Государственное образовательное учреждение
высшего профессионального образования
**«Томский государственный университет
систем управления и радиоэлектроники»**

ТЕМАТИЧЕСКИЙ РЕФЕРАТИВНЫЙ СБОРНИК № 20-1/2

“Radar Signal Processing”
(«Обработка РЛ сигналов»)

Журнальные публикации

Источник: *Digital Library IEEEXplore*
Язык: *английский*
Глубина поиска: *2006 – 2007 гг.*
Дата формирования: *март 2011 г.*
Составитель: *В.И. Карнышев*

Томск – 2011

"Combined Multistatic Adaptive Pulse Compression and Adaptive Beamforming for Shared-Spectrum Radar"

The recently proposed Multistatic Adaptive Pulse Compression (MAPC) algorithm has been shown to successfully suppress both range sidelobes and interference from multiple radars operating in the same spectrum, thus enabling shared-spectrum multistatic radar. In this paper, we present a method to increase the overall information capacity of the MAPC algorithm by performing joint adaptive pulse compression in conjunction with adaptive beamforming. The addition of an adaptive beamforming stage to the MAPC algorithm enables further mutual interference suppression and thus better estimation performance such that the number of multistatic radars simultaneously operating in the same spectrum may be increased for the same mean-square estimation error. Analysis of the performance of the adaptive beamforming MAPC algorithm in a variety of scenarios is presented. In addition, Monte Carlo analyses on the number of shared-spectrum radars are also presented [J1741]

"Adaptive CFAR Radar Detection With Conic Rejection"

In this paper, we deal with the problem of adaptive signal detection in colored Gaussian disturbance. Since the classical receivers may exhibit severe performance degradations in the presence of steering vector mismatches and sidelobe interfering signals, we try to account for the quoted drawbacks, very usual in realistic radar scenarios, at the design stage. To this end, we first characterize the set where the useful received signal may lie and its complement, i.e., the set which may contain the signals to be rejected. Then we resort to the generalized likelihood ratio (GLR) principle and devise detectors capable of operating in the presence of array response mismatches and sidelobe interfering signals. At the analysis stage, we assess the performance of the newly introduced receivers also in comparison with previously proposed detectors. The results show that the new processors are characterized by a wide range of performance compromises, selectable at the design stage through the regulation of a design parameter, between the detection of useful signals and the rejection of sidelobe interference [J1742]

"Concurrent Operation of Two Over-the-Horizon Radars"

By exploiting the reflective and refractive nature of high-frequency (HF) radiowave propagation through the ionosphere or the conducting sea surface, over-the-horizon radar (OTHR) systems perform wide-area surveillance at long range well beyond the limit of the horizon of conventional line-of-sight (LOS) radars. Improved characterizations of the targets can be achieved by using multiple OTHRs operating simultaneously as compared to a single OTHR operating alone. In this paper, we consider concurrent operations of two OTHR systems that occupy the same frequency band with different chirp waveforms. The objective is to respond to the advanced wide-area surveillance needs without reducing the wave repetitive frequency. For this purpose, a new cross-radar interference cancellation technique is developed and its effectiveness is verified through both analytical and simulation results [J1743]

"An Efficient Implementation of a Robust Phase-Unwrapping Algorithm"

A robust phase-unwrapping algorithm has been recently proposed and applied to accurately locate fast moving targets in multifrequency antenna array synthetic aperture radar imaging. This algorithm is based on two dimensional (2-D) searching and its complexity may be high. In this letter, we propose an efficient implementation of the robust phase-unwrapping algorithm. We show that the range of the 2-D searching, and therefore the complexity of the robust phase-unwrapping algorithm, can be significantly reduced [J1744]

"Adaptive Waveform Design and Sequential Hypothesis Testing for Target Recognition With Active Sensors"

Cognitive radar is a recently proposed approach in which a radar system may adaptively and intelligently interrogate a propagation channel using all available knowledge including previous measurements, task priorities, and external databases. A distinguishing characteristic of cognitive radar is that it operates in a closed loop, which enables constant optimization in response to its changing understanding of the channel. In this paper, we compare two different waveform design techniques for use with active sensors operating in a target recognition application. We also propose the integration of waveform design with a sequential-hypothesis-testing framework that controls when hard decisions may be made with adequate confidence. The result is a system that updates multiple target hypotheses/classes based on measured data, customizes waveforms as the class probabilities change, and draws conclusions when sufficient understanding of the propagation channel is achieved [J1745]

"Minimax Robust MIMO Radar Waveform Design"

We consider the problem of minimax robust waveform design for multiple-input multiple-output (MIMO) radar based on mutual information (MI) and minimum mean-square error (MMSE) estimation for target identification and classification. Recognizing that a single, precise characterization of target power spectral density (PSD) is rare in practice, we assume the PSD lies in an uncertainty class of spectra bounded by known upper and lower bounds, which markedly relaxes the required target a priori knowledge. Based on this band model, we develop minimax robust waveforms for MIMO radar under both MMSE and MI criteria. These robust waveforms bound the worst-case performance at an acceptable limit, and also could insure performance will be sufficiently good for any PSD in the uncertainty class. Our findings also indicate that the MI and MMSE criteria lead to different minimax robust waveform solutions, which is in contrast to the case of the perfectly known target PSD [J1746]

"Introduction to the issue on adaptive waveform design for agile sensing and communication"

The 18 papers in this issue focus on the following areas: waveform design; adaptive waveform design; surveillance and classification in radar; multiple-input multiple-output (MIMO) radar systems; and wireless communications. [J1747]

"Ambiguity Function and Frame-Theoretic Properties of Periodic Zero-Autocorrelation Waveforms"

Periodic constant-amplitude zero-autocorrelation (CAZAC) waveforms u are analyzed in terms of the discrete periodic ambiguity function A u. Elementary number-theoretic considerations illustrate that peaks in Auare not stable under small perturbations in its domain. Further, it is proved that the analysis of vector-valued CAZAC waveforms depends on methods from the theory of frames. Finally, techniques are introduced to characterize the structure of Au, to compute u in terms of Au, and to evaluate MSE for CAZAC waveforms [J1748]

"Real-Time Remote Onboard Diagnostics Using Embedded GPRS Surveillance Technology"

Onboard-diagnostic (OBD) system is developed to detect engine operation conditions for air-pollution monitoring. The diagnostic trouble code from vehicle microprocessor is generated resulting from a system error or malfunction. Based on a practical demand, this paper presents a modified system construction from vehicle surveillance technology for OBD data report in real time. A circuit system is designed and fabricated to convert OBD protocol into RS-232 protocol for data transmission via general-packet-radio-service mobile communication. The proposed system integrates the developing technology for both OBD and intelligent-transportation-system applications. In this paper, hardware and software in both design and implementation are discussed and verified by road tests [J1749]

"Radar Interferometric Measurements With a Planar Patch Antenna Array"

A planar patch antenna array has been made for radar interferometry. The antenna array consists of 32 rectangular patches on a ceramic loaded teflon substrate. The patches are individually coupled to the microwave electronics in two orthogonal circular polarizations. The radar interferometer is intended for topographic imaging in industrial environment, in this case, a blast furnace producing hot metal for the steel and metal industry. Ordinary imaging techniques with IR or visible radiation are not possible to use due to high temperatures, scattering from dust and particles. A model of blast furnace burden material surface was measured and detected. [J1750]

