be known. Therefore a quasilinear inversion scheme is used which estimates the surface elevation from complex SAR data. [C973]

"Study on complex dielectric properties of saline soils"

Using the Vector Microwave Network Analyzer in broad band (from 0.2 to 18 GHz), a controlled laboratory experiment was conducted on artificially prepared wet saline soil samples. The complex dielectric constants of soil samples in a wide range of moisture and salinity contents were measured and the relationship to the moisture and salinity of the soils were analyzed. The experiment results shows that the imaginary part of the dielectric constant of wet soil is more sensitive to the salinity of soils at low frequency range (f [C974]

"Sea ice classification using multi-frequency polarimetric SAR data"

This paper discusses the capability of the complex Wishart classifier for sea ice and classification using multifrequency, fully polarimetric SAR data. C-, L-, and P-band data acquired by the JPL AIRSAR in the Beaufort Sea was used. Classification using the unsupervised Wishart classifier is a two-stage process. An initial classification is required to seed the algorithm and can be derived using other classification methods. The Wishart classifier then used in iterations where the class means are updated after every step. The convergence of this approach is investigated. The Wishart classifier was found to be extremely dominant so that the classification result after a few iterations depends not necessarily on the initial classification used to derive the first class means. Even an initial classification derived with a random number generator leads to a good result after a few iterations. [C975]

"Direct estimation of vegetation parameters from covariance data in polarimetric SAR interferometry"

Polarimetric SAR interferometry (POLINSAR) is an emerging technique for the characterization of volumetric scattering processes. Each pixel of a POLINSAR interferogram is a 6Ч6 matrix of complex sample covariances among the polarimetric channels in the image pair. A model of polarimetric scattering from vegetation specifies the expected covariance matrix as a function of the vegetation parameters. The data matrix obeys a complex Wishart probability distribution that depends on the expected covariance. Using this, one can rind the maximum-likelihood estimate of the parameters from the data matrix. This paper presents the formula for the expected covariance matrix, as predicted by the model of Treuhaft and Siqueira for a random canopy over flat ground. An algorithm for computing the maximum-likelihood parameter estimate is derived. We test the algorithm on simulated data and compare its results to estimates derived from coherence samples. We conclude by discussing the extension of the direct estimation technique to more general POLINSAR scattering models. [C976]

"Potential of RADARSAT-2 for sea ice classification"

Polarimetric data acquired by the CCRS CV-580 airborne SAR are used to assess the capability of RADARSAT-2 for operational sea ice classification. The information content of the polarimetric data is illustrated by showing how specific scattering mechanisms are portrayed by the entropy, anisotropy and α-angle features. Ice type classes are derived from the full polarimetric data set using a complex Wishart classifier. The classes are then mapped into 2-D scatterplots to compare the information content between dual and fully polarimetric data. While dual polarimetric data are an improvement over single channel data, it is found that fully polarimetric data are needed to provide accurate ice classification performance. [C977]

"A parametric scheme for ocean wave spectra retrieval from complex SAR data using prior information"

A parametric inversion scheme for the retrieval of two dimensional ocean wave spectra from look cross spectra (LCS) acquired by spaceborne synthetic aperture radar (SAR) is presented. The scheme takes information about the spectral shape of different wave systems from a prior wave spectrum, while estimates for wavelength, waveheight and wave propagation direction are extracted from SAR cross spectra. The Partition Rescaling and Shift Algorithm (PARSA) is based on a partioning of a prior wave spectrum, e.g. taken from ocean wave models. For each ocean wave system a stochastic model is set up, which defines the probability that the propagation direction, the wavelength or the energy of the different wave systems deviate from the prior knowledge. The prescribed probabilities thereby quantify the confidence into the prior wave spectrum. Based on the probability models for the prior wave spectrum and the measured cross spectrum an optimal ocean wave spectrum is estimated using a maximum a posteriori approach. To solve the corresponding minimization problem the prior model is approximated with a multivariate Gaussian model. The optimization problem is solved with a Gauss-Newton method. The scheme is tested using both simulated cross spectra and reprocessed wave mode data acquired by the ERS-2 SAR. The reprocessed data are similar to the products, which will be available from the ENVISAT satellite launched in March 2002. [C978]

"Detection of extreme waves using synthetic aperture radar images"

Within the last years a considerable number of large ships have been lost due to severe sea state conditions. The cause of accidents are in many cases believed to be rogue waves, which are individual waves of exceptional wave height or abnormal shape. In particular steep breaking waves can be fatal for smaller ships. Damage is sometimes can also be caused by unusual grouping of waves, which can lead to dangerous ship motion. In situ measurements of extreme waves are sparse with most observations reported by ship masters after the encounter. In this paper a global data set of 5 Ч 10 km sized synthetic aperture radar (SAR) images acquired by the European Remote Sensing satellite ERS-2 every 200 km along the track is used to analyse extreme ocean wave events. As the European Space Agency (ESA) does not provide this dataset as a standard product wave mode raw data were reprocessed to complex SAR images using the processor BSAR developed at the German Aerospace Center (DLR). About 1000 globally distributed SAR wave mode images are available every day. Two dimensional ocean wave fields are derived from SAR images by inversion of the SAR imaging mechanism. Individual high waves are detected in the derived wave fields using a matched filter technique. The inhomogeneity of ocean wave fields is analysed using a parameter, which describes the shift invariance of the wave spectrum. [C979]

"Parameter estimation for the phase statistics in interferometric SAR"

In interferometric SAR applications, the complex coherence between two channels, ρejθ, and the effective number of looks, n, are required to describe the joint channel statistics. Accurate modeling of the statistics is critical in the determination of Ground Moving Target Indication (GMTI) CFAR detection rules in along-track interferometry, and the estimation of topography accuracy in across-track interferometry. In this paper, we

propose a method for estimating n and ρ based on the interferometric phase density function. We validate the robust, real-time implementable method with real SAR data in various types of terrain. Particularly, we show how the method can be extended to model the phase distribution even in extremely heterogeneous terrain. We show that the estimation relies only upon the multi-looked interferogram, without reference to the individual channels thereby reducing data storage requirements. [C980]

"The dynamic monitoring and management of coastal zone with SAR remote sensing and fractal approach"

It is known that coastal zone and its environments are the complex and specialized areas. Synthetic aperture radar (SAR) with all weather is the powerful tools for monitoring the dynamic changes of those regions, and fractal approaches may be a good ideal technologies for managements on the unprecedented amount of information from the coastal spatial and temporal processes and remote sensing images etc. database. The needs of coastal dynamic monitoring are introduced at the first. The imaging mechanisms and the technologies as well as the example studies of SAR detecting coastal zone are described in detail. [C981]

"Detection of extreme waves using radar-image sequences"

A method is presented to localize wave groups spatially and spatio-temporally utilizing synthetic aperture radar (SAR) images and nautical radar-image sequences of the ocean surface. Extreme waves can grow in space and time as a result of wave group evolution. These wave groups have to be taken into account for instance for the design of offshore platforms, breakwaters or ships, because they can cause severe damage on those structures. To detect extreme waves, dominant wave groups are selected from SAR images and radar-image sequences by considering the wave envelope. A radar-image sequence is transformed into the wave-number frequency domain using a 3D Fourier transform where the signal of the ocean gravity waves is filtered using a band pass filter based on the dispersion relation for linear surface gravity waves. Thereafter, a 3D Hilbert transform is applied to the filtered complex Fourier coefficients, which are then transformed back into the spatio-temporal domain applying an inverse 3D Fourier transform. The resulting spatio-temporal complex envelope of the wave field is investigated for the dominant wave groups, by considering the amplitude of the complex envelope. With slight changes the algorithm can also be applied to single radar images. To test and verify the algorithm, several radar image sequences were acquired with the wave monitoring system WaMoS-II, which is based on a nautical radar operating in the X-band (9.5 GHz) near grazing incidence. The instrument was operated on towers in the North Sea. All these data sets are exploited with respect to the localization of extreme waves and wave groups. [C982]

"CryoSat level 1b processing algorithms and simulation results"

The CryoSat synthetic interferometric altimeter (SIRAL) has been designed to extend the coverage of conventional pulse-limited altimeters to allow the measurement of sea ice thickness and the elevation of the marginal regions of ice sheets. The science data acquired by the instrument is of a more complex nature than the conventional radar altimeter and is in one of three forms each of which are described in the paper. Examination of simulated echoes from each of these 3 modes provides a useful insight into how the CryoSat mission will tackle its primary objectives, and how an improvement in elevation measurement will be made over its conventional satellite borne counterpart. [C983]

"Track decoupling: linear joint IPDA (LJIPDA) and multi-target linear IPDA (MLIPDA)"

This paper presents a new approach to multi-target tracking. Rather than forming complex hypotheses based on all possible combinations of measurement origins, we attempt to decouple individual tracks based on the probabilities of measurement origins. Two such algorithms, both based on the IPDA algorithm, are presented in this paper. One, which we call linear joint IPDA (LJIPDA), recalculates IPDA using the probabilities of measurement origin. The other, which we call multitarget linear IPDA (MLIPDA), uses the probabilities of measurement origin to modify IPDA results. Both algorithms are recursive and yield formulae for both data association and probability of track existence. Simulations were carried out to compare these algorithms with IPDA in a dense and non-homogenous clutter situation. [C984]

"Deconvolution approach to terrain scattered interference mitigation"

Terrain scattered interference or hot clutter is a problem in radar ECCM, especially for airborne radar with low sidelobe antennas and conventional adaptive sidelobe cancellation. A deconvolution approach is proposed to mitigate terrain scattered interference. This approach is based on obtaining an estimate of the complex multipath impulse response from a short time interval in the received signals. The impulse response estimate is then convolved with a direct path reference signal to generate an estimate of the received terrain scattered

interference signal. This interference signal estimate is then subtracted from the received main beam signal to generate a main beam signal with mitigated terrain scattered interference. [C985]

"Detection of UWB signals reflected from complex targets"

The questions of detection of radar-tracking signals are discussed, which parameters are unknown. The method for detection of radar signals which parameters are unknown is considered. The method is based on correlation processing of signals received in the adjacent periods of sounding-the interleaved periodic correlation processing (IPCP). [C986]

"Tracking a ballistic object on reentry: performance bounds and comparison of nonlinear filters"

Tracking of a ballistic reentry object from radar observations is a highly complex problem in nonlinear filtering. We derive the Cramer-Rao lower bounds (CRLBs) for the variance of the estimation error for this problem. Subsequently we compare several nonlinear filtering techniques to the derived CRLBs. The considered nonlinear filters include the extended Kalman filter, the unscented Kalman filter and the bootstrap (particle) filter. Considering the computational and statistical performance, the unscented Kalman filter is found to be the preferred choice for this application. [C987]

"Monte Carlo simulation of ionospheric scintillation"

The ionosphere is an important consideration in the design of radars, especially those that operate at UHF frequency and below. A statistical model of ionospheric scintillation is developed on the basis of data analysis and known empirical results. From a mathematical point of view, we model the effect of scintillation on radar signals via a constructed stationary random process. The complex PDF and autocorrelation of the process are designed to match the observed phenomenon. The resulting scintillation algorithm can be used to model ionospheric effects in real and simulated radar data. [C988]

"Feature analysis using millimeter-wave real beam and Doppler beam sharpening techniques"

A challenging problem in digital signal and image processing is that of automatic target recognition (ATR) and object classification. In defense operations in particular, rapid object discrimination is critical. While this problem has been studied extensively, it remains a challenge, due to the complex and time-intensive methods of typical approaches. This study involved constructing features from the range profile signal returns, identifying the "best" set of features and performing ATR. Confusion matrices are presented for the targets of interest for simulation. Although the selection techniques for the features were not optimized, the results for ATR are promising [C989]

"Reducing Cross-Target Products in Thinned Antenna Arrays using Nonlinear Processing"

Antenna array thinning by nonlinear multiplicative processing of subarray signals is highly efficient. It allows thinning rates of up to 90% and is, therefore, very profitable for phased or digital beamforming radar arrays to save significantly on the cost of the antenna elements. However, thinning by multiplicative processing does not come without problems, such as false responses in complex multiple-target situations due to cross-target product terms. The reasons for the occurrence of these ghost targets will be outlined in this paper and a new method to counteract them will be presented. Measurements carried out at 77 GHz are consulted to assess the applicability and the benefit of the proposed method to high resolution radar. [C990]

"Multiple target DOA estimation by exploiting knowledge of the antenna main beam pattern"

We propose a new approach to the estimation of the direction of arrival (DOA) of multiple radar targets present in the main lobe of a mechanically rotating antenna. The method is based on the maximum likelihood (ML) technique and it exploits knowledge of the antenna beam pattern. Two scenarios are considered: multiple targets with deterministic unknown complex amplitudes, and multiple targets with random complex Gaussian distributed amplitudes. The performance of the proposed estimator is assessed through Monte Carlo simulation and compared with the Cramer-Rao lower bound. [C991]

"Multifractal features of sea clutter"

Sea clutter refers to the backscattered returns from a patch of the sea surface illuminated by a transmitted radar pulse. Since the complicated sea clutter signals depend on the complex wave motions an the sea surface, it is reasonable to study sea clutter from nonlinear dynamics, especially chaos, point of view, instead of simply based on random processes. In the past decade, Dr. Simon Haykin's (1997) group at the McMaster University of Canada carried out analysis of some sea clutter data using chaos theory, based on the the assumption that a

chaotic attractor is fully characterized by a non-integer fractal dimension and a positive Lyapunov exponent. Thus, they concluded that sea clutter signals are chaotic. In other words, the complicated sea clutter waveforms are generated by nonlinear deterministic interactions of a few modes (i.e., number of degrees of freedom). However, a numerically estimated non-integral fractal dimension and a positive Lyapunov exponent may not be sufficient indication of chaos. Cowper and Mulgrew (see Proc. UCNN, vol.4, p.2633, July 1999), Noga (see Ph.D thesis, Cambridge University, 1998), and Davies (1994) separately have questioned the chaoticness of the radar sea clutter. We show, using the direct dynamical test for deterministic chaos developed by Gao and Zheng, which is one of the more stringent criteria for low-dimensional chaos, a two minute duration sea clutter data is not chaotic. We also carry out a multifractal analysis of this sea clutter data set, and find that the original sea clutter amplitude signal is approximately multifractal, while the envelope signal, formed by picking up the successive local maxima of the amplitude signal, thus measuring the energy of successive waves on the sea surface, is well modeled as multifractals. These behaviors determine that the amplitude signal follows approximately log-normal distribution while the envelope signal, and thus the energy of the successive waves of the sea surface, is log-normally distributed. Approximate log-normal distributions for the amplitude signal has been observed earlier. However, by using the multiplicative multifractal theory, there is theoretical justification for the log-normal distribution of sea clutter, as discussed. The implications of the multifracta- l nature of sea clutter may have relevance for the detection of point targets on the sea surface. [C992]

"A 38/76 GHz automotive radar chip set fabricated by a low cost PHEMT technology"

Two complex transmit MMICs have been developed for the conversion of a 38 GHz VCO signal to 76 GHz. They consist of a 38 GHz driver amplifier, a frequency doubler and 76 GHz output amplifiers. These MMICs achieve a saturated output power of 14 dBm at 76 GHz and a maximum conversion gain of 9 dB and 12 dB, respectively. The transmit chips are supplemented by a 38 GHz voltage-controlled oscillator with 1.5 GHz tuning bandwidth and 10 dBm output power. The developed MMICs are designed for flip-chip mounting and have been fabricated by a production oriented PHEMT technology. They are suited for low cost automotive radar systems [C993]

"Optimization of migration method to locate buried object in lossy medium"

We present an optimized frequency-wavenumber (F-K) migration method to localize buried objects such as landmines in lossy medium. F-K migration has been proposed to find the location of a buried object using ground penetrating radar (GPR) data. This approach makes use of a wave equation in the Fourier domain to back-propagate the received wavefield. For GPR applications however, standard F-K migration assumes that the ground surface is flat and the medium is loss-free which are not true in reality. When implemented in the Fourier domain, the wave equation becomes the Helmholtz equation. It is then straightforward to incorporate a complex index of refraction in the Helmholtz equation to describe wave phenomenon in lossy medium. We generalize F-K migration to the case of rough ground surface and lossy medium. In the framework of Tikhonov regularization, we develop an algorithm that optimally alters the wave propagation velocity and the complex index of refraction to take into account of the ground roughness and lossy medium. In the process of searching the optimal velocity and complex index of refraction, the algorithm is constrained to produce an image of minimum entropy. By minimizing the entropy of the resulting image, better results are obtained in terms of enhanced mainlobe, suppressed sidelobes, and reduced noise. We use examples from field data to demonstrate the performance of our method. [C994]

"Model-based principal component techniques for detection of buried landmines in multiframe synthetic aperture radar images"

Here we consider the use of model-based methods for the detection of buried objects from a sequence of synthetic aperture images obtained by a radar sensor moving linearly down a track. The scattering physics of the underlying sensing modality cause the relevant target signatures to change in a complex yet predictable manner from one image to the next. To arrive at a tractable processing scheme that exploits these motion-induced changes, we develop a flexible parametric model capable of capturing the full variation of these signatures. A detection scheme based on a principal components analysis of estimated model vectors is then derived. Results are demonstrated using field data from a forward-looking sensor. [C995]

"A new method for radiometric calibration of spaceborne SAR and its global monitoring"

To calibrate synthetic aperture radar (SAR) images to normalized radar cross sections (NRCS) a calibration constant is required. Usually the calibration constant is determined by analyzing measurements of corner reflectors. However, due to the high costs there are only a very limited number of corner reflectors available. In this paper a new method for estimating the calibration constant on the basis of a few days of SAR data is introduced. The method is based on knowledge of the dependency of the NRCS on the ocean surface wind,

which is described by well-tested empirical C-band models, e.g., CMOD4 and CMOD IFR2. Given the mean wind vector at each SAR wave mode image both models enable to derive the mean NRCS of the image. Application of the method is demonstrated and validated utilizing a total of 34000 SAR imagettes and co-located winds from the European Centre for Medium range Weather Forecast and the ERS-2 scatterometer. The SAR imagettes were processed to ENVISAT ASAR-like single look complex SAR images using three weeks of SAR wave mode data. It is shown that the method is an ideal tool for retrieving the SAR calibration constant and is capable to monitor and estimate variations of the calibration constant, e.g., due to saturation of the SAR analogue to digital convertor or gain drifts. [C996]

"A comparison between IEM-based surface bistatic scattering models"

The original IEM surface scattering model used a simplified surface current estimate leading to relatively simple but accurate results for forward and backscattering configurations. Since then other estimates of the surface current based upon the same set of integral equations have appeared in the literature. A major reason for considering a more complex estimate is because in the original IEM model the phase in the Green's function was not included in the integration process over the surface current to find the scattered field. Thus, it is not applicable to multiple scattering calculations. Currently, there are three different modifications suggested by different investigators: (1) use of the phase factor in the Green's function of the upper medium for integration over surface current, (2) use of the phases in the Green's function in both the upper and lower medium for integration over surface current, and (3) in addition to (2) further modify the Fresnel reflection coefficient to be the sum of reflection coefficients evaluated at the incident and scattering angles divided by two. In this paper we want to compare model predictions based on the use of the above surface current estimates under backscattering and bistatic conditions. [C997]

"Understanding and responding to earthquake hazards"

Understanding the earthquake cycle and assessing earthquake hazards is a topic of both increasing potential for scientific advancement and social urgency. A large portion of the world's population inhabits seismically-active regions, including the megacities of Los Angeles and Mexico City, and heavily populated regions in Asia. Population growth will exacerbate the potential for huge earthquake-related casualties. However, powerful new tools to observe tectonic deformation have been developed and are being deployed with encouraging results for improving knowledge of fault system behavior and earthquake hazards. In the future, the coupling of complex numerical models and orders of magnitude increase in observing power promises to lead to accurate targeted, short-term earthquake forecasting. Dynamic earthquake hazard assessments resolved for a range of spatial scales (large and small fault systems) and time scales (months to decades) will allow a more systematic approach to prioritizing the retrofitting of vulnerable structures, relocating populations at risk, protecting lifelines, preparing for disasters, and educating the public. The suite of spaceborne observations needed to achieve this vision has been studied, and the derived requirements have defined a set of mission architectures and enabling technologies that will accelerate progress in achieving the goal of improved earthquake hazard assessments. [C998]

"Matrix spectral form of the full polarization-Doppler response function"

This paper pays attention to the polarization-Doppler response function in time and spectral domain as a description for a complex radar object. The methods of partial polarization, partial coherence and their spectral description over a given bandwidth are used in the problem solution. The interest of these investigations has been increased because modern computing possibilities allow us to calculate the spectral density of the scattered field polarization parameters in real time. [C999]

"The nonlinear multiharmonic theory of two-stream free electron laser of klystron type"

Physical analysis of two-stream superheterodyne free electron lasers of klystron type is accomplished. It accounts for the multi-harmonic properties of signal, pumping, and space charge wave and the presence of longitudinal focusing magnetic field in the system work bulk. It is found that main merits of its devices are the following: compactness, extremely high level of amplification, possibility for smooth changing of the work frequency, high level of input-output decoupling, capability to work at many signal-harmonics simultaneously (i.e., capability to amplify signals with complex multi-harmonic spectrum, etc). [C1000]

"On platform-based sensor management"

The design of a generic mechanism for platform-based data fusion and sensor management is described. It is based on the duality between two types of agents, task agents and sensor agents. Task agents buy information from sensor agents that sell it, and sensors produce information that tasks consume. These buy and sell

interactions occur very frequently for systems involving sensors that work with small action durations. When several sensors are available, the sell/buy interaction involve selection and scheduling of sensors. The task concept is similar to the old decision or OODA (observe/orient/decide/act) loop that has since long been used for understanding human participation in complex command and control problems. A task might be described as a tiny OODA loop, with predefined purpose and processing capability. There are numerous task types, each dedicated to a certain skill or sensor process. The design is evaluated in single and multiplatform applications. [C1001]

"Radar signal generator and its usage for SAR algorithm tests"

To develop and to test different data processing algorithms for radar applications, a reliable raw radar data source is required. The most straightforward way for obtaining such data is to generate simulated data using specialized program tools. The presented radar signal simulator (RSS) is a Matlab program that can generate raw complex radar data based on supplied radar parameters and environmental data. The use of RSS for generating raw SAR data and for testing different SAR algorithms is also presented. [C1002]

"Radioabsorbing material optimal using in the reduction of aircraft radar cross-section"

Local scattering parts on smooth convex object elements make the most important contribution to reflected signal energy. So, the surface parts of complex shape objects are coated with a radioabsorbing materials (RM) for camouflage purposes. As a rule, the radioabsorbing coating (RC) has sizeable weight and cost. The optimal coating method for the reduction of radar cross-section (RCS) has been obtained for certain illumination and reception directions under limiting conditions for the quantity of RC used. An optimal coating has been realized by solving an integer linear programming problem. Using this method, we present RCS numerical results for a reductive aircraft model partly coated by RM. [C1003]

"Algorithm of decentralized secondary processing radar information"

An algorithm of decentralized secondary processing radar information was synthesized in the multiposition radar complex. Filtration of circuit coordinate estimation takes place in some separated receiving places. In the information processing station after classification of the received estimation, the last predicted estimation is formed. [C1004]

"Tracking radar digital matched-filter ASIC design and its error analysis"

The matched-filter is widely used in real time signal processing, especially in radar signal processing. This paper presents a novel structure of a digital tracking radar matched-filter, whose hardware overhead is one third of the traditional design but its throughput is doubled. With block-floating-point arithmetic, the precision is highly improved. The whole digital matched-filter is implemented in just one FPGA chip. This ASIC has two work modes: 512 points pulse compression and 256 points pulse compression. It complements three channels of 512 points complex signals in 102 μs. The signal-to-noise ratio formula of this matched-filter is deduced at the end of the paper. [C1005]

"Theory of search for moving objects"

The objectives of the paper are a development of a system of rules called "theory of search for moving objects", and a development of a new class of search problems for moving objects within the frames of this system, rather than a selection, classification or enumeration of all published articles, manuals, monographs, tasks statements and other in the theory of search area. The following issues are considered in the paper: (1) analysis and classification of search problems; (2) an axiomatic basis of the research approach; (3) axioms of the theory of search; (4) common theorem of additivity; (5) theorems of multiplicity; and (6) computer prototype for the theory of search. The case of a complex observation system integrated within one carrier is a core of the proposed approach. A case of two different observation systems is considered, when an observation zone for the second system (contact detector like a laser) is approximated as a line or a rectangle. It is possible to determine a probability area of target localization when one or both observation systems detected the target (theorem of multiplicity). A computer prototype of the theory of search for moving objects has been designed based on the object-oriented approach. It appeared to be a useful tool for any theoretical research and a flexible media for the further development of the theory of search for moving objects. It is also shown that it can be implemented for an adequate computer interpretation of search problems. [C1006]

"An HF-radar test deployment amidst an ADCP array on the West Florida Shelf"

For 11 days in January 2002, the Conrad Blucher Institute for Surveying and Science, Texas A&M University-