"A Portable Noncontact Heartbeat and Respiration Monitoring System Using 5-GHz Radar"

A portable noncontact heartbeat and respiration monitoring system operating in 5-GHz band is reported in this letter. Compared with the previously reported system operating at Ka-band, this system has been simplified to include only two PCB antennas, a palm-size PCB radio module, a data acquisition module, and a laptop. The system, powered by the laptop battery through USB connection, is compact, low-cost, and convenient for field

test. A detection accuracy of better than 80% has been achieved at a distance of 2.8 m and at a low transmitted power of 20 muW. The system can be used for various applications in biology, medicine, and security. [J1751]

"Let the Data Speak for Themselves"

An estimation algorithm for stationary random data automatically selects a single time-series (TS) model for a given number of observations. The parameters of that model accurately represent the spectral density and the autocovariance function of the data. The increased computational speed has given the possibility to compute hundreds of TS models and to select only one. The computer program uses a selection criterion to determine the best model type and model order from a large number of candidates. That selected model includes all statistically significant details that are present in the data, and no more. The spectral density of high-order TS models is the same as the raw periodogram, and the autocorrelation function can be the same as the lagged product (LP) estimate. Therefore, the periodogram and the LP autocorrelation function are very high-order TS candidates. However, those high-order models are never selected in practice because they contain many insignificant details. The automatic selection with the algorithm lets the data speak for themselves: a single model is selected without user interaction. The automatic program can be implemented in measurement instruments for maintenance or in radar, by automatically detecting differences in signal properties [J1752]

"First- and Second-Order Moments of the Normalized Sample Covariance Matrix of Spherically Invariant Random Vectors"

Under Gaussian assumptions, the sample covariance matrix (SCM) is encountered in many covariance based processing algorithms. In case of impulsive noise, this estimate is no more appropriate. This is the reason why when the noise is modeled by spherically invariant random vectors (SIRV), a natural extension of the SCM is extensively used in the literature: the well-known normalized sample covariance matrix (NSCM), which estimates the covariance of SIRV. Indeed, this estimate gets rid of a fluctuating noise power and is widely used in radar applications. The aim of this paper is to derive closed-form expressions of the first- and second-order moments of the NSCM [J1753]

"Adaptive Waveform Design for Improved Detection of Low-RCS Targets in Heavy Sea Clutter"

The dynamic adaptation of waveforms for transmission by active radar has been facilitated by the availability of waveform-agile sensors. In this paper, we propose a method to employ waveform agility to improve the detection of low radar-cross section (RCS) targets on the ocean surface that present low signal-to-clutter ratios due to high sea states and low grazing angles. Employing the expectation-maximization algorithm to estimate the time-varying parameters for compound-Gaussian sea clutter, we develop a generalized likelihood ratio test (GLRT) detector and identify a range bin of interest. The clutter estimates are then used to dynamically design a phase-modulated waveform that minimizes the out-of-bin clutter contributions to this range bin. A simulation based on parameters derived from real sea clutter data demonstrates that our approach provides around 10 dB improvement in detection performance over a nonadaptive system [J1754]

"Effect of Fast Motion on Range Images Acquired by Lidar Scanners for Automotive Applications"

The scanning process of lidar scanners is extended over time. Hence, relative motion between sensor and object during the scanning leads to a motion-dependent blur, here called motion-scan effect. Due to this effect the lidar's distance map is deteriorated, which has a negative impact on the subsequent signal processing. This paper quantifies this effect and compares it to statistical errors. In order to compensate for the negative impact, motion models for a simple car model are formulated, and the model parameters are checked for identifiability. Identification of the parameters allows to compensate for the effect. Thus the accuracy and the control mode can be improved, which is particularly important for safety-critical applications, e.g., autonomous vehicles [J1755]

"MIMO Radar Ambiguity Functions"

Multiple-Input Multiple-Output (MIMO) radar has been shown to provide enhanced performance in theory and in practice. MIMO radars are equipped with the ability to choose freely their transmitted waveforms at each aperture. In conventional radar systems Woodward's ambiguity function is used to characterize waveform resolution performance. In this paper we extend the idea of waveform ambiguity functions to MIMO radars. MIMO ambiguity functions are developed that simultaneously characterize the effects of array geometry and transmitted waveforms on resolution performance. Overall resolution performance is shown to be governed by a space-time covariance function that can be controlled by the system on transmit using waveform diversity. Visual examples are provided to illustrate the resolution enhancement possible using MIMO technology [J1756]

"Automatic Radar Waveform Recognition"

In this paper, a system for automatically recognizing radar waveforms is introduced. This type of techniques are needed in various spectrum management, surveillance and cognitive radio or radar applications. The intercepted radar signal is classified to eight classes based on the pulse compression waveform: linear frequency modulation (LFM), discrete frequency codes (Costas codes), binary phase, and Frank, P1, P2, P3, and P4 polyphase codes. The classification system is a supervised classification system that is based on features extracted from the intercepted radar signal. A large set of potential features are presented. New features based on Wigner and Choi-Williams time-frequency distributions are proposed. The feature set is pruned by discarding redundant features using an information theoretic feature selection algorithm. The performance of the classification system is analyzed using extensive simulations. Simulation results show that the classification system achieves overall correct classification rate of 98% at signal-to-noise ratio (SNR) of 6 dB on data similar to the training data [J1757]

"Information Theoretic Adaptive Radar Waveform Design for Multiple Extended Targets"

In this paper, we use an information theoretic approach to design radar waveforms suitable for simultaneously estimating and tracking parameters of multiple extended targets. Our approach generalizes the information theoretic water-filling approach of Bell to allow optimization for multiple targets simultaneously. Our paper has three main contributions. First, we present a new information theoretic design criterion for a single transmit waveform using a weighted linear sum of the mutual informations between target radar signatures and the corresponding received beams (given the transmitted waveforms). We provide a family of design criteria that weight the various targets according to priorities. Then, we generalize the information theoretic design criterion for designing multiple waveforms under a joint power constraint when beamforming is used both at the transmitter and the receiver. Finally, we provide a highly efficient algorithm for optimizing the transmitted waveforms in the cases of single waveform and multiple waveforms. We also provide simulated experiments of both algorithms based on real targets and comment on the generalization of the proposed technique for other design criteria, e.g., the linearly weighted noncausal MMSE design criterion [J1758]

"Optimal Signal Design for Detection of Gaussian Point Targets in Stationary Gaussian Clutter/Reverberation"

In this paper, we address the design of an optimal transmit signal and its corresponding optimal detector for a radar or active sonar system. The focus is on the temporal aspects of the waveform with the spatial aspects to be described in a future paper. The assumptions involved in modeling the clutter/reverberation return are crucial to the development of the optimal detector and its consequent optimal signal design. In particular, the target is assumed to be a Gaussian point target and the clutter/reverberation a stationary Gaussian random process. In practice, therefore, the modeling will need to be assessed and possibly extended, and additionally a means of measuring the "in-situ" clutter/reverberation spectrum will be required. The advantages of our approach are that a simple analytical result is obtained which is guaranteed to be optimal, and also the extension to spatial-temporal signal design is immediate using ideas of frequency-wavenumber representations. Some examples are given to illustrate the signal design procedure as well as the calculation of the increase in processing gain. Finally, the results are shown to be an extension of the usual procedure which places the signal energy in the noise band having minimum power [J1759]