Corpus Christi, in collaboration with the College of Marine Science, University of South Florida, deployed a pair of 25-MHz CODAR Ocean Systems HF-radars on the West Florida Shelf over an array of six acoustic Doppler current profilers. The radar footprint had a maximum range of 60 km offshore, and it included mooring locations between the 10 m to 30 m isobaths. We examine, using a variety of metrics, the correlation between the surface currents measured remotely by the HF-radar and the subsurface currents measured by the ADCPs, which were either bottom- or surface buoy-mounted. Qualitative comparisons are generally good for this inner-shelf environment where the wind-driven current magnitudes were less than about 40 cm/s. The scalar regression analysis shows correlation coefficients (R) of 0.8 to 0.9 for the alongshelf components but 0.6 or less for the cross-shelf components. Complex vector correlation produces correlation values of 0.76 to 0.90 and a consistently clockwise veering from the radar-measured currents to the ADCP-measured ones ranging from 1.3 to 5.2 . The alongshelf surface currents measured by the radar are about 30% larger than those of the ADCPs measured 2 to 3 m below the surface according to standard deviations and linear regression slopes. [C1007]

"Edge-preserving image reconstruction for coherent imaging applications"

We propose a method for edge-preserving regularized reconstruction in coherent imaging systems. In our framework, image formation from measured data is achieved through the minimization of a cost function, which includes nonquadratic regularizing constraints for suppressing noise artifacts, while preserving the object boundaries in the reconstruction. The cost function we use effectively deals with the complex-valued and random-phase nature of the scattered field, which is inherent in many coherent systems. We solve the challenging optimization problems posed in our framework by a novel extension of half-quadratic regularization methods. We present experimental results from three coherent imaging applications: digital holography, synthetic aperture radar, and medical ultrasound. The proposed technique produces images where coherent speckle artifacts are effectively suppressed, and boundaries between different regions in the scene are preserved. [C1008]

"System modeling and design using genetic programming"

In this paper we describe nonlinear system modeling and design using genetic programming (GP). In order to demonstrate the ability of GP to design complex systems, we first present a novel scheme called improved least squares genetic program (ILS-GP) that attempts to reconstruct the functional form of a nonlinear dynamical system from its noisy time series measurements. ILS-GP augments the structural search ability of GP with a novel parameter estimation scheme called improved least squares designed specifically to eliminate bias in parameter estimates of the nonlinear dynamical system in the presence of measurement noise. We use different test chaotic systems and real-life radar sea scattered signals to demonstrate the effectiveness of the ILS-GP approach in reconstructing nonlinear systems. Having shown the ability of GP to reconstruct complex systems from their time series measurements, we apply GP to the reverse problem of constructing optimal systems for generating specific sequences called spreading codes in CDMA communications. Using different approaches including correlation properties and the bit error rate, we use the proposed GP approach to design chaotic piecewise maps that generate optimal spreading codes in complicated communication environments such as multi-path. Based on computer simulations, we have shown improved performance of the GP-generated maps when compared to the other approaches including the standard Gold code [C1009]

"Dynamic network-based secure VPN deployment in GPRS"

A dynamic network-based virtual private network (VPN) deployment, which is established between the general packet radio services (GPRS) border gateway and a corporate intranet gateway, is presented and analyzed. By relying on a sequence of concatenated protection mechanisms (GPRS ciphering and VPN deployment), it is possible to provide secure remote access to mobile users without requiring an extra tunnel overhead on the radio link or the implementation of computationally intense encryption algorithms in the mobile station. The VPN functionality is based on IPsec. For VPN initialization and key agreement procedures, an Internet key exchange (IKE) protocol proxy scheme is proposed, which enables the mobile user to initiate a VPN, while shifting complex key negotiation to the network infrastructure. The required enhancements for security service provision can be integrated in the existing network infrastructure, and therefore, the proposed security scheme can be used as an add-on feature of the GPRS. [C1010]

"Grouping salient scatterers in InSAR data for recognition of industrial buildings"

InSAR data are used to recognise large industrial building complexes. Such buildings often show salient regular patterns of strong scatterers on their roofs. A previous segmentation which uses the intensity, height and coherence information extracts building cues. Strong scatterers are filtered by a spot detector and localised by a cluster formation. Strong scatterers are grouped in rows by a process that uses the contours of the building cues

as context. Stich buildings are labelled as industrial buildings and serve as seeds to assemble adjacent buildings into complex structured building aggregates. The structure of the grouping process is depicted by a production net. [C1011]

"Relational graph labelling using learning techniques and Markov random fields"

This paper introduces an approach for handling complex labelling problems driven by local constraints. The purpose is illustrated by two applications: detection of the road network on radar satellite images, and recognition of the cortical sulci on MRI images. Features must be initially extracted from the data to build a "feature graph" with structural relations. The goal is to endow each feature with a label representing either a specific object (recognition), or a class of objects (detection). Some contextual constraints have to be respected during this labelling. They are modelled by Markovian potentials assigned to the labellings of "feature clusters". The solution of the labelling problem is the minimum of the energy defined by the sum of the local potentials. This paper develops a method for learning these local potentials using "congregation" of neural networks and supervised learning. [C1012]

"Bottom mounted active sonar for detection, localization, and tracking"

A bottom-mounted, wideband active sonar system designed to detect unfriendly vessels entering a closed area is described. We present signal processing algorithms for target detection, classification, localization, and tracking, and present performance predictions based on simulations. These algorithms are shown to be effective with state of the art, realizable sonar systems. The signals are binary phase shift keyed (BPSK) with a range resolution of approximately 0.01 m and Doppler resolution of 0.5m/s. Received signals from multiple directional receive beams are basebanded and Hilbert transformed to obtain complex representation. These signals are correlated with replicas of the transmitted signal time compressed or dilated to represent a number of different hypothetical target Dopplers, giving a processed signal with three dimensions: time, channel, and target Doppler. Background interference is estimated using a block-transversal filter. The processed signal is divided by the estimated background to obtain signal-to-interference ratio (SIR) and SIR threshold crossings are detected and contiguous detections are clustered. Range is estimated using arrival time. Bearing is estimated using amplitude comparison for adjacent receive beams. Elevation is estimated using split beam phase between signals from elements separated vertically. Finally, the crossings are clustered by location and Doppler. Clusters are classified based on amplitude and estimated physical extent and shape. Clusters with sufficiently high classification are passed to a tracking algorithm that computes a Kalman filter track using clusters derived from sequential transmissions. This filter operates using linked line of sight (LOS) coordinates, a technique long used in radar. The LOS coordinates used in this application are range, range rate, bearing, and elevation. Use of such coordinates is advantageous in this application because the errors in the coordinates are nearly independent of one another. Performance of this algorithm was investigated using active acoustic signals synthesized by the Sonar Simulation Toolset (SST), a digital program written by Robert Goddard at the Applied Physics Laboratory. This program generates a complex baseband representation of the acoustic signal in each chan- nel. This signal is processed by the detection, classification, and tracking algorithms. SST simulates effects of acoustic propagation including refraction and scattering and reflection from a target. Several simulated encounters with different target geometries are presented to illustrate detection, localization, and tracking performance. [C1013]

"A comparison of partially adaptive STAP techniques for airborne element digitised phased array radar"

In future there will be a growing requirement to use high levels of spatial and temporal sampling to enable the use of space time adaptive processing (STAP) to improve target detection in complex interference environments. However, in practice, the processing power and training data requirements will restrict the degrees of freedom (DOF) that can be used. A number of algorithms have been developed to take advantage of phased array architectures employing many DOF without suffering from slow processing, poor beam pattern control or inadequate training data. This can be achieved using either adaptive or non-adaptive DOF reduction techniques. We evaluate a number of partially adaptive techniques via simulations with airborne element digitised array radar (EDAR). [C1014]

"The specification and measurement of radar performance"

The overall problem of procuring a radar system is very complex, covering many other issues such as reliability, maintainability and through life support. This paper is only concerned with the problems of specifying and measuring detection performance that are especially prominent in modem adaptive radars. It starts with a discussion on the nature of radar performance specifications. This is followed by a review of the adaptive nature of modem radars and the problems associated with specifying their performance. This leads onto a discussion of

the implications for future procurement methodology. Finally, successful implementation of the ideas presented here requires further research in several areas, which are summarised. [C1015]

"Robust mapping of tropical cyclone wave fields using HF skywave radar"

The prospect of obtaining real-time measurements of oceanographic and meteorological conditions over vast areas of the Earth's oceans by means of HF skywave ('over-the-horizon') radar has been the subject of many investigations over the past three decades. The remote sensing information is obtained by interpretation of echoes from the sea surface, whose time-varying geometry imposes a complex modulation on the radar signals. Depending on radar design and ionospheric conditions, a map spanning several million square kilometres may be acquired on a grid with resolution typically 10-20 km in less than 30 minutes. We describe methods developed in the Defence Science and Technology Organisation (DSTO) to overcome, or at least minimise, the deleterious effects of radio interference, disturbed ionospheric propagation conditions, scattering from very rough seas and the intrinsic complications of wave fields generated by intense weather systems. The goal is the integration of these various measures into a fully automated cyclone mapping system. [C1016]

"Hybrid optoelectronic processor for complex signals detection"

A hybrid optoelectronic processor (HOEP) is discussed for interception of spread-spectrum signals. HOEP integrates an electrooptical array antenna and an interferometer for detection, angle-of-arrival estimation and spectrum analysis. This new acoustooptic structure is proposed for effective spread-spectrum signal processing. [C1017]

"Optical arbitrary waveform generator for radar applications at high frequency resolution"

In future radar systems, highly complex synthetic waveforms are needed to perform sophisticated signal processing functions at high speed. An opto-electronic arbitrary radar waveform generator is proposed. It permits one to generate predefined waveforms by driving phase-amplitude distributions of optically carried microwave signals. [C1018]

"The method of range profile for step frequency MMW radar based on wavelet transform power spectrum estimator"

The range profile method for step frequency MMW radar targets based on a wavelet transform power spectrum estimator is studied. This method can successfully measure the power spectrum in samples for which traditional methods often fail because the samples are finite sized, have a complex geometry, or are varyingly sampled. We apply this method to the practical step frequency MMW radar target echo signals, and on the condition of the same sampling frequency and sampling data length, it can achieve a one dimensional range profile with profile resolution superior to FFT. Compared with the FFT algorithm using a wavelet spectrum estimator of short data series, we can achieve high resolution, high accuracy, and low SNR threshold. The experimental results make clear that the DWT estimator is a sensitive tool in range profile of step frequency NMW radar. [C1019]

"Detecting weak sinusoidal signal by LMP test"

A simple CFAR detector is proposed in this paper for detecting complex sinusoidal signals with unknown parameters in complex Gaussian noise with unknown variance. The detector is based on the locally most powerful test (LMP), which performance approaches the uniformly most powerful test (UMP) when the signal-to-noise ratio (SNR) approaches zero. It can maximize the probability of detection for a given false alarm rate, especially when the signal is weak. We adopt the estimate and plug detector method to complete the design. The performance analysis shows that the detector we designed is an approximate constant false alarm rate (CFAR) detector. Compared with the generalized likelihood ratio test (GLRT), it is easier to complete. Simulation results support our conclusion. [C1020]

"Differential cepstrum for radar HRR profiles-aligning"

The signal properties and the mathematical model of the high-resolution range profile of radar are studied. A novel tool, called a differential complex cepstrum (DCC), is then introduced for radar target recognition. Research into the radar signal model is conducted on the basis of the model, and two properties are derived. The DCC is suggested to be utilized for the statistics of airplane recognition. Simulations are given to show that the DCC is suitable for radar target recognition and the proposed algorithm is effective. [C1021]

"Fuzzy pre-extracting method for support vector machine"

The support vector machine (SVM) learning algorithm is a method for small samples learning, but the selected support vectors (SVs) must be obtained by an optimal algorithm. To counter the low speed of the SVM learning, a new fast method combining SVM and a fuzzy method is proposed. The SVs are pre-extracted by an iterative algorithm and a fuzzy method is used instead of solving the complex quadratic program problem. The method greatly reduces the training samples and improves the speed of SVM learning, while the ability of the SVM is not degraded. Better results are obtained over other SVM methods, which makes this new fuzzy pre-extracting SVM method useful in practice. [C1022]

"Clonal operator and antibody clone algorithms"

Based on clonal selection theory, the main mechanisms of a clone in the immune system, which are explored in the field of artificial intelligence, are analyzed. An artificial immune system algorithm, antibody clone algorithm, is put forward. Compared with an improved gene algorithm, the new algorithm is shown to be an evolutionary strategy capable of solving complex machine learning tasks, like multi-modal optimization. Using Markov chain theories, it is proved that the antibody clone algorithm is convergent. [C1023]

"Advanced point cloud generation for photogrammetric modeling of complex 3D objects"

A novel method using self-adaptive image correlation windows for photogrammetric point cloud generation is reported. By combining existing tie points used in the bundle adjustment with a flood-fill matching process that uses a tie point as a seed, the algorithm makes it possible to develop point clouds and surfaces automatically for a variety of complex real world scenes. The performance assessment is on-going, but first results show that, although computationally expensive, the method can be utilized in a practical setting with little operator intervention. Future work will focus on improving the adaptive windows and on fitting various surfaces during matching so that composite object types can be sent to the CAD environment as an alternative to point clouds, which are expensive to manipulate. [C1024]

"Polarimetric target decomposition and physical interpretation of NASA (JPL) AIRSAR data in mountainous terrain"

Two types of polarimetric Target Decomposition (TD) theories were used to investigate the effects of surface slopes on the physical scattering mechanisms over mountainous scattering surfaces. This study is implemented with the L- & P-band NASA (JPL) airborne SAR (AIRSAR) data, which was acquired during PACRIM-II Korea campaign in September 2000. Although the dominant scattering mechanism of mountainous forest area is volume scattering in pine forest scattering surface, detailed scattering mechanism varies with respect to the local incidence angle variations due to the local topography and wavelength. [C1025]

"Land cover classification of polarimetric synthetic aperture radar (POLSAR) data based on scattering mechanisms and complex Wishart distribution"

The use of C- and L-band polarimetric synthetic aperture radar (POLSAR) data for classifying land cover features in a tropical area is investigated in this study. The POLSAR data were acquired during the NASA/JPL PACRIM-1 mission over the northern part of Peninsular Malaysia on 3rd December 1996. Prior to classification, the Lee polarimetric filter was applied to the complex covariance matrix for speckle suppression. In unsupervised classification, the scattering mechanism of each pixel in the speckle-suppressed images was analyzed and grouped into one of the three categories: (1) odd-bounce, (2) even-bounce, or (3) diffuse scattering. Training samples were then generated from the outputs of the unsupervised classification, to be used in subsequent supervised classifications of various frequency and polarization combinations. The Kappa statistics computed for classification using single-frequency fully polarized C- and L-band data were 0.69 and 0.73, respectively. An improvement to 0.79 was achieved by using the dual-frequency (combined C and L bands), fully polarized data in the classification. [C1026]

"SAR polarimetry for permafrost active layer freeze/thaw processes"

In this paper, a feasibility study is conducted in regard to using SAR for the freeze/thaw processes monitoring. The backscatter polarimetry parameter defined as a proportion of the statistically averaged HH backscatter to the VV one is calculated through solving the Maxwell equations in the small perturbation method approximation. In order to provide for the soil complex dielectric constant dependencies on moisture, texture, frequency, and temperature the generalized refractive mixing dielectric model is used. The polarimetry parameter size of changing, due to seasonal soil temperature profile deviations, soil moisture variations, and the radar look angle alterations have been analyzed in detail. The outcomes of the performed analysis intend for planning SAR observations and data processing in the experiments on active permafrost layer monitoring. [C1027]

"A multi DSP board for real time SAR processing using the HiPAR-DSP 16"

At the University of Hannover a fully programmable DSP, the HiPAR-DSP 16, was developed. This HiPAR-DSP 16 contains 16 parallel datapaths and a 2-dimensional memory adapted to image processing algorithms. For real time SAR processing high computational power is required. Therefore a multi DSP board with 6 HiPAR-DSP 16 is developed. The high performance of up to 28 GOPS enables a SAR processing in real time. The calculation time for the wk-algorithm running on this board was estimated. For blocks of 4096 lines with 4096 8 bit complex samples real time processing is possible to a pulse repetition frequency (PRF) of 1200 Hz. Due to a low power consumption and the small size of 160Ч230 mm2of this board the use in on-board systems is predestinated. [C1028]

"Quantitative assessment of interferometric SAR images registration accuracy"

Accurate registration of images is very important for interferometric SAR topography mapping. The interferogram (phase pattern) extracted from the conjugate product of two complex images registered with different registration algorithms will be slightly different too. In this paper, we investigate the theoretical relationship between registration accuracy and probability of residue. Based on the derived model, we present that the number of residues can be used as a criterion to judge the registration accuracy and select the optimal interferogram. A pair of ERS1/2 SAR images has been used to illustrate the effectiveness of this means. [C1029]

"Signal operator cores for SAR real time processing hardware"

This work deals with the mathematical formulation and hardware implementation of computing methods for the action of one and two-dimensional operators on discrete, finite length signals representing real time synthetic aperture radar (SAR) image formation data. We give emphasis to modular and scalable computing methods. The complex Hilbert spaces l2(ZN) and l2(ZRЧZS) are used to represent signals of very large size. These spaces are converted into algebras using circular convolution and cyclic Hadamard signal operations. The operators themselves are also represented as being part of matrix algebras for computational studies and algorithm development. Special attention is given to unitary operators, such as the discrete Fourier transform (DFT), and to finite impulse response (FIR) operators. For FIR operators, we concentrate on the study of properties of convolutional algebras and present new mathematical formulations of filtering theories. [C1030]

"Moose Mountain Virtual Explorer: A learning and ground-truthing tool to explore high-resolution remote sensing and geoscience data in mountainous area"

The objective of the Moose Mountain Virtual Explorer system (MMVE http://www.cgq-qgc.ca/geoide/) is to provide access, through an efficient web interface, to a geologically-rich digital library to remote sensing and geoscience researchers, resource explorationists and students. Data sets are all geographically located within a rugged area of the Rocky Mountain Foothills of Alberta. The library collection was acquired through field campaigns, and airborne and satellite acquisitions, over the course of a 3-year canadian GEOIDE Network of Excellence project (Moose Mountain project, Lebel et al. 2001). High-resolution aerial orthoimages, oblique aerial and terrestrial photographs, radar imagery, geological data, maps and cross-sections constitute the database content. The project is nearing completion and aims to promote the integration of geoscientific, photogrammetric and remote sensing data as a guide for oil and gas exploration in mountain fold and thrust belts. Moose Mountain was selected because it represents a surface analogue of complexly faulted carbonate rock formations that host a gas field at depth. MMVE can thus be used to explore the complex relationships that exist between rock properties and hydrocarbon reservoir favourability within the context of small and subtle gas plays that are being explored in the deep subsurface of the Canadian Cordilleran Foothills. [C1031]

"Image classification in complex spaces"

Addresses issues related to classification of images in complex spaces. The image is represented in terms of phase and amplitude components. The classifier optimizes functions of joint real and imaginary conditional probability density functions. A bound on the total probability of errors in terms of Rayleigh quotient is derived and compared to the cases where a non-complex amplitude-only signal is used. Examples of application of the proposed approach on polarimetric radar imagery indicate several orders of magnitude improvement in performance. [C1032]

"Coherence region shape extraction for vegetation parameter estimation in polarimetric SAR interferometry"

Polarimetric SAR interferometry (POLINSAR) provides volumetric information about electromagnetic scattering

processes, whereas standard INSAR assumes that only surface scattering is present. Instead of a single complex interferometric coherence for each pixel, POLINSAR observes a polarization-dependent coherence function whose range is called the coherence region. To estimate canopy parameters, the shape of this region must be matched to predictions from scattering models. For computational efficiency, the region must be represented by a small number of samples. Current sampling methods find the stationary points of coherence magnitude or phase; it is questionable whether the coherence region can be characterized adequately with so few samples. We have developed an algorithm for sampling the outer boundary of the coherence region. We formulate the problem of finding the minimum and maximum real part of the coherence as an eigenvalue problem. The solutions specify two points on the boundary. Other points are found by applying a phase shift to the POLINSAR cross-correlation matrix. The mathematical literature shows that the coherence region is convex, and hence the algorithm rinds the entire boundary. We present a comparison of boundary sampling to standard methods on L-band POLINSAR data from the SIR-C platform. It is evident that boundary sampling describes the shape of the coherence region more thoroughly than other methods. [C1033]

"The new curvature methods of image fine registration for synthetic aperture radar interferometry"

The image fine co-registration whose accuracy has a direct influence on DEM accuracy, is more important for synthetic aperture radar interferometry (INSAR). The co-registration based on intensity values is easy to implement and computationally efficient but the least accurate. To get better accuracy, we must consider the characteristics of the complex images intensity, the geometrical characteristics of the distributed targets, and the correlative characteristics between the two characteristics. This paper presents the curvature method for fine co-registration of the images. It makes use of not only the intensity value of the pixel, but also the geometric distributing of the group of pixels. At the same time, the characteristic surface is built by combining the two characteristics. The curvatures of some curves in surface show the geometric characteristics of the surface, which have no relation with the surface flexibility and its coordinate position. The characteristic of the registration objects is obvious when using the curvature of surface as the fine co-registration object. This method is feasible and easy to be implemented. Detailed theoretical deduction and practical research is done in this paper. The experiment result shows that the registration accuracy is better than that of traditional methods. [C1034]

"Amplitude-driven coherence filtering in complex interferograms"

Presents a new method for filtering the coherence image issued from an interferometric pair. The basic idea is to determine for each pixel an adaptive neighborhood with respect to the amplitude information. Then, complex averaging is performed using values of pixels in the determined neighborhood to derive the filtered coherence value. It is shown that the proposed technique performs better than the standard fixed-neighborhood filtering technique, both objectively and subjectively. [C1035]

"Analytical expression for the posterior distribution of signals in colored Gaussian noise"

The paper describes a Bayesian approach to estimate the amplitude of a given signal embedded in complex zero-mean Gaussian noise with unknown covariance. By employing Jeffreys priors to unknown parameters, the posterior distribution is derived analytically. While the resulting estimates are merely reproductions of classical estimates, the Bayesian approach offers an enhanced ability to predict the quality of estimates conditioned on the measured data. This ability is further highlighted by simulations using finite training sets. [C1036]

"A super resolution SAR imaging method based on CSA"

Available conventional super resolution SAR imaging methods are based on complex images obtained by SAR imaging algorithms, and form super resolution SAR images via 2-D spectral estimation methods. A super resolution SAR imaging method combined with the chirp scaling algorithm (CSA) is presented in this paper. The new method forms a super resolution image by performing the range and the azimuth processing independently. This method can reduce the effects of phase errors on super resolution processing. The method is suitable for practical application since it does not require heavy computation. Experimental results show the effectiveness of the presented method. [C1037]

"Bit-plane compression of high dynamic range SAR imagery"

The paper describes a technique to compress 16 bit/pixel magnitude or 32 bit/pixel complex synthetic aperture radar (SAR) imagery without loss. The image is divided into its 16 or 32 individual bit-planes and each bit-plane is separately subjected to a raster scan to record the run-lengths of zeros and ones. The run-lengths are then coded using the CCITT Group 3 facsimile standard (a modified Huffman code). Performance is measured by comparing this technique to other lossless image compression techniques, such as JPEG-LS and JPEG-2000. [C1038]

"Next generation technologies to enable sensor networks"

Examples are advances in ground moving target indicator (GMTI) processing, space-time adaptive processing (STAP), target discrimination, and electronic counter-countermeasures (ECCM). All these advances have improved the capabilities of radar sensors. Major improvements expected in the next several years will come from exploiting collaborative network-centric architectures to leverage synergies among individual sensors. Such an approach has become feasible as a result of major advances in network computing, as well as communication technologies in both wireless and fiber networks. The exponential growth of digital technology, together with highly capable networks, enable in-depth exploitation of sensor synergy, including multi-aspect sensing. New signal processing algorithms exploiting multi-sensor data have been demonstrated in non-real-time, achieving improved performance against surface mobile targets by leveraging high-speed sensor networks. The paper demonstrates a significant advancement in exploiting complex ground moving target indicator (GMTI) and synthetic aperture radar (SAR) data to accurately geo-locate and identify mobile targets. [C1039]

"A review of radar as a sensor for advanced surface movement guidance and control systems (A-SMGCS)"

Over the past decade or so there has been increasing interest and recognition of the ground movement environment as part of the overall air traffic control problem. There are a number of reasons for this, both on safety and airport efficiency grounds. One recognition of this was the adoption by Eurocontrol of a gate to gate air traffic control concept. There is also considerable activity by organisations such as FAA, ICAO, the EU, and EUROCAE. As an example of this, the FAA is currently procuring a large number of ground surveillance systems for use at USA airports. Equally many European airports and aviation authorities are purchasing or have recently purchased surface movement systems. Traditionally, radar has been the main sensor for surveillance of the airport surface. While this is still the case, the overall concept of ground movement control is considerably more complex than that of the radar alone, and will involve multiple types of sensor data fused to provide data output. This paper presents a short review of the overall A-SMGS system concept, before discussing in more detail the radar problem per se and a overview of current system trends. [C1040]

"The relative and absolute geometric algorithm for the ERS baseline estimation"

Two fundamental parameters in synthetic aperture radar (SAR) interferometry are baseline orientation and baseline length, which are the key elements of the interferometric geometry. These parameters control how topography is mapped into interferogram phase, and affect the accuracy of the DEM directly. Without ephemeris or the accuracy parameters in it, how to estimate more accurate baseline parameters is an important question. It is an important way to make use of the ground target position in the sub-satellite track, the relative information in the image and other correlative information. In fact, it can estimate the fundamental parameters with the position of the satellite, the difference of two homonymic points' position, the spatial resolution. etc. Considering the ERS characteristics, the correlative information in the two complex images, and the position of the reference points to the sea level, this paper presents the relative and absolute geometric algorithm to estimate the two parameters. The algorithm is simple in computing, and facile in actualizing. The estimation accuracy is more precise by tests using the ERS data for interferometry. [C1041]