"Multitarget Tracking in Distributed Sensor Networks"

In this article, a survey of techniques for tracking multiple targets in distributed sensor networks is provided and introduce some recent developments. The single target tracking in distributed sensor networks is reviewed. The tracking and resource management issues can be readily extended to MTT. The MTT problem is also briefly reviewed and describe the traditional approaches in centralized systems. Then focus on MTT in resource-constrained sensor networks and present two distinct example methods demonstrating how limited resources can be utilized in MTT applications. Finally, the most important remaining problems are discussed and suggest future directions [J1760]

"GLRT-Based Direction Detectors in Homogeneous Noise and Subspace Interference"

In this paper, we derive and assess decision schemes to discriminate, resorting to an array of sensors, between the H0hypothesis that data 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 of the observables. The disturbance is modeled in terms of complex normal random vectors plus deterministic interference assumed to belong to a known subspace. We assume that a set of noise-only (secondary) data is available, which possess the same statistical characterization of noise in

the cells under test. At the design stage, we resort to either the plain generalized-likelihood ratio test (GLRT) or the two-step GLRT-based design procedure. The performance analysis, conducted resorting to simulated data, shows that the one-step GLRT performs better than the detector relying on the two-step design procedure when the number of secondary data is comparable to the number of sensors; moreover, it outperforms a one-step GLRT-based subspace detector when the dimension of the signal subspace is sufficiently high [J1761]

"Cramйr–Rao Bound Analysis on Multiple Scattering in Multistatic Point-Scatterer Estimation"

The resolution improvements of time reversal methods through exploiting nonhomogeneous media have attracted much interest recently with broad applications, including underwater acoustics, radar, detection of defects in metals, communications, and destruction of kidney stones. In this paper, we analyze the effect of inhomogeneity generated by multiple scattering among point scatterers under a multistatic sensing setup. We derive the Crameacuter-Rao bounds (CRBs) on parameters of the scatterers and compare the CRBs for multiple scattering using the Foldy-Lax model with the reference case without multiple scattering using the Born approximation. We find that multiple scattering could significantly improve the estimation performance of the system and higher order scattering components actually contain much richer information about the scatterers. For the case where multiple scattering is not possible, e.g., where only a single target scatterer exists in the illuminated scenario, we propose the use of artificial scatterers, which could effectively improve the estimation performance of the target despite a decrease in the degrees of freedom of the estimation problem due to the introduced unknown parameters of the artificial scatterers. Numerical examples demonstrate the advantages of the artificial scatterers [J1762]

"Iterative Generalized-Likelihood Ratio Test for MIMO Radar"

We consider a multiple-input multiple-output (MIMO) radar system where both the transmitter and receiver have multiple well-separated subarrays with each subarray containing closely spaced antennas. Because of this general antenna configuration, both the coherent processing gain and the spatial diversity gain can be simultaneously achieved. We compare several spatial spectral estimators, including Capon and APES, for target detection and parameter estimation. We introduce a generalized-likelihood ratio test (GLRT) and a conditional generalized-likelihood ratio test (cGLRT) for the general antenna configuration. Based on GLRT and cGLRT, we then propose an iterative GLRT (iGLRT) procedure for target detection and parameter estimation. Via several numerical examples, we show that iGLRT can provide excellent detection and estimation performance at a low computational cost [J1763]

"Wireless Sensors in Distributed Detection Applications"

Detection problems provide a productive starting point for the study of more general statistical inference problems in sensor networks. In this article, the classical framework for decentralized detection is reviewed and argued that, while this framework provides a useful basis for developing a theory for detection in sensor networks, it has serious limitations. The classical framework does not adequately take into account important features of sensor technology and of the communication link between the sensors and the fusion center. An alternative framework for detection in sensor networks that has emerged over the last few years is discussed. Several design and optimization strategies may be gleaned from this new framework [J1764]

"Reflection of radar signals from multiple phase-modulated surfaces"

A phase-modulated surface (PMS) has been shown to provide an effective method of dynamically controlling the scattering from simple planar or cylindrical targets. Real radar targets however have complex geometry comprised of many scattering centres, and multiple interactions may occur between these. Therefore, the authors explore whether the PMS technique is still effective when applied to more realistic target geometries [J1765]

"Electromagnetic Propagation of GPR Signals in Martian Subsurface Scenarios Including Material Losses and Scattering"

A study on the electromagnetic propagation in various models of the Martian subsurface is performed with a relevance to ground penetrating radar (GPR) operating onboard rover missions. Measurements of the electromagnetic properties of Mars soil simulants are obtained; on this basis, the attenuation features of the GPR signals are estimated, including both electric and magnetic losses. The effect on propagation of inhomogeneities inside the soil is also taken into account by means of a specific model with randomly distributed scatterers. The GPR performance in terms of resolution and maximum penetration depth is evaluated in the considered scenarios for different operating frequencies, thus providing a basic information for the design of systems for future subsurface sounding investigations on Mars [J1766]

"Analysis of the Effects of Faraday Rotation on Spaceborne Polarimetric SAR Observations at - Band"

Spaceborne microwave observation of subcanopy and subsurface requires the polarimetric synthetic aperture radar (SAR) technology at lower microwave frequencies, such as P-band. However, SAR observation at P-band is remarkably influenced by the Faraday rotation (FR) effect through the ionosphere. An example in this paper illustrates why the measured polarimetric data with FR at P-band cannot be directly applied to terrain surface classification. We further present that the parameters u, nu, H, alpha, A for terrain surface classification derived from the polarimetric data without FR, which are recovered from the data with FR, can be applied to the surface classification, there is a plusmnpi/2 ambiguity error unresolved. Based on gradual change of the FR degree along a geographical location, a method to eliminate the plusmnpi/2 ambiguity error is designed. Thus, the polarimetric scattering vector and Mueller matrix without FR and plusmnpi/2 ambiguity can be fully inverted from the measured polarimetric data with FR [J1767]

"Comparisons Between SAR Backscattering Coefficient and Results of a Thermodynamic Snow/Ice Model for the Baltic Sea Land-Fast Sea Ice"

We have compared the time series of C-band HH-polarization backscattering coefficients (sigmadeg) of the Baltic Sea land-fast level ice with results from a 1-D high-resolution thermodynamic snow/ice model (HIGHTSI). The sigmadeg time series were obtained from ENVISAT synthetic aperture radar (SAR) images. The study period was from the middle of the winter to the early melt season, February 3-April 7, 2004. Due to the large incidence angle range of the SAR images, the sigmadeg values were divided into three subseries. In general, the HIGHTSI results greatly helped to interpret the sigmadeg behavior with changing ice and weather conditions. The modeled snow-surface temperature, cases of snow melting, and evolution of snow and ice thickness were related to the changes in sigmadeg. Equally useful information could not be obtained solely on the basis of large-scale atmospheric models. Realistic forcing data for HIGHTSI were available in the form of coastal-weather observations and model results of the European Centre of Medium-Range Weather Forecasts (ECMWF). The latter make it possible to apply HIGHTSI in the interpretation of SAR data from all ice-covered seas. There were some cases where detailed ground truth, combined with theoretical sigmadeg modeling, would have been needed for interpretation of the sigmadeg trends. A very interesting observation was the large variation of level ice sigmadeg with changing weather conditions, which complicates automatic classification of the SAR images, and thus, the algorithms must be tuned for different ice conditions. The HIGHTSI model could act as an indicator of various ice conditions for algorithm development [J1768]

"Increasing the Existence of Very Shallow-Water LIDAR Measurements Using the Red-Channel Waveforms"

Mapping shallow-water bathymetry with acoustic techniques is complicated and expensive. The environmental parameters in shallow-water (<2 m) areas become more variable and greatly impact the depth extraction from the survey measurements. Current airborne light detection and ranging (LIDAR) bathymetry surveying in shallow-water depths uses green-channel waveforms to measure the water depth. Unfortunately, due to difficulties in distinguishing between the surface and bottom return of the water column, the timing of the bottom return is often ambiguous. Furthermore, the water often becomes optically "dirty" due to turbulence at these shallow depths. Therefore, it is common to find coastal areas that lack any measured depths. This paper presents a novel approach for measuring water depths in these shallow coastal waters with airborne LIDAR. Observations of the red-channel waveforms show that the waveforms are divided into two groups, namely: (1) waveforms in deep waters (>2 m) whose shape is invariant with respect to the water depth and (2) waveforms in shallow-water depths that show a change in shape as a function of the depth in the water column. The data for this study are from the US Geological Survey LIDAR surveys of Lake Tahoe, CA, and Lake Michigan, using a SHOALS-400 LIDAR system [J1769]

"Data Fusion for Reconstruction of a DTM, Under a Woodland Canopy, From Airborne L-band InSAR"

This paper investigates the utility of different parameters from polarimetric interferometric synthetic aperture radar (InSAR) data for the identification of ground pixels in a woodland area to enable accurate digital terrain model (DTM) generation from the InSAR height of the selected ground hit pixels. The parameters assessed include radar backscatter, interferometric coherence, surface scattering proportion (based on Freeman-Durden decomposition), and standard deviation of the interferometric height. The method is applied to Monks Wood, a small seminatural deciduous woodland in Cambridgeshire, U.K., using airborne E-SAR data collected in June 2000. The 1428 variations of SAR-derived terrain models are validated with theodolite data and a light detection and ranging-derived DTM. The results show that increasing the amount of data used in the DTM creation does

not necessarily increase the accuracy of the final DTM. The most accurate method, for the whole wood, was a fixed-window minimum-filtering algorithm, followed by a mean filter. However, for a spatial subset of the area using the upsi3backscattering coefficient to identify ground pixels outperforms the minimum filtering method. The findings suggest that backscatter information may often be undervalued in estimating terrain height under forest canopies [J1770]

"Statistical Properties of Low-Grazing Range-Resolved Sea Surface Backscatter Generated Through Two-Dimensional Direct Numerical Simulations"

Statistical properties of the X-band sea clutter are studied using 2-D direct numerical simulations. Surfaces are modeled as realizations of a Gaussian random process with the Pierson-Moskowitz or Elfouhaily spectrum. The Creamer transform is further applied to account for the lowest-order surface nonlinearities. Backscattered field at a given frequency is found using the first-principles boundary integral equation (BIE) technique. Calculations are repeated at a number of frequencies, which allows synthesizing the surface response to a pulse as short as 2.2 ns (the corresponding spatial resolution is 0.33 m). Large-scale Monte Carlo trials are used to evaluate the correlation properties and to obtain the probability distributions for the vertically- and horizontally-polarized clutter. This paper concentrates on the incident angle of 85deg (5deg grazing), with a few results for moderate 60deg incidence also reported for comparison. The effects of variations in wind speed (sea state) and radar resolution on the clutter statistics are investigated. An L-band example (with proportionally longer pulse) helps explore the role of a different electromagnetic (e/m) wavelength. The simulation technique also allows for the isolation and examination of the impacts of certain e/m and hydrodynamic approximations, including the replacement of rigorous solution to the BIE by a simpler analytical scattering model. The amplitude statistics of the simulated backscatter are compared to the Weibull and K distributions that are often used to describe surface clutter [J1771]

"A Takagi–Sugeno Fuzzy Rule-Based Model for Soil Moisture Retrieval From SAR Under Soil Roughness Uncertainty"

Radar remote sensing has shown its potential for retrieving soil moisture from bare soil surfaces. Since the backscattering process is also influenced by soil roughness, the characterization of this roughness is crucial for an accurate soil moisture retrieval. However, several field experiments have shown a large variability of the roughness parameters. Describing these parameters by means of possibility distributions allows to account for their uncertainty. Verhoest et al. introduced a retrieval procedure which calculates from these uncertain roughness parameters the possibility distribution of retrieved soil moisture, from which a soil moisture value and uncertainty upon the retrieval are estimated. The main disadvantage of their technique is the high computational demand, which hampers an operational application. In this paper, a fuzzy modeling approach, which is based on fuzzy rules of the Takagi-Sugeno type, is introduced that accurately simulates the soil moisture and the uncertainty upon its retrieved value as obtained by the possibilistic procedure [J1772]

"Spatial and Temporal Behavior of Microwave Backscatter Directional Modulation Over the Saharan Ergs"

Radar backscatter (sigmadeg) from ergs is modulated with view direction [incidence (thetas) and azimuth (phi) angles], where the modulation characteristics reflect the surface geometry. sigmadeg also varies spatially and reflects the spatial inhomogeneity of the sand surface. We use sigmadeg measurements at different thetas and phi angles from the NASA, European Remote Sensing satellite, and SeaWinds scatterometers to understand the relationship between wind and erg bedforms. A model incorporating the sigmadeg phi-modulation and spatial inhomogeneity is proposed. Surface slope variations are related to the sigmadeg spatial inhomogeneity. We compare the backscatter model results with numerically predicted wind direction data provided by the European Centre for Medium-Range Weather Forecasts (ECMWF) over the erg surfaces. We use the maxima of the phi-modulation at thetas=33deg to infer the orientation of the dominant slip-sides on the sand surface. These orientations are consistent with the ECMWF wind directions spatially and temporally [J1773]

"Suppression of Surface Clutter Interference With Precipitation Measurements by Spaceborne Precipitation Radar"

The sidelobe surface clutter along the nadir direction severely interferes with the rain echo in the off-nadir angle observations made using a spaceborne Precipitation Radar (PR). A new method to suppress this sidelobe clutter interference is introduced. A characteristic of the 1-D phased array antenna system is that high sidelobes arise along the beam scan plane. The proposed method tilts the antenna beam scan plane from the nadir such that these high sidelobes would not be directed along the nadir direction, along which a specular component of the backscattering radar cross section of the Earth's surface is dominant. The simulation results using the designed

parameters of a Ka-band spaceborne PR indicate the validity of this method, which is also quantitatively confirmed using Tropical Rainfall Measuring Mission/PR observation data sets [J1774]

"Coregistration Based on Three Parts of Two Complex Images and Contoured Windows for Synthetic Aperture Radar Interferometry"

The coregistration of complex image pairs is a very important step in synthetic aperture radar interferometry (InSAR) data processing. This letter proposes a novel coregistration method that only needs three arbitrary parts of the two complex images instead of four parts in the existing coregistration methods. This method constitutes an integrated three-part method for InSAR data processing with our contoured-correlation-interferometry method for phase-image generation. Saving one part transmission makes a significant advantage when processing SAR images on satellites. Furthermore, we demonstrate that, by means of using fringe contoured windows instead of squared windows, the accuracy of the coregistration for both the three-part coregistration method and the existing methods can be improved considerably [J1775]