"A piece-wise polynomial fitting method to filter the interferogram phase noise [CInSAR]"

Among many important factors for the whole interferometric processing, the interferometric phase quality affects the phase unwrapping and the accuracy of the DEM directly. The noise, which exists in the single complex image, affects the judgment of the image. After the interferogram phase (IP) is taken out from the complex images, the distribution of the phase noise is complicated. To get the high quality IP, the IP noise, which always exists, must be eliminated. The IP noise should be distributed continuously in one period and disconnected from one period to another. The polynomial fitting method can eliminate the phase noise in the continuous interval, but it can also add noise in the discontinuous interval, especially in the whole phase interval. This paper brings forward the piece-wise polynomial fitting (PWPF) method that can eliminate the IP noise. The PWPF can be obtained from the range and azimuth director respectively in the whole IP image. The experiment shows this method has a better IP noise eliminating effect. [C1042]

"Generalized refractive mixing dielectric model for moist soils"

In this paper, a technique for estimating the maximum bound water content and complex dielectric constants for both the bound and the free water in soil is presented. The thus attained dielectric properties for the water in soil, are used to derive the Debye spectroscopic parameters for both types of water. Empirical data sets for the soil complex dielectric constant as a function of moisture measured only at two frequencies are sufficient for

applying this technique. As a result the model for predicting soil complex dielectric constant in the microwave band is proposed and validated. [C1043]

"Optimum interpolation and resampling for PSC identification"

The first basic step in the permanent scatterers analysis technique is the location of the stable reflectors. For this purpose, an inter-image amplitude analysis, on a pixel-by-pixel basis, is performed, and the scatterers showing stable amplitude response are named Permanent Scatterer Candidates (PSC). The effects of the interpolation of the SLC (Single Look Complex) images are considered, with particular attention to the oversampling factor and to the interpolation kernels. Finally, experimental results are shown to confirm the PSC theory and the interpolation analysis. [C1044]

"Evidence for a peculiar style of ground deformation at Vesuvius volcano revealed by 10 years of ERS mission"

We present results obtained via an innovative spaceborne SAR interferometry algorithm showing that, despite its quiescent stage, the Somma-Vesuvius volcanic complex is subject to a particular deformation process. This is characterized by a rather continuous subsidence effect, revealed by both ERS satellite data and levelling surveys, between 1992 and 2000. These deformations are mainly localized in two zones involving the Vesuvius cone and a narrow discontinuous annular area that extends around the base of the Somma edifice. A likely explanation of subsidence at both sites involves the joint effect of gravitational sliding and extensional tectonic stress occurring at the contact between different lithological units. [C1045]

"Aircraft HRRP classification based on RBFNN"

We present a classification scheme based on a new kind of RBFNN (radial basis function neural network) whose structure is similar to that of AWNN (adaptive wavelet neural network). To be more suitable for HRRP (high resolution range profile) classification, this kind of RBFNN substitutes wavelet basis functions in AWNN with Gaussian basis functions. In addition, we also devise an RBFNN initialization method of clear physical significance, and propose a decision rule based on average output vectors of RBFNNs. The new scheme is applied to HRRP classification of six aircraft at different SNR levels, and the results are compared with that obtained by MCCM (maximum correlation coefficient method). It is indicated that the RBFNN-based classification method has the potential in complex target classification and is promising to develop more practical HRRP classifiers [C1046]

"An automatic target recognition (ATR) scheme in colored Gaussian noise based on parametric model and hybrid algorithm"

This paper firstly presents a concise and physically relevant parametric model for use in automatic target recognition (ATR), data compression and scattering studies. Then, the extraction algorithm of high-resolution target feature vectors for ATR in the presence of colored Gaussian noise is developed, which is not restricted by the low SNR and Rayleigh resolution limit. Therefore, an eight-stage ATR scheme based on the hybrid algorithm is proposed. The experimental results show its practicability in the application [C1047]

"A powerful practical coherent adaptive radar detector"

An adaptive detector for the case of a radar target with unknown Doppler and unknown complex amplitude in AR (autoregressive) noise of unknown parameters has been derived. The secondary data is also used to improve the detection performance. The proposed detector has the form of a detector bank. The computational load of efficient realization of this detector bank is also presented. Finally the performance of the proposed detector is evaluated using both simulated and real clutter data [C1048]

"Analysis of a nonsinusoidal radar signal and the formation of it's coded pulses"

This paper analyses a nonsinusoidal radar signal, presents a programmable coded pulse (PCP) design scheme for generating a complex radar pulse signal and puts it into implementation. It is shown that the system implemented through this scheme can produce an arbitrary combination code pulse wave. Therefore this scheme provides a new train of thought and method for the design and research of a complex radar wave [C1049]

"Radar waveform design and target detection using wavelets"

The projection of the conventional radar waveform in wavelet space is comparatively complex, which complicated the wavelet decomposition of the radar waveform. A novel radar waveform design method is

proposed. The proposed approach uses the wavelet function of a specific scale as the waveform and thus the inter-dependency of the wavelet coefficients in different subspaces is reduced. Better detection performance is achieved when only two wavelet decomposition coefficients are used. Through theoretical analysis and simulation results it is shown that the proposed approach has improved adaptation to non-stationary noise and the echos of the large target has a smaller negative effect on the adjacent range cell [C1050]

"Pole patterns of radar-target scattering model based on ultra-wideband Gaussian pulses"

Time domain and frequency domain analysis of a radar-target scattering model based on ultra-wideband Gaussian pulses are presented. The scattering model is a useful tool for computing the range profile, or image, of a complex target that is illuminated by electromagnetic impulses. Computer plots of range profiles and pole patterns are obtained for a complex target that is composed of a finite number of scattering centers. The range profiles and the pole patterns are valuable information for radar-target classification and identification [C1051]

"An efficient method of radar target detection in complex background"

An efficient method of radar target detection based on multifractals and a neural network is proposed and applied to armored target detection in a complex background. The detection experiment results are encouraging and show that the proposed method is superior [C1052]

"Complimentary measurement of geophysical deformation using repeat-pass SAR"

Differential radar interferometry has proven to be an excellent method to measure displacements associated with geophysical phenomena such as glacier flow, subsidence, tectonic plate motion, and earthquake displacement. Since the technique utilizes the interferometric phase, it is limited in cases where large displacements in the slant range direction result in complete decorrelation. Similarly, if the surface deformation causes rotation of the scene or other disturbances the interferometric signal will be lost. The geophysical displacement field can also be measured via incoherent or coherent cross-correlation of small image chips. This method has the advantages that it does not require phase unwrapping. In cases where there is some degree of interferometric coherence between data acquisitions, the single-look complex image speckles themselves become features that can be accurately tracked. This method is complimentary to the phase-based approach since it works well with the large displacements. Examples for the successful application of the two techniques are found in the mapping of the velocity fields of surging glaciers and displacement fields of major earthquakes. Furthermore, image cross-correlation measurements yield the two-dimensional displacement field while measurements of the phase yield deformation only along the line-of-sight. Accuracy of the cross-correlation method is dependent on the scene content, correlation, and image chip size [C1053]

"Polarimetric edge detector based on the complex Wishart distribution"

A new edge detector for polarimetric SAR data has been developed. The edge detector is based on a newly developed test statistic for equality of two complex covariance matrices following the complex Wishart distribution and an associated asymptotic probability for the test statistic. The new polarimetric edge detector provides a constant false alarm rate and it utilizes the full polarimetric information. The edge detector has been applied to polarimetric SAR data from the Danish dual-frequency, airborne polarimetric SAR, EMISAR. The results show clearly an improved edge detection performance for the full polarimetric detector compared to single channel approaches [C1054]

"Automated sea ice classification using spaceborne polarimetric SAR data"

This paper discusses the capability of spaceborne polarimetric C-band SAR data for sea ice detection and classification. Unsupervised classification using polarimetric decomposition and the complex Wishart classifier was performed on SIR-C data acquired off the coast of Newfoundland in April 1994. The algorithm is used for sea ice applications for the first time, and appears promising. In addition to polarimetric classification, three of the measured features were found to have ice edge detection capability: HV-intensity, HH/VV-ratio and anisotropy. These features show a clear separation between sea ice and open water and simple thresholds can be applied [C1055]

"Full-wave computation of clutter for VHF ground RADAR over irregular terrain"

The present paper proposes a method to compute the complex impulse response of wireless channels based on a parabolic equation (PE) propagation algorithm. The choice of a full-wave method, instead of an asymptotic algorithm (knife-edge, UTD/GTD), has been made considering that the last is inappropriate for terrestrial VHF/UHF paths. It is indeed well known that, in these bands, scatterers and diffracting obstacles are often close

to each other and to the ground (in comparison with the wavelength). The propagation algorithm gives the complex signal (amplitude and phase) at the receiver in CW operation for several values of the frequency (ie, sampled values of the transfer function). The impulse response of the deterministic channel is then obtained after FFT computing. The main limitation of this method is the fact that horizontal scattering and diffraction as well as depolarization cannot be fully taken into account because of its 2D nature. This method seems well suited to transmission and RADAR applications (prediction and simulation). We show sample computations of ground clutter for a monostatic VHF RADAR in pulse mode over an irregular terrain. Moreover, it can be extended to stochastic channels. We also exhibit comparisons between computed results and experimental data obtained with a vector-type Cox sounder for terrestrial VHF links located in rural areas [C1056]

"Concurrent polarization operation mode of location system"

Equipment for active location with optical and radar wave bands receives information on the object from the formation of sounding signals and the analysis of scattered signal. Radar systems are successfully used in monitoring environment, remote sensing of polarization characteristics, measurement of hydrometeor characteristics. Laser locators (lidars), on the basis of polarization measurements, allow one to estimate the characteristics of atmospheric aerosols, to control for atmospheric pollution. The high frequency of laser radiation provides very narrow diagrams of lidar direction, the formation of impulse sounding signals of short duration and the following peculiarities: great time of the operating region review; strong weakening by atmosphere of the sounding laser radiations and those reflected from the target; most of the targets are spacially distributed. Superposition of radar and optical channels in a complex location system (CLS) allows one to avoid the limitation of each of the systems. The paper describes the concurrent polarization operation mode of a CLS system [C1057]

"Quadratic phase coupling estimation of two-dimensional harmonics"

In this paper, the problem of nonlinear phase coupling estimation of two-dimensional harmonics is discussed, which has not been solved before. From the definition of third-order cumulant of the data, we separate the coupling harmonics and the other harmonics. Then, we select one method of two-dimensional harmonics retrieval to estimate the parameters. Both the complex and the real signal are concerned [C1058]

"Bayesian model based city reconstruction from high resolution ISAR data"

We present Bayesian information extraction methods for feature extraction from metric resolution interferometric radar data. The extracted information is naturally related to a three-dimensional environment. We consider this information for the reconstruction of complex urban settlement areas. We target the higher complexity of the scene that is captured by the high resolution of the sensors by using hierarchical models of the data. Their stochastic nature allows us to deal with the uncertainties that are inherent in both the acquisition process and in the data themselves. We present results of the application of the described concept to the separation and characterization of typical man-made objects appearing in urban areas [C1059]

"Optimal combination of multiple SAR differential interferometric measurements for monitoring terrain displacements"

Synthetic aperture radar (SAR) differential interferometry is a powerful technique that allows to measure very small movements of the terrain happened between two data acquisitions. In previous works we demonstrated how to overcome the main limitations of the technique (i.e. decorrelation noise and atmospheric artifacts) by means of a method for unwrapping sparse phase data and by performing a temporal analysis of successive acquisitions. In this work we explore the possibility of considering together the space and time properties of the studied signal. The two steps mentioned above (i.e., sparse phase unwrapping and temporal analysis) act in the space and in the time domains separately. A significant advance can be obtained by considering the data as samples of a function in a three-dimensional (3D) space-time, and by exploiting this structure in the processing. The 3D structure of the data makes the processing more complex but can help both phase unwrapping and atmospheric (and other) artifact filtering [C1060]

"The study of the statistical characteristics of monopulse ratio"

In many monopulse radars, the angular information of targets is abstracted from the monopulse ratio, so the statistical characteristics of the monopulse ratio influences the tracking effect directly. This paper derives in detail the mean, variance and distribution of the monopulse ratio for a Rayleigh target and explains their physical meaning. Unlike most of the previous investigation, complex DOA is taken in here to make the conclusion more generalized [C1061]

"A new maximum likelihood blood velocity estimator incorporating spatial and temporal correlation"