"Random Noise Radar/Sodar With Ultrawideband Waveforms"

Random noise waveforms with ultrawide bandwidth improve the range resolution and reduces the probability of intercept in radar/sodar. As a result of the nonperiodic waveform, the range ambiguity is removed as well. By transmitting a sine signal that is phase or frequency modulated by random noise, autocorrelation functions with improved side lobe suppression in range can be formed. There are great similarities in the signal-processing algorithms applied in noise radar and sodar. The much slower propagation velocity of sound compared to light reduces the signal bandwidth but increases the time of measurement, however. In both sodar and radar, the range resolution is determined by the wavelength band occupied by the transmitted waveform, while the velocity resolution is controlled by the ratio of wavelength and time of measurement. The slower sound velocity also enhances the range/Doppler ambiguity problem in sodar when periodic waveforms are applied. This ambiguity could be suppressed if nonperiodic waveforms are introduced, such as random noise. In this paper, fundamental similarities and differences on system level between sodar and radar are first discussed, and signal-processing algorithms applied in random noise radar/sodar are reviewed. In particular, the noise floor of the ambiguity function and its relationship to spectrum width and time of measurement are analyzed, including improved side lobe suppression using mismatched filtering. The signal-processing algorithms were tested on raw data from sodar measurements on moving targets, buildings, vegetation, and water surfaces. An adaptive filter algorithm for suppression of the increased noise floor from dominant reflectors was derived and successfully applied to both sodar and stepped frequency radar data [J1776]

"Quartic-Phase Algorithm for Highly Squinted SAR Data Processing"

In this letter, an algorithm based on a quartic-phase model is discussed for processing highly squinted synthetic aperture radar (SAR) data from a large range swath. In the algorithm, a precise quartic-phase model is adopted to describe a range-dependent property of the SAR signal; a constant factor and a secondary scaling process are introduced to make the algorithm easy to be utilized compared with traditional nonlinear chirp scaling algorithms. The novel algorithm can process SAR data under a squint angle above 50deg and achieve a focus depth over 60 km [J1777]

"Reduced-Dimensional Processing for Ground Moving Target Detection in Distributed Space-Based Radar"

With multisatellite radar systems, several additional features are achieved: multistatic observation, interferometry, ground moving target indication (GMTI). In this letter, a new reduced-dimensional method based on joint pixels sum-difference (Sigma-Delta) data for clutter rejection and GMTI is proposed. The reduced-dimensional joint pixels Sigma-Delta data are obtained by the orthogonal projection of the joint pixels data of different synthetic aperture radar (SAR) images generated by a multisatellite radar system. In the sense of statistic expectation, the joint pixels Sigma-Delta data contain the common and different information among SAR images. Then, the objective of clutter cancellation and GMTI can be achieved by adaptive processing. Simulation results demonstrate the effectiveness and robustness of the proposed method even with clutter fluctuation and image coregistration errors [J1778]

"Submillimeter Accuracy of InSAR Time Series: Experimental Validation"

This paper presents the results of a blind experiment that is performed using two pairs of dihedral reflectors. The aim of the experiment was to demonstrate that interferometric synthetic aperture radar (InSAR) measurements can indeed allow a displacement time series estimation with submillimeter accuracy (both in horizontal and

vertical directions), provided that the data are properly processed and the impact of in situas well as atmospheric effects is minimized. One pair of dihedral reflectors was moved a few millimeters between SAR acquisitions, in the vertical and east-west (EW) directions, and the ground truth was compared with the InSAR data. The experiment was designed to allow a multiplatform and multigeometry analysis, i.e., each reflector was carefully pointed in order to be visible in both Envisat and Radarsat acquisitions. Moreover, two pairs of reflectors were used to allow the combination of data gathered along ascending and descending orbits. The standard deviation of the error is 0.75 mm in the vertical direction and 0.58 mm in the horizontal (EW) direction. GPS data were also collected during this experiment in order to cross-check the SAR results [J1779]

"Angular Dependence of -Distributed Sonar Data"

Backscattered signal statistics are widely used for target detection and seafloor characterization. The K-distribution shows interesting properties for describing experimental backscattered intensity statistics. In addition to the fact that its probability distribution function accurately fits actual sonar data, it advantageously provides a physical interpretation linked to the backscattering phenomenon. Sonar systems usually record backscattered signals from a wide angular range across the ship's track. In this context, previous studies have shown that backscatter statistics strongly depend on the incidence angle. In this paper, we propose an extension of previous works to model the angular evolution of the K-distribution shape parameter. This evolution is made clear and analyzed from experimental data recorded with two sonar systems: a 95-kHz multibeam echosounder and a 110-kHz sidescan sonar. Model fitting with data backscattered from six seafloor configurations shows the improvement provided by our extension as compared to two previous models [J1780]

"SAR Imaging Degradation by Ionospheric Irregularities Based on TFTPCF Analysis"

The effects of ionospheric irregularities on spaceborne synthetic aperture radar (SAR) signal propagation with double path and multilook angle are studied in a model in which a two-frequency and two-position coherence function (TFTPCF) has been adopted for analysis. The TFTPCF is derived from the phase-screen principle. The ambiguity function based on TFTPCF has been used to analyze the effects of ionospheric turbulence on range resolution and cross resolution. The results show that, in some cases, the effects from the irregularities on SAR imaging can be very serious [J1781]

"A New Statistical Similarity Measure for Change Detection in Multitemporal SAR Images and Its Extension to Multiscale Change Analysis"

In this paper, we present a new similarity measure for automatic change detection in multitemporal synthetic aperture radar images. This measure is based on the evolution of the local statistics of the image between two dates. The local statistics are estimated by using a cumulant-based series expansion, which approximates probability density functions in the neighborhood of each pixel in the image. The degree of evolution of the local statistics is measured using the Kullback-Leibler divergence. An analytical expression for this detector is given, allowing a simple computation which depends on the four first statistical moments of the pixels inside the analysis window only. The proposed change indicator is compared to the classical mean ratio detector and also to other model-based approaches. Tests on the simulated and real data show that our detector outperforms all the others. The fast computation of the proposed detector allows a multiscale approach in the change detection for operational use. The so-called multiscale change profile (MCP) is introduced to yield change information on a wide range of scales and to better characterize the appropriate scale. Two simple yet useful examples of applications show that the MCP allows the design of change indicators, which provide better results than a monoscale analysis [J1782]

"Use of C-Band Ground Penetrating Radar to Determine Backscatter Sources Within Glaciers"

The question of penetration of synthetic aperture radar (SAR) signals at C-band frequency into polar glaciers is addressed by comparing ground penetrating radar (GPR) and SAR backscatter signatures. Profiles of the Kongsvegen glacier, Svalbard, were obtained with a C-band GPR. The received signal is converted to the equivalent radar cross section using the standard radar equation, thus mapping the effective scattering sources within the glacier at this frequency. The depth of the observed scattering sources is greatest in the superimposed ice where layers are clearly seen to a depth of approximately 14 m. The very high scattering properties of the upper firn layers preclude layers deeper than approximately 6 m from being imaged. Integrating the radar cross sections over the depth gives a single backscatter value that we compare with the backscatter coefficient (scattering cross section per unit area) of the processed SAR data for the same profile. The comparison indicates that for coincidentally acquired GPR and SAR data, the radar cross section measured by the GPR does represent the features that contribute to the SAR signal [J1783]

"Mathematics of Synthesizing Range Profile"

The mathematics of synthesizing a high-range resolution profile (HRRP) is discussed. With a generalized model of synthetic wideband signal and its echo signal, stretch processing technique is extended and refined. Then, an investigation on the mathematic principle of synthesizing a range profile demonstrates that quadratic phase error criterion does not exactly represent the effect of motion on a synthetic range profile (SRP). Therefore, a least-mean-square error criterion is proposed, and several conclusions about the new criterion are derived. In addition, specific conclusions about the distortion for a stepped-frequency waveform (SFW) are investigated with some simulations [J1784]

"Microstrip antenna array with series-fed 'through-element' coupled patches"

A new microstrip antenna array with series-fed patches is proposed. To reduce the length of feeding lines the `through-element' feeding technique has been developed. A microstrip patch in which the input feeding line is directly connected and the output line is coupled to a patch is investigated. By adjusting the length of the coupling region an appropriate coupling level is achieved. A 4 Ч 1 antenna array operating within the 24 GHz frequency band for radar sensor applications is designed using the proposed feeding technique [J1785]

"Scan-based emitter passive localization"

This paper investigates the problem of estimating the position of a scanning emitter using a passive scan-based geolocation technique. This is achieved by taking advantage of the geometric constraints introduced by the uniform rotating motion of the antenna main beam as it sweeps across a number of separate receivers. A detailed analysis of the estimation process and accuracy of the emitter position is given and a number of computer simulations showing the benefits of this geolocation technique are also included [J1786]

"Spatially Adaptive Wavelet-Based Method Using the Cauchy Prior for Denoising the SAR Images"

The speckle noise complicates the human and automatic interpretation of synthetic aperture radar (SAR) images. Thus, the reduction of speckle is critical in various SAR image processing tasks. In this paper, we introduce a new spatially adaptive wavelet-based Bayesian method for despeckling the SAR images. The wavelet coefficients of the logarithmically transformed reflectance and speckle noise are modeled using the zero-location Cauchy and zero-mean Gaussian distributions, respectively. These prior distributions are then exploited to develop a Bayesian minimum mean absolute error estimator as well as a maximum a posteriori estimator. A new context-based technique with a reduced complexity is proposed for incorporating the spatial dependency of the wavelet coefficients with the Bayesian estimation processes. Experiments are carried out using typical noise-free images corrupted with simulated speckle noise as well as real SAR images, and the results show that the proposed method performs favorably in comparison to some of the existing methods in terms of the peak signal-to-noise ratio, speckle statistics and structural similarity index, and in its ability to suppress the speckle in the homogeneous regions [J1787]

"Measurement Method for Imbalance Factors in Direct-Conversion Quadrature Radar Systems"

In quadrature direct-conversion Doppler radar systems, the I and Q receiver channels are subject to amplitude and phase imbalance factors caused by circuit and component imperfections. This nonideality results in an undesired linear transformation of the baseband output signals which degrades output accuracy and sensitivity. With known imbalance factors, compensation can be achieved through digital signal processing, but accuracy is affected by circuit modifications required to determine those factors. Presented here is a new measurement method for I/Q imbalance factors that can be performed without significant modification to the radar system, allowing more precise imbalance correction to be achieved. A phase shifter is introduced at the receiver input to simulate a target approaching with constant velocity, resulting in sinusoidal outputs which can be easily compared to determine phase and amplitude imbalance [J1788]

"Phase-coded waveforms for radar"

This correspondence focuses on the use of phase-coded (PC) waveforms for radar. The authors present tradeoffs between the use of matched versus mismatched filters, loss in signal-to-noise ratio (SNR), time sidelobe levels, and Doppler intolerance for random and cyclic codes. A multiple hypothesis approach is introduced for countering intrapulse Doppler intolerance [J1789]

"Sparse-periodic hybrid array beamformer"

A novel approach to the design of spatial arrays is presented. The hybrid array beamformer consists of a sparse

array in which some of the elements are arranged periodically, thus creating a periodic sub-array. The outputs of the sparse and periodic arrays are then fused to create a beampattern with good resolution and low peak sidelobe levels. This approach is seen as matching the performance of standard periodic arrays but with a significant saving in terms of the required number of elements. Applications include sonar, radar and ultrasonic systems [J1790]

"Experimental investigation of directional characteristics for ionospheric clutter in HF surface wave radar"

The unwanted radar echoes from the ionosphere are collectively called ionospheric clutter. It has proved to be the greatest impediment to achieve consistently good performance in long-range detection of surface vessels and sea-state monitoring for high-frequency surface wave radar (HFSWR). Field experimental data recorded by the HFSWR OSMAR2003 (Ocean State Monitor and Analysis Radar, manufactured in 2003) has been used in detailed investigations of the directional characteristics for this ionosphere clutter, leading to the development of effective mitigation techniques based on antenna design and adaptive signal processing. Particular attention is given to the amplitude and phase relationship among multiple spatial channels for two types of ionospheric clutter. Preliminary experimental results show that the random gain and phase variation of the antenna pattern overhead null destroyed the amplitude and phase consistency among channels. As a result, no significant measured directivity is observed in this type of specular clutter. For the incidence clutter from a lower elevation angle, it is observed that the spread clutter possesses high directivity. A nonlinear receiving array composed of multiple V-shaped antennas without deep and broad null at near-vertical incidence is proposed for adaptive ionospheric clutter suppression [J1791]

"Non-coherent radar CFAR detection based on goodness-of-fit tests"

This paper considers the problem of constant false alarm rate (CFAR) detection of radar targets using multiple observations. In the Gaussian clutter scenario, the structure of the optimum (uniformly most powerful) CFAR detector is rather simple, but when the clutter is heavy-tailed, that is non-Gaussian distributed, the derivation of the optimal detector becomes infeasible. For this latter relevant case, a new CFAR algorithm is porposed based on goodness-of-fit (GoF) tests. The performance of the proposed detector is numerically investigated through Monte Carlo simulations assuming heavy-tailed Weibull and Lognormal distributed clutter. Numerical results shown that, in heavy-tailed clutter and also when several interfering targets exist, the proposed detector outperforms the conventional CFAR detector based on binary integration. Performance is also tested processing real sea clutter data collected by a non-coherent navigation radar [J1792]

"Knowledge-based recursive least squares techniques for heterogeneous clutter suppression"

The design of knowledge-based adaptive algorithms has been dealt with for the cancellation of heterogeneous clutter. To this end, the application of the recursive least squares (RLS) technique has been revisited for the rejection of unwanted clutter, and modified RLS filtering procedures have been devised accounting for the spatial variation of the clutter power as well as of the disturbance covariance persymmetry property. Then the authors introduce the concept of knowledge-based RLS and explain how the a priori knowledge about the radar operating environment can be adopted for improving the system performance. Finally, the authors assess the benefits resulting from the use of knowledge-based processing both on simulated and on measured clutter data collected by the McMaster IPIX radar in November 1993 [J1793]

"Distance Estimation Using Bidirectional Communications Without Synchronous Clocking"

A fundamental problem when locating sensors in a network is to estimate the distance between pairs of sensors. This paper considers a variety of time-of-arrival and phase-shift approaches that use bidirectional signaling to bypass the need for accurate synchronous clocking. The measurement techniques are simulated and analyzed to assess the accuracy of the distance estimation. The analysis demonstrates tradeoffs between the accuracy of the oscillators, the accuracy of the subsequent distance estimation, and the complexity of the methods [J1794]