The blood flow in the human cardiovascular system obeys the laws of fluid mechanics. Investigation of the flow properties reveals that a correlation exists between the velocity in time and space. The possible changes in velocity are limited, since the blood velocity has a continuous profile in time and space. This paper presents a new estimator (STC-MLE), which incorporates the correlation property. It is an expansion of the maximum likelihood estimator (MLE) developed by Ferrara et al. With the MLE a cross-correlation analysis between consecutive RF-lines on complex form is carried out for a range of possible velocities. In the new estimator an additional similarity investigation for each evaluated velocity and the available velocity estimates in a temporal (between frames) and spatial (within frames) neighborhood is performed. An a priori probability density term in the distribution of the observations gives a probability measure of the correlation between the velocities. Both the MLE and the STC-MLE have been evaluated on simulated and in-vivo RF-data obtained from the carotid artery. Using the MLE 4.1% of the estimates deviate significantly from the true velocities, when the performance is evaluated on the simulated data. These deviating estimates arise, as the search range in the correlation analysis exceeds one wavelength. By performing a similar investigation with the STC-MLE, no highly deviating estimates occur. The allowed search range is therefore larger with the STC-MLE. The performance evaluation on in-vivo data further reveals that the number of highly deviating velocity estimates in the tissue parts of the RF-signals are reduced with the STC-MLE. In general the resulting profiles are continuous and more consistent with the true velocity profile, and the introduction of the correlation property has improved the estimates [C1062]

"Adaptive CFAR detection via Bayesian hierarchical model based parameter estimation"

Radar CFAR detection is addressed in this paper where the unknown noise/clutter statistics are modeled using a hierarchical structure. Considering the secondary data as a probability mixture due to the complex and heterogeneous background, parameter estimation is achieved using the empirical Bayesian approach. Unlike conventional cell averaging CFAR (and its variations) and order statistics CFAR, the new CFAR detection algorithm is less sensitive to the clutter edge location/duration. Performance evaluation is conducted via numerical simulation [C1063]

"Low-rank approximation of improper complex random vectors"

In reduced-rank signal processing for radar, sonar, and digital communications, we seek the right tradeoff between model bias and model variance for reconstructing signals from noisy data. Here, we extend the classical theory by considering the low-rank approximation of complex random vectors, which may or may not be proper. We show that, in general, widely linear approximation is superior to strictly linear approximation, unless the vector to be approximated is proper, in which case the optimum procedure is strictly linear. We analyze the case where the approximated random vector becomes proper in its internal coordinate system. This class of random vector, which we call generalized proper, possesses qualities similar to proper random vectors [C1064]

"Detecting and tracking of multiple targets in IR image sequences in heavy background"

This paper constructs a real-time IR signal processing system, which consists of hardware design and software algorithm. The algorithm can detect and track not only point targets but also spot targets and large targets at the same scene. The algorithm presents a new idea, which applies row-mean-minus to eliminate temperature nonlinear distribution in. spatial and aggregate points after a high-pass filter. The hardware is designed to satisfy complex computation and real time requirement [C1065]

"RCS analysis and calculation system in all-band region based on object-oriented and visualization design"

A software scheme for radar cross sections (RCS) of complex radar targets analysis and calculation system (named RCSAS1.0 version) in the all-band region is presented. The software system includes three subsystems: pre-processing (target geometric modeling generation and processing), electromagnetic calculation (EM solver) and post-processing (results analysis). The target surface is modeled with popular CAD software or Catmull-Rom geometrical continuity spline in the first subsystem. The second subsystem includes low-frequency, high-frequency and important aircraft components and RCS calculation. Low-frequency RCS is obtained by using the MOM based on the rescan loop method and CG-FFT; high-frequency RCS computation is solved by greco (graphical electromagnetic computing) method. The third subsystem is results analysis. The whole software system is developed and integrated based on object-oriented and scientific computing visualization design. The standard Windows interface is adopted for the software interface; it is compact., friendly, and easily handled for the user, and has a perfect on-line help system. Meanwhile in this paper, the computational results agree with

the measurement results, and the effectiveness of this computation system is demonstrated. The error between computing and measuring results for typical objects is less than 1 dB, and less than 3 dB for complex radar targets [C1066]

"A fast and robust adaptive beamformer"

Based on a unitary transformation, improved adaptive beamforming via orthogonal projection is proposed. The new algorithm firstly transforms a complex-valued covariance matrix into a real-valued matrix by means of a unitary transformation, then eigen-decomposes the transformed matrix for adaptive beamforming. The overall computational load can be significantly reduced, to about only one-fourth of that of the original orthogonal projection method. During the course of the computation for the real-valued matrix, the inherent forward-backward averaging effect, which is equivalent to double the number of snapshots, may upgrade the robustness in the case of a small number of snapshots and closely spaced jamming sources and may raise the output signal-to-interference-plus-noise ratio. Additionally, the spatial smoothing can decorrelate possibly correlated source pairs; therefore, the presented method has a better performance for jammer suppression and stronger ability to reshape the beam as compared to the orthogonal projection and sample matrix inversion algorithms in scenarios with partially correlated or fully coherent sources. The performance of the presented algorithm does not depend on the particular choice of the unitary matrix. Computer simulations demonstrate the effectiveness of the proposed method [C1067]

"An efficient interference canceler"

This paper deals with adaptive interference cancellation in the presence of array imperfections and beam pointing error. A new interference canceler with robust capabilities is proposed. This interference canceler first obtains the modified interference subspace (MIS) by employing the covariance differencing technique, then it obtains the projection vector of the steering vector of the desired signal onto the orthogonal complementary space of the MIS as the weight vector. Compared to the eigenanalysis interference canceler (EIC), the proposed interference canceler is not only robust to the array complex gain errors, but also to beam pointing error. The performance of this interference canceler is examined via simulations [C1068]

"The design and implementation of a data structure for "soft-radar" system"

This article presents the design and implementation of a new data structure. The data structure is specially designed for parallel signal processing based on a general radar signal processing system. The main characteristics of this data structure are: (1) setting the complex data and matrix data as the basic data unit, which can describe the signal processing algorithms more conveniently; (2) using the "description symbol" to access the matrix data in order to support parallel signal processing; (3) defining the "input/output" data style, which can allow the programmer to take part in the assignment of memory. This operation can increase the system's efficiency for solving real time signal processing problems [C1069]

"The properties of range profile of aircraft"

Wideband radar can obtain more target information, for its range resolution is high. With an airplane, because its size is smaller than the resolution of conventional radar, it can be regarded as a 'point'. But to wideband radar, with a few hundred MHz bandwidth, the range resolution is smaller than a meter, and the airplane echoes of one impulse compose a high resolution range profile (HRRP), which includes target shape information, so it can be used for automatic target recognition (ATR). It is difficult to recognize a target by observing range profiles by eye; although the range profile is divided into range resolution cells, every range cell still has many scatterers, so that the complex amplitude of one range cell echo can be regarded as the sum of the echoes of many scatterers. When the angle-of-sight has changed little, although the change of the range of each scatterer to the radar is small, it is great relative to the wavelength and leads to the phase difference being great, which results in the complex amplitude varying with aspect, that is, the aspect sensitivity is great. In order to use the range profile for target recognition, the properties of the range profile need to be studied. Preprocessing is needed to obtain stable range profiles [C1070]

"A signal detection algorithm based on higher-order statistics for HFSW-OTH radar"

A signal detection algorithm based on higher-order statistics (HOS) is presented and applied to ship detection of high frequency surface wave over-the-horizon radar (HFSW-OTHR), where a complex domain time delay estimation (TDE) algorithm based on HOS is used to restrain the background noise. The key problem of reducing estimation variance of TDE based on HOS is solved under short data samples and low signal-to-noise ratio (SNR) situations. The detection performance of the proposed algorithm has advantages over that of traditional methods under a low SNR condition. The results by simulations and actual HF radar data show that

the algorithm can obtain the desired detection performance (P d=90%, pf=10-6) when the SNR of the original data is only about 11 dB. Therefore, the resultant detector can not only extend the detection range, but also improve the performance of detection [C1071]

"Statistical analysis of a time-varying amplitude polynomial phase signal"

We derive the error formula of the estimated frequency of a time-varying amplitude complex discrete-time sinusoid. We extend the obtained result to a time-varying amplitude polynomial phase signal. We derive the bias and the variance of the proposed estimator [C1072]

"Coding theoretic approach to image segmentation"

This paper introduces multi-scale tree-based approaches to image segmentation, using Rissanen's coding theoretic minimum description length (MDL) principle to penalize overly complex segmentations. Images are modelled as Gaussian random fields of independent pixels, with piecewise constant mean and variance. This model captures variations in both intensity (mean value) and texture (variance). Segmentation thus amounts to detecting changes in the mean and/or variance. One algorithm is based on an adaptive (greedy) rectangular recursive partitioning scheme. The second algorithm is an optimally pruned "wedgelet" decorated dyadic partitioning. We compare the two schemes with an alternative constant variance dyadic CART (classification and regression tree) scheme which accounts only for variations in mean, and demonstrate their performance on SAR images [C1073]

"Computation of time optimal movements for autonomous parking of non-holonomic mobile platforms"

We present a method for calculation of time optimal movements for parking of non-holonomic mobile platforms. The parking problem is considered as a specialization of the general problem of path planning for non-holonomic robots. This is formulated as a nonlinear optimal control problem and solved using advanced numerical methods. The concept of artificial potential field is used for accounting for the obstacles in the environment. This method allows us to compute the time optimal control for all possible parking configurations (parallel, diagonal, row parking). The experiments show that using this method the movements for different complex situations can be calculated in a timely fashion. [C1074]

"SIREV- Sector Imaging Radar for Enhanced Vision"

SIREV (Sector Imaging Radar for Enhanced Vision) is an innovative radar system which can supply high-quality images of a sector in front of an aircraft under almost all weather conditions. In contrast to synthetic aperture radar (SAR) systems, no relative motion between sensor and targets is required in SIREV. The high frame repetition frequency in SIREV allows us to detect even very rapid changes in the imaged scenes. Besides a map of the Earth's surface, the complex-valued radar images can be further processed to supply additional information about the topography and objects in the field of view. A fast processing algorithm has been developed for SIREV which allows a very accurate, phase-preserving and efficient image formation. Raw data were obtained by a first demonstration flight using a helicopter, as a platform and the data processing results show good agreement with the theory. Motion errors of the platform could be extracted from the range compressed raw data avoiding the need of an inertial navigation system. After the image formation, coherent and incoherent image averaging processes have been applied to improve the image quality. The evaluation of the computational effort shows that a real-time hardware realization can be carried out using off-the-shelf digital components [C1075]

"3D echographic data segmentation and carotid artery turbulences mapping by Doppler velocimetry by a common approach based on calculus of variations"

The DOLPHINS project is supported in part by the 4thEuropean RTD Framework Program, and deals with echographic applications dedicated to arterial walls and plaque segmentation, plaque motion and degree of stenoses analysis. For this purpose, we have adapted geodesic active contours methods for arterial walls segmentation, to characterize stenose severity with regularized high resolution Doppler spectrum analysis by turbulences mapping from a Doppler spectral width measurement. The original contribution of our approach consists in using the same calculus of variations framework for image segmentation and Doppler velocimetry. We prove that we can, by analogy, find the equivalent mean curvature flow equation, used for geodesic active contours, for Doppler analysis by considering the complex autoregressive polynomial as a closed plane curve immersed in the oriented Euclidean plane [C1076]

"New system-level simulation of noise spectra distortion in FM-CW autonomous cruise control radar"

The design of complex MMICs such as ACC car radar involves the development of efficient and fast simulation techniques to predict the characteristics of the circuits. Their noise behavior simulation is one of the main drawback due to its complexity and large computation time. We propose in this paper, a new method based on a circuit envelope to simulate the noise spectra conversion of a signal passing through a MMIC. The efficiency of the proposed method is shown with the comparison between simulation and measures of the AM/PM conversion of a millimeter wave transmitter [C1077]

"Modelling of interferometric phase for forested areas"

We present a coherent model to study radar backscattering by forested areas. This full wave model is based on complex summation of fields radiated by all forest contributors (leaves, branches, trunks, soil) at the observer locations. This fully coherent model uses outputs of a coupled incoherent one, which alleviates the computational effort. The models are described and the Fontainebleau forest briefly presented. We display the center phase height derived from interferometric complex coherence simulations using ground truth descriptions. The influence of parameters like frequency and polarisation is investigated [C1078]

"Rain clouds tracking with radar image processing based on morphological skeleton matching"