"Nonstationary Hidden Markov Models for Multiaspect Discriminative Feature Extraction From Radar Targets"

This paper presents a new scheme for radar target recognition, in which we fuse sequential radar echoes from multiple target-radar aspect angles. The nonstationary hidden Markov model (NSHMM) is employed to characterize the sequential information contained in multiaspect radar echoes. Features from echoes are extracted via the multirelax algorithm, and moments are used to reduce the extracted-feature dimensionality. The proposed NSHMM has many parameters and states to be estimated, so the Markov chain Monte Carlo sampling

algorithm is adopted. Finally, this new scheme is demonstrated with experiments on inverse synthetic aperture radar data [J1795]

"Hexagonal Multicarrier Modulation: A Robust Transmission Scheme for Time-Frequency Dispersive Channels"

By regarding signal transmission as tiling of the time-frequency plane, we propose a multicarrier transmission scheme on hexagonal lattice, coined the term hexagonal multicarrier modulation. To optimally combat the impact of the propagation channels, the underlying lattice parameters and the pulse shape of modulation waveform are jointly optimized to adapt to the channel scattering function from a minimum energy perturbation point of view. It comes out that there exist two equivalent pulse and lattice matching criteria for each channel scattering function to achieve minimal interpulse interference (IPI). Robustness of the proposed system against the wireless channels is analyzed in terms of robustness factor. Numerical analysis and simulation results show that the hexagonal multicarrier transmission system outperforms conventional orthogonal-frequency-division multiplexing (OFDM) and lattice-OFDM (LOFDM) systems with regard to robustness against channel dispersion [J1796]

"Evaluation of Transmit Diversity in MIMO-Radar Direction Finding"

It has been recently shown that multiple-input multiple-output (MIMO) antenna systems have the potential to dramatically improve the performance of communication systems over single antenna systems. Unlike beamforming, which presumes a high correlation between signals either transmitted or received by an array, the MIMO concept exploits the independence between signals at the array elements. In conventional radar, the target's radar cross section (RCS) fluctuations are regarded as a nuisance parameter that degrades radar performance. The novelty of MIMO radar is that it provides measures to overcome those degradations or even utilizes the RCS fluctuations for new applications. This paper explores how transmit diversity can improve the direction finding performance of a radar utilizing an antenna array at the receiver. To harness diversity, the transmit antennas have to be widely separated, while for direction finding, the receive antennas have to be closely spaced. The analysis is carried out by evaluating several Cramer-Rao bounds for bearing estimation and the mean square error of the maximum likelihood estimate [J1797]

"Demonstration of Long-Pulse Power Amplification at 1 GHz Using 4H-SiC RF BJTs on a Conductive Substrate"

In this letter, we report 4H-SiC RF bipolar junction transistors (BJTs) on an n-type 4H-SiC conductive substrate with, for the first time, RF power amplification at 1 GHz. The devices were fabricated using a double-mesa etch and interdigitated emitter-base finger design. When tested under common-base and pulsed Class AB mode at 1 GHz, the packaged devices with external matching exhibited a 10.1-dB power gain and a 22.9-W output power, with a 40.8% power-added efficiency (PAE) at 1-ms pulsewidth and 10% duty cycle. The RF power density is 313.8 W/cm2, normalized to the total emitter finger area. At a longer pulsewidth of 6 ms and the same duty cycle of 10%, devices can still deliver a 16.2-W (222.2 W/cm2) output power, with 10-dB gain and 28.3% PAE. The RF performance combined with the lower cost SiC conductive substrate, as compared to the semi-insulating substrate, makes these devices promising for use in power amplifiers for long-pulse L-band radar applications [J1798]

"AESS Radar Systems Panel [JSociety News & Information]"

{no data available} [J1799]

"The Institution of Engineering and Technology International Conference on Radar Systems-RADAR 2007"

{no data available} [J1800]

"Experimental Study of Phase Pushing in a Fundamental-Mode Multiple-Beam Klystron"

The authors present the results of experimental measurements of the radio frequency phase as a function of cathode voltage for an eight-beam four-cavity multiple-beam klystron (MBK) operated at a driven frequency of 3.25 GHz. The phase-pushing factor was measured in both the small- and large-signal regimes of amplifier operation and was found to be 0.0134deg/V and 0.0148deg/V, respectively. The experiment was also modeled with a simple analytic function and with telegraphist's equations solution for linear beam amplifiers, a multiple-beam 2.5-D nonlinear klystron code, with both methods yielding good agreement with the measured data. The low values for the phase-pushing factor are a benefit of the MBK's high-perveance operation that results in a shorter circuit length relative to single-beam devices of comparable power. These advantages contribute to the

growing interest in the use of multiple-beam devices for high-power phase-sensitive applications such as advanced radar and high-data-rate digital communications [J1801]

"Correspondence"

{no data available} [J1802]

"Microwave measurements Part I: Linear Measurements"

By convention, radio frequency (RF) and microwave frequencies range between 30 MHz and 300 GHz. Conversely, this means their wavelengths range between 10 m and 1 mm. Intense research in radar development during World War II extended the RF spectrum beyond the usual applications in radio communications. The use of shorter wavelengths resulted in laboratory equipment with proportionally smaller dimensions to generate, convey, transmit, and detect higher-frequency signals. Wavelengths shorter than 1 mm require equipment too small to be realized. Voltage, current, and impedance concepts lose their conventional meanings when the operating wavelength is approximately equal to the dimensions of the structures under test. The behavior of propagating electromagnetic waves must then be analyzed in terms of electric and magnetic field. Unfortunately, no simple and direct way exists to measure these quantities, so we must resort to indirect methods. In the following sections, we briefly review the concept and need for measurements of scattering parameters. We also describe the two key instruments for microwave measurements: VNAs and spectrum analyzers. [J1803]

"An Approximate Inverse-Power Algorithm for Adaptive Extraction of Minor Subspace"

This correspondence develops a novel and efficient algorithm to recursively extract multiple minor components from an N-dimensional vector sequence. This algorithm is of computational complexity O(N2)and obtained by approximating the well-known inverse-power iteration in conjunction with Galerkin method. Moreover, the convergence speed of the proposed algorithm is faster than that of the stochastic gradient-based algorithms with complexity O(Ngamma), where gamma is the number of minor components. Global convergence of the proposed algorithm is established. Unlike the classical recursive-least-squares-type algorithms (Ljung and Ljung, Automatica, 1985), it is shown by simulations that the proposed algorithm may have good numerical stability over a very large data sequence due to no use of the well-known matrix inversion lemma. [J1804]

"Algebraic Algorithms to Separate Overlapping Secondary Surveillance Radar Replies"

The secondary surveillance radar (SSR) is a transponder system used in air-traffic control (ATC). Due to growing traffic densities, it is increasingly likely that a ground station receives a mixture of responses of various aircraft, partly overlapping in frequency and time. Currently such "collisions" are disregarded, at a loss of system performance and reliability. In this paper, we propose to equip the ground station with an antenna array, and investigate techniques to blindly separate such a mixture based on source waveform properties. At baseband, 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 three algebraic algorithms to compute the separating beamformers by taking into account the particular modulation format of the received signal. The Cramer-Rao bound (CRB) is derived, extensive simulations are presented, and an experimental platform has been built to collect measurement data and demonstrate the algorithms. [J1805]