The aim of this study is to perform a short term forecasting of dynamic radar clutter evolution (shape and position). This dynamic clutter, like thunderstorms, can be tracked by means of adapted algorithms based on the matching of the morphological skeleton polygonal approximation by relaxation labeling processes. The efficiency of our methods is demonstrated on meteorological radar images. The objective of this application is dedicated to civil traffic regulation according to severe atmospheric phenomenon, as described in Monnier & al. (1997). Through radar environment assessment, we observe radar clutter, like precipitation, submitted to very complex deformations that cannot be modelized easily. In Barbaresco (1999), we proposed a method based on morphological skeleton deformation to forecast the fluid topological evolution. This method allows management of very complex shapes evolution thanks to polygonal approximation of the skeletons and matching of their closed couple of elements by the relaxation algorithm. The skeleton simplifies shape analysis and deformation but also distinguishes clutter displacement and articulated deformation by skeleton matching from homothetic deformation (inflation and deflation) by medial axis (radius of maximal disks contained in the shape) tracking [C1079]

"Iterative spectrum analysis for pre-cleaning of narrow-band interference from radar data"

Examples of pre-cleaning of ionograms are presented by using a new method of spectrum analysis of 512 complex data samples, independently in the period after each transmitter pulse. The exact amplitude and exact frequency of the four largest interference signals are determined in the partial spectrum and subtracted from the time-domain data. A new spectrum is created from the modified data of a single pulse period until the remaining spectral amplitude peaks are less than 10 dB above the running average spectral amplitude. After this procedure the total data are processed the standard way. In contrast to all known methods of filtering the time-domain data (to reduce the leakage caused by the finite data sampling length) and the "punching out" of spectral lines with large amplitude, this method has the least effect on the amplitude and phase of the wanted data [C1080]

"Development of a complete radar system model"

This paper describes an approach to modelling synthetic aperture radar (SAR) and ground moving target identification (GMTI) modes that is applicable to both monostatic and bistatic operation. We describe an extensible method for modelling large complex radar systems that can be used to model platform and target motion, analogue and digital electronic components and complex signal processing algorithms. The key to this approach is a common data file format that allows the user to exchange simulated datasets for real flight trials data or combine the two without any recompilation of the modelling [C1081]

"An adaptive algorithm for enhanced target detection for bistatic space-based radar"

The use of space-based bistatic radar has many attractive features (particularly related to covert observation and survivability) over that of conventional monostatic systems. However (if detection performance is to approach the monostatic case) these advantages come at the price of inherently more complex hardware and processing algorithms. In particular, when considering a bistatic system that utilizes a space-based transmitter/ground-based receiver architecture, obtaining detection ranges of practical value is problematic without having unrealistic requirements for space-based transmitter ERP or ground-based receiver antenna size. A predetection signal processing scheme is postulated which adapts to the nature of the bistatic signal, thus allowing for longer

coherent integration times and correspondingly larger signal processing gain [C1082]

"Velocity-based track discrimination algorithms"

Velocity-based track discrimination is posed as a detection problem. Four discrimination algorithms are presented and compared in terms of their discrimination performance and computational load. One of these algorithms is an optimal, though computationally complex, Bayesian likelihood ratio detector. It turns out that one of the other three approximates the optimal performance, while requiring only a fraction of the computational load associated with the optimal one. [C1083]

"MFR surveillance optimisation-a pragmatic systems engineers' approach"

This paper summarises a study undertaken as a segment of an MOD Corporate Research Programme project run by the then-named DERA. A multi function radar (MFR) offers great opportunity to vary radar parameters, waveforms and signal processing, in real time, in response to the environment and the required performance, in order to optimise the use of energy and time. Many experts in the field of radar take a view that this optimisation process is extraordinarily challenging because there are many, inter-related parameters that can be varied. This study postulates that such a view might be overly pessimistic and that performance is relatively insensitive to many of the parameters so that "fine tuning" is unnecessary. We set out, therefore, to determine which parameters are the most rewarding ones to adjust on a continuous basis. Having determined these, we attempted to define rules of thumb or empirical relationships that could be employed as simple system rules. It was, therefore, a pragmatic, systems engineers' approach to solving a potentially complex problem. [C1084]

"Application of array processing techniques to multibaseline InSAR for layover solution"

Synthetic aperture radar interferometry (InSAR) is a modern technique to derive digital height maps of the land surface from SAR images. In recent years there has been great interest in exploiting the advanced multibaseline operation for solving layover effects that can degrade SAR and InSAR imagery. We consider detailed modelling of this problem including speckle noise for extended targets, application of several nonparametric and parametric spectral estimation methods to multibaseline layover solution, and performance analysis. The problem of layover solution is formulated as the estimation of a multi-component signal composed by multiple cisoids corrupted by complex multiplicative Gaussian noise and additive white Gaussian thermal noise. Beamforming, Capon's, High-Order Yule-Walker, MUSIC, Min-Norm, and ESPRIT spatial spectral estimators are applied to this interferometric problem, and an extensive simulated performance comparison is carried out in terms of statistical accuracy and resolution [C1085]

"Fluorescent paint for roadway lane-markers"

As a compromise between unaided and fully automated driving, we have been investigating the concept of “sensor friendly highways and roadways”. In this paper we report our work in this context with fluorescent paint for roadway lane-marking lines. The approach we envision is to add one or more fluorescent pigments to the lane-marking paint, or possibly to the retro-reflective glass beads that are typically sprinkled on the wet paint immediately after its application. Vehicles would be equipped with light transmitters and receivers at the appropriate fluorescence excitation and emission wavelengths. In the simplest embodiment, e.g., as a sensor that detects just lane departure, an annunciator would inform the driver whenever a lane boundary line is crossed. In more complex embodiments, a small code space could be created by using mixtures of several pigments and measuring the relative signal intensities at the corresponding excitation and emission wavelengths. A few bits of local information could thus be encoded in the lane-marking lines, for example, the line identity (e.g., it is the roadway edge line, or the centerline, or the border-line between the second and third lanes, etc.), or some important feature of the roadway (an exit ramp is a short distance ahead, etc.). If the technology provides only minimal signal-to-noise margin it may be feasible to probe only the lane-marking line immediately alongside the vehicle, or only a short distance ahead, but if there is “signal to burn” it will be possible to look correspondingly further ahead of the vehicle. With adequate signal-to-noise it would be possible also to use fluorescent paint technology to mark roadside obstacles, e.g., sign and luminaire posts, so as to cooperatively eliminate them as clutter in a collision warning radar signal stream. Our experiments and analysis indicate that the method is technically feasible given a few plausible improvements in fluorescent materials technology, and economically viable given reasonable assumptions about the cost of vehicle instrumentation and roadway treatment [C1086]

"Opportunity of reduction of objects visibility using diffraction-reflecting coverings in conditions of application laser detection systems"

We consider a single-channel locator without accumulation of an uninterrupted signal, this is, actually, close

enough to a real situation, when the target is immobile and the value of Doppler shift of frequency is given, as far as it is determined by the rate of the movement of the receiving system. Further we use the characteristics of the laser heterodyne locator produced by Rockwell, which has the parameters close to the heterodyne locators of MTL complexes as an example [C1087]

"PEOD: Pade estimated optimum (radar) detector"

An expression for the optimum non-Gaussian radar detector is derived from the non-Gaussian SIRP model (spherically invariant random process) clutter and a Pade approximation of the characteristic function of the SIRP. The SIRP model is used to perform coherent detection and to modelize the non-Gaussian clutter as a complex Gaussian process whose variance is itself a positive random variable (r.v.). The probability density function (PDF) of the variance characterizes the statistics of the STEP and after performing a Pade approximation of this PDF from reference clutter cells we derive the so-railed Pade estimated optimum (radar) detector (PEOD) without any knowledge about the statistics of the clutter. We evaluate PEOD performance for an unknown target signal embedded in K-distributed clutter and compare it with optimum detector performance (optimum in particular clutter statistics such as Optimum K Detector-OKD-in K-distributed clutter) [C1088]

"Clutter suppression in radar by quasi-continuous complex signal and processing algorithm structure optimization"

The synthesis algorithm of a pair of signal-linked filters for navigational radars with one antenna using a complex amplitude-phase modulated waveform of long duration with coherent processing in the receiver is considered. A harmful influence of the ambiguity function (AF) sidelobes on target detection and parameter measurement is a significant obstacle to using the long pulse duration complex modulated waveform in marine radars. We discuss waveforms and linked processing for clutter suppression by means of AF sidelobe reduction. Some relationships for the quasi-continuous complex signal synthesis of amplitude-phase modulated waveform (APW) are given. The received signals are processed by a mismatch filter. The synthesis criterion of the mismatch filter structure was a root mean square minimization of the output signal sidelobe level. The computer synthesis software of the quasi-optimum mismatch processing structure has been developed. We give some examples of the waveform and mismatch algorithms of their professing which could be used in marine and coastal radars for surveillance of surface targets and navigation [C1089]

"INSAR activities in central Asia using mobile SAR receiving station"

From March 7th 1999 till July 2nd1999 an INSAR campaign of GFZ/DLR with a mobile receiving station was established at Kitab in Usbekistan. The mobile ground station contains three subsystems: receiving system, SAR processing system and INSAR processing system. Everyday more than 10 scenes of the received SAR raw data were processed to single look complex image data, then the corresponding interferograms from tandem pair as well as differential interferograms can be produced. Besides receiving and archiving the ERS-1/2radar data, the task of the campaign is to test a simultaneous SAR- and INSAR-Processing of the ERS1/2 data in field. The aim of the processing in field is to demonstrate and enable near-real-time SAR-Interferometry. In this paper some preliminary results of the campaign in the selected test area of Fergana-Valley and Urumqi are presented [C1090]

"Speckle reduction of SAR images in the complex wavelet domain"

Dual tree complex wavelet transformation (CWT), proposed by N. G. Kingsbury (1999), is used for speckle reduction of SAR images. The CWT is useful for speckle reduction through its subband images and the speckle reduction is obtained by thresholding the subband-image coefficients of the digitized SAR images. Two thresholding methods are used; soft thresholding and thresholding using non-linear functions which are adapted for each of selected subband and is based on sigmiod functions. The denoising method shows great promise for speckle removal and hence should provide good detection performance for SAR based recognition [C1091]

"Change detection in polarimetric SAR data and the complex Wishart distribution"

When working with multi-look fully polarimetric synthetic aperture radar (SAR) data an appropriate way of representing the backscattered signal consists of the so-called covariance matrix. For each pixel this is a 3Ч3 Hermitian, positive definite matrix which follows a complex Wishart distribution. Based on this distribution a test statistic for equality of two such matrices and an associated asymptotic probability for obtaining a smaller value of the test statistic are given and applied to change detection in polarimetric SAR data. In a case study EMISAR L-band data from 17 April 1998 and 20 May 1998 covering agricultural fields near Foulum, Denmark are used. The derived test statistic can be applied as a line or edge detector in fully polarimetric SAR data also [C1092]

"Global distribution of sea surface features from SAR wave mode data"

A global set of single look complex (SLC) synthetic aperture radar (SAR) images is processed, from wave mode raw data using the B-SAR processor developed at Deutsches Zentrum fur Luft und Raumfahrt (DLR). Multilook methods are used to reduce speckle or to analyze the time evolution of the ocean surface cross section during SAR Integration time. Using imagettes instead of image power spectra allows to study ocean surface features caused by natural slicks, sea ice or atmospheric processes. Different automatic image analysis methods are used to detect and classify these features. About 200 imagettes are acquired over the Arctic every day, from these data sea ice parameters are derived [C1093]

"Superresolution ISAR imaging by 2-D complex asymmetric half-plane lattice predictors"

An efficient algorithm to obtain high resolution ISAR images in the case of limited frequency band and small angular section is presented. The method is based on the 2-D autoregressive asymmetric half-plane modeling of the backscattered data using a 2-D complex lattice predictor. The locations of the scattering centers are determined by the zeroes of the transfer function of the prediction error filter. A simulation example is included to show the performance of the algorithm [C1094]

"A space-time analysis technique for monitoring terrain displacements from SAR differential interferometric measurements"

Synthetic aperture radar (SAR) differential interferometry is a powerful technique that allows to measure very small movements of the terrain that occurred between two data acquisitions. In previous works we demonstrated how to overcome the main limitations of the technique (i.e. decorrelation noise and atmospheric artifacts) by means of a method for unwrapping sparse phase data and by performing a temporal analysis of successive acquisitions. In this work we explore the possibility of considering together the space and time properties of the studied signal. The two steps mentioned above (i.e., sparse phase unwrapping and temporal analysis) act in the space and in the time domains separately. A significant advance can be obtained by considering the data as samples of a function in a three-dimensional (3D) space-time, and by exploiting this structure in the processing. The 3D structure of the data makes the processing more complex but can help both phase unwrapping and atmospheric (and other) artifact filtering [C1095]

"Phase analysis for the limitations of the tomographic paradigm on a 3D scene"

The tomographic paradigm argues that the demodulated pulses from a spotlight mode SAR system trace a 2D slice of the 3D Fourier transform of the complex surface reflectivity. This paper derives the phase errors that result from imaging a 3D surface from a non planar collection geometry and shows how correct projection to the true surface can eliminate many of the errors. The response from an ideal scatterer is derived and then approximated to simplify the expression into a manageable and meaningful form and so that insight can be gained into the artifacts produced. The theory indicates that warping an image by distorting the final image to correct for layover doesn't eliminate the second order blurring terms produced by the relief and that both the layover and these blurring affects can be properly eliminated through correct projection to the real ground plane [C1096]

"Pre-formation SAR to SAR image registration"

A critical step in the formation of multi-pass IFSAR and CCD products involves the registration to subpixel scales of two complex SAR images. This is usually performed as a two step process where correspondences between the images are determined followed by a warping of the imagery. Since more information is available in the phase history data (PHD) it might be expected that improved registration results could be achieved. This paper investigates a number of registration approaches in the PHD and shows that the techniques are equivalent to each other and to registration in the image domain. It is also demonstrated that processing in the PHD, although potentially minimizing the impact of numerical errors from resampling introduces complexity when estimating local registration estimates and has difficulty in regions that decorrelate [C1097]

"Multi-baseline polarimetric SAR data classification using the complex Wishart distribution and principal component analysis"

In this paper is introduced a classification approach for multi-baseline polarimetric interferometric SAR data sets, based on a principal component analysis of coherent scattering vectors. From the Wishart probability density function of a restricted data set, is defined a maximum likelihood decision rule to perform an iterative adaptive classification [C1098]

"Another surface scattering model for bistatic scattering"

In the development of the IEM model for surface single scattering a simplifying assumption was applied to the phase of the Green's function in the average power calculation leading to a surface scattering model in algebraic form. We remove this assumption yielding a more complex model but still in algebraic form. We show that the simplifying assumption used in the past does not cause an appreciable difference in forward and backscattering directions. However, for different incident and scatter directions there is a noticeable difference especially when the surface roughness is small and scattering is weak. For surfaces with large root mean square height the difference between the original IEM and the new IEM is generally small [C1099]

"Optical and physical characterization of European and Indo-Asian pollution plumes with six-wavelength aerosol lidar"

Optical and physical particle properties of two typical pollution plumes emitted from the European continent during the Aerosol Characterization Experiment ACE 2, and from the Indo-Asian continent during INDOEX are characterized from six-wavelength lidar observations. In both cases effective radii were 0.1-0.25 µm. Complex refractive indices were <1.6-0.0075i for the measurement during ACE 2. values >1.6-0.01i were obtained for the INDOEX case. Accordingly the single scattering albedo was 0.95-1.0 at 532 nm in the first case, but 0.8-93 in the second case [C1100]

"Inventory of forest biomass in Brazilian Amazon: a local approach using airborne P-band SAR data"

The objective of this study is to explore the use of airborne P-band SAR polarimetric data, to stratify biomass by primary and secondary vegetation typology. To ensure that different landscapes of Amazon upland forest are represented, a test-site located in the lower Rio Tapajos region, Pari State, was selected. The backscatter signals derived from the complex image of the P-band SAR were correlated with field data obtained from a forest inventory, for different physiognomic-structural aspects of the tropical rainforest The estimation of above-ground biomass for these forest types was modeled by DBH and total height measurements, including the use of general allometric equations. Statistical regression models were applied to establish the relationship between biomass and radar data at HH, HV and VV polarization. The overall objective of this P-band experiment is to improve the regional monitoring process of biomass dynamics as well as landscape changes, due to human action [C1101]

"Mapping seasonal vegetation changes with multi-temporal radar segmentation"

The wet/dry cycle particular to the Northern Australian climate creates a distinctively harsh environment for the vegetation species present. At a particular location a species adapted to immersion in water may flourish whilst the site is inundated but as the water dries up will be replaced by a species capable of surviving in the drier conditions. In this way particular species continually replace one another as the cycle progresses. For this highly complex environment single date image classification does not do justice to the constantly changing patchwork of vegetation as the drying cycle progresses. As moisture is a major determinant of the dielectric properties of most non-metallic materials, and vegetation in particular, any change with time may be mapped. A multi temporal approach to the situation is well suited to highlight not only the changes in vegetation community between seasons, but also that occurring between years. A region of the South Alligator River floodplain, within Kakadu National Park was surveyed to ascertain if these changes could be accurately mapped. Analysis of three multi temporal radar images obtained by Radarsat during the period of 1998-1999 were co-registered and subjected to GMRFM segmentation. The results of this segmentation were then used in a statistical clustering algorithm in order to regroup spatially separate segments into a smaller number of classes. Subsequent air photo interpretation and ground truth information have shown that the technique is invaluable in determining the timing and location of ecological classes in a highly variable climate [C1102]

"Doppler polarimetry of high resolution radar sea clutter"

The non-stationary nature of high resolution grazing angle X-band radar backscatter of the sea surface is investigated. The temporal behavior is modeled as resulting from a fast and a slow process, and statistical parameters are derived for both processes separately. It is found that the fast process is consistent with an underlying complex Gaussian process, independent of polarization or range resolution, while the slow process is responsible for the spiky nature of the HH backscatter [C1103]

"Global tracking of swell with complex ERS-2 wave mode data"

Complex synthetic aperture radar (SAR) data acquired by the European remote sensing satellite ERS-2 are used to analyze the propagation of swell on a global basis. The study is based on complex SAR wave mode imagettes, which were processed from ERS-2 SAR raw data using the DLR BSAR processor. Complex imagettes allow to apply the so called cross spectra technique globally for the first time. In contrast to conventional SAR intensity images, cross spectra provide information on ocean wave propagation without 180° ambiguity. A test data set of three weeks of complex imagettes (≈36000) is used to measure ocean swell. Distribution of swell is studied based on maps showing swell direction, wave height and wavelength. Temporal swell dynamics is analyzed using data acquisitions with small spatial distance and a time gap of ≈12 h. Apart from providing information on ocean swell the study is a preparation for the coming ENVISAT era where cross spectra will be a standard product of the European Space Agency (ESA) [C1104]

"On the performance of curved SAR-mapping"

Normally SAR-mapping is performed along a straight path. A curved path might increase the mapping rate significantly, however. Drawbacks are more complex signal processing and that defocusing may occur. In this paper, curved SAR-mapping is analysed in more detail including forward look geometry. Relationships are shown how resolution performance and mapping rate are influenced by the curved SAR-path. Examples are also presented showing how the phase error depends on side acceleration and scene geometry [C1105]

"Global wind speed retrieval from complex SAR data using scatterometer models and neural networks"

The global availability of synthetic aperture radar (SAR) wave mode data from the European remote sensing satellite ERS-2 allows to investigate the wind field over the ocean on a global and continuous basis. For this purpose 27 days of ERS-2 SAR wave mode data were processed to single look complex SAR images, representing a total of 34310 images of size 5 kmЧ10 km, available every 200 km along the satellite track. In this paper two methods for retrieving wind speeds from SAR images are presented and validated, showing the applicability of both methods for global ocean wind retrieval. The first method is based on the well tested empirical C-band scatterometer (SCAT) models which describe the dependency of the normalized radar cross section (NRCS) on wind speed and direction. To apply C-band models to SAR data the NRCS has to be accurately calibrated. This is achieved by a new simple but effective method using a subset of collocated ERS-2 SCAT and model winds from the European Center for Medium Range Weather Forecast (ECMWF). SAR derived wind speeds are compared to the entire set of collocated ERS-2 SCAT and ECMWF model data. Comparison to ERS-2 SCAT results in a correlation of 0.94 with a bias of -0.45 m s-1and a root mean square error of 1.21 m s-1. The second approach is based on neural network algorithms allowing one to retrieve wind speeds from uncalibrated SAR images. For this purpose a neural network is trained using ERS-2 SAR data and collocated wind data from ERS-2 SCAT and the ECMWF atmospheric model. Validation of the neural network retrieved SAR wind speeds to ERS-2 SCAT and ECMWF model wind data is performed. A correlation of 0.95 with a bias of -0.1 m s-1 and a root mean square error of 1.03 m s-1is achieved in comparison to ERS-2 SCAT [C1106]

"Biophysical forest type characterisation in the Colombian Amazon by airborne polarimetric SAR"

Fully polarimetric C-, L- and P- band data were collected by NASA's AirSAR system at the Araracuara test site, a well-surveyed forest reserve in the centre of the Colombian Amazon. The area is characterised by a high diversity of forest types, soil types and flooding conditions. A polarimetric classification technique is used to assess AirSAR's potential for forest structural type mapping and, indirectly, forest biophysical characterisation. Field observations were made at 23 0.1 ha plots to obtain additional quantitative descriptions on forest structure and ground surface conditions, but also to assess the suitability of existing map legends for SAR mapping. It could be shown that a new type of legend leads to physically better interpretable results. A method based on iterated conditional modes is introduced and is shown to yield radar-derived maps with a high level of agreement with existing maps, as well as with the ground observations. The following results may indicate the high level of accuracy obtained: 15 classes can be differentiated, the average radar map agreement ranges from 68-94% (depending on the type of map and approach) and for only a few classes the agreement is less than 70%. The relation between physical forest structure and polarimetric signal properties is studied explicitly using polarimetric decomposition. A new method is introduced based on the decomposition of polarimetric coherence, instead of power. It is based on simple physical descriptions of the wave-object interaction. The accuracy of the complex coherence estimation derived from the complex Wishart distribution. Thus several interesting physical relations between polarimetric signal and forest structure can be revealed. The physical limitations of this technique and its relation with sample size are indicated [C1107]

"Investigation of ocean waves and currents with PacRim along-track interferometry (ATI)"

The investigation of ocean surface waves and current velocity using conventional synthetic aperture radar techniques is not an easy task. Recently, airborne along-track interferometric synthetic aperture radars (AT-INSARs) have been developed, which employ two antennas, which are physically separated along the platform flight path (along track) direction. The two complex images received from two antennas are combined interferometrically into a single complex ATI image. The phase of the resulting complex image is proportional to the radial component of the ocean surface scatterers velocity. This velocity is the sum of the orbital motion of water particles from the swell, phase velocity of the Bragg waves, and ocean currents. We have tested and investigated the ATI data which was collected by the PacRim-I AIRSAR experiment over the Kohala coast, on the northwest shore of the big island of Hawaii. We investigated the ocean wave and current features and have retrieved dominant ocean wave spectrum. This research is a part of the PACRIM-II ATI related research off Ulsan study area, Korea [C1108]

"Optimal transmit signal design for active sonar/radar"

This work is concerned with the optimization of an active sonar or radar transmit signal, to maximize the probability of detecting a nonmoving point target in the presence of signal-dependent reverberation and colored ambient noise whose power spectral densities are known. An analytical solution first reported by Kooij (1968) is corrected and extended. A simple example for the white ambient noise case is included to provide insight into the transmit signal optimization. This example shows that the effect of the solution is to "pre-emphasize" the transmit signal, which results in the whitening of the signal-dependent reverberation power spectral density. [C1109]

"Efficient detection in the presence of angular spreading"

The spatial channel in applications such as radar, sonar, and wireless communications is typically characterized by complex signal scattering leading to multiple signal components arriving at the array from a spread of angles. This multipath angle spread is well known to lead to loss of spatial signal coherence across a receiving sensor array, requiring complicated combining schemes to achieve optimal performance, particularly when the signal is only partially coherent across the array. We show that the discrete Fourier transform serves as an efficient, robust, and asymptotically optimal spatial combiner for uniform linear arrays in multipath channels. In addition, the proposed spatial processing allows for convenient integration of conventional frequency-domain methods for angle-of-arrival searches. Simulation results show that the proposed combining scheme provides near-optimal performance at significantly less computation, even for arrays of modest size. [C1110]

"Bayesian optimum radar detector in non-Gaussian noise"

A theoretical expression of the optimum nonGaussian radar detector is derived from the non-Gaussian SIRP model (spherically invariant random process) clutter and a Bayesian estimator of the characteristic function of the SIRP. The SIRP model is used to perform coherent detection and to model the clutter as a complex Gaussian process whose variance is itself a positive random variable (r.v.). The PDF of the variance characterizes the statistics of the SIRP and after performing a Bayesian estimation of this PDF from reference clutter cells we derive the Bayesian optimum radar detector (BORD) and its statistical asymptotic form without any knowledge about the statistics of the clutter. We evaluate BORD performance for an unknown target signal embedded in K-distributed clutter and compare with optimum detectors performance (such as optimum K detector-OKD-in K-distributed clutter). [C1111]

"Improved multiedge detection and reflectivity estimation for SAR images"

We propose sliding-window multiedge detectors and reflectivity estimators for complex SAR images. The novel detectors and estimators allow to take into account additive observation noise and colored signal (speckle) and noise processes; furthermore, they employ an exponential data weighting to improve spatial resolution. In the multiedge case, simulation results demonstrate a substantial performance improvement over existing methods when the speckle is colored and additive noise is present. [C1112]

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