"Rao Test for Adaptive Detection in Gaussian Interference With Unknown Covariance Matrix"

This paper deals with the problem of detecting a signal known up to a scaling factor in the presence of Gaussian disturbance with unknown covariance matrix. A new detector based on the Rao test criterion is introduced and its invariance properties and constant false alarm rate (CFAR) behavior are studied. At the analysis stage, the performance of the new receiver is assessed, also in comparison with some classical adaptive radar detectors, both in the matched as well as in the mismatched signal case. Remarkably, the Rao test may achieve a matched detection performance which is commensurate with that of the generalized likelihood ratio test (GLRT)-based detectors if a sufficient number of training data is available. Moreover, it also exhibits better rejection capabilities of mismatched signals than the counterparts. In the last part of the work, a two-stage detector whose second stage coincides with the Rao test is devised. It represents a suitable means to restore the detection performance of the plain Rao test in the presence of a small number of training data. Finally, the performance of the aforementioned two-stage processor is analyzed in closed form and the CFAR behavior is proved. [J1806]

"Concurrent Extraction of Target Range and Doppler Information by Using Orthogonal Coding Waveforms"

In this paper, a novel approach for concurrent extraction of target range and Doppler information in radar systems is introduced. A pair of orthogonal waveforms with different pulse repetition frequencies (PRF) are bundled and transmitted as a single hybrid radar waveform for target measurement. At the receiver, two orthogonal signal processing channels consisting of a low PRF (LPRF) channel and a high PRF (HPRF) one, perform the extraction of target range and Doppler information, respectively. The CLEAN algorithm is innovatively used to suppress the interference from the cross-correlation residues and the autocorrelation sidelobe in the LPRF channel. The processing results, based on the proposed signal processing approach, demonstrate the technical feasibility of implementing such a signal processing scheme in radar systems. [J1807]

"Cooperative UAV Formation Flying With Obstacle/Collision Avoidance"

Navigation problems of unmanned air vehicles (UAVs) flying in a formation in a free and an obstacle-laden environment are investigated in this brief. When static obstacles popup during the flight, the UAVs are required to steer around them and also avoid collisions between each other. In order to achieve these goals, a new dual-mode control strategy is proposed: a "safe mode" is defined as an operation in an obstacle-free environment and a "danger mode" is activated when there is a chance of collision or when there are obstacles in the path. Safe mode achieves global optimization because the dynamics of all the UAVs participating in the formation are taken into account in the controller formulation. In the danger mode, a novel algorithm using a modified Grossberg neural network (GNN) is proposed for obstacle/collision avoidance. This decentralized algorithm in 2-D uses the geometry of the flight space to generate optimal/suboptimal trajectories. Extension of the proposed scheme for obstacle avoidance in a 3-D environment is shown. In order to handle practical vehicle constraints, a model predictive control-based tracking controller is used to track the references generated. Numerical results are provided to motivate this approach and to demonstrate its potential. [J1808]

"Charging Information Collection Modeling and Analysis of GPRS Networks"

Charging is one of the most important functionalities in a telecommunication service system. In a general packet radio service (GPRS) wireless network, the load of charging information flow depends on the intensity of call traffic and the size of charging records. During busy hours, the GPRS network might not be able to transfer charging records on a timely basis if new charging records are generated too fast. On the other hand, when a call happens, the related charging information must be collected and transferred to the billing system. If a failure of the data link occurs, a secondary data link must be employed to transfer the charging information. However, this redundant operation might result in charging information duplication. This paper formally addresses these two issues. A timed Petri net model is built to support the analysis of the charging system performance versus various factors when the system works in the normal status, which, in particular, gives the maximum supportable busy hour call attempts of the GPRS network. The Petri net approach is also used to model and verify the correctness of the redundancy operation in case a connection failure occurs. [J1809]

"Dynamic Configuration of Time-Varying Waveforms for Agile Sensing and Tracking in Clutter"

The advent of waveform-agile sensors has enabled the design of tracking systems where the transmitted waveform is changed on-the-fly in response to the tracker's requirements. This approach can provide performance improvements over individual optimization of the sensor waveform or the tracking algorithm. In this paper, we consider joint sensor configuration and tracking for the problem of tracking a single target in the presence of clutter using range and range-rate measurements obtained by waveform-agile, active sensors in a narrowband environment. We propose an algorithm to select and configure linear and nonlinear frequency-modulated waveforms to minimize the predicted mean square error (MSE) in the target state estimate; the MSE is predicted using the Cramer-Rao lower bound on the measurement error in conjunction with the unscented transform. We further extend our algorithm to match wideband environments, and we demonstrate the algorithm performance through a Monte Carlo simulation of a radar tracking example. [J1810]

"Analytic Implementations of the Cardinalized Probability Hypothesis Density Filter"

The probability hypothesis density (PHD) recursion propagates the posterior intensity of the random finite set (RFS) of targets in time. The cardinalized PHD (CPHD) recursion is a generalization of the PHD recursion, which jointly propagates the posterior intensity and the posterior cardinality distribution. In general, the CPHD recursion is computationally intractable. This paper proposes a closed-form solution to the CPHD recursion under linear Gaussian assumptions on the target dynamics and birth process. Based on this solution, an effective multitarget tracking algorithm is developed. Extensions of the proposed closed-form recursion to accommodate nonlinear models are also given using linearization and unscented transform techniques. The proposed CPHD implementations not only sidestep the need to perform data association found in traditional methods, but also dramatically improve the accuracy of individual state estimates as well as the variance of the estimated number

of targets when compared to the standard PHD filter. Our implementations only have a cubic complexity, but simulations suggest favorable performance compared to the standard Joint Probabilistic Data Association (JPDA) filter which has a nonpolynomial complexity. [J1811]

"Magnetic-Field-Induced ELF Currents in a Human Body by the Use of a GSM Phone"

A finite element method (FEM) with nonuniform mesh is employed for the calculation of extremely low frequency (ELF) currents induced in a human body by a global system for mobile communications (GSM) phone. The magnetic field of the phone is measured, and an equivalent source with magnetic dipoles is constructed for the numerical simulation. A cell of variable size is used in the simulation to accurately model the most important areas of the body model, namely areas close to the source and parts of the central nervous system. Three different mobile phone positions are considered: normal operation on the side of the head, breast pocket, and the small of the back where the spinal cord is close to the phone. Obtained results are compared with the guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP). [J1812]

"Stationary Phase Derivation for RCS of an Ellipsoid"

This letter derives a factor needed to correct an omission in Ruck et al., Radar Cross Section Handbook, Vol. I & II, eq. (5.1-54), for the RCS of an ellipsoid. The derivation goes back to first principles to calculate geometrical optics (GO) expression for the RCS of an ellipsoid by evaluating the physical optics (PO) integral using the stationary phase method. It is shown there is a factor missing from Ruck's expression. Once this factor is included, the new expression for the bistatic RCS of an ellipsoid correctly reduces to the stated monostatic expression. The new expression also agrees with other published results for the bistatic RCS of the prolate spheroid published Crispin and Siegel, methods of radar cross-section analysis, and Bowman, Senior, and Uslenghi, electromagnetic and acoustic scattering front simple shapes. It also reduces to the special case for RCS of a sphere when the major and minor axes are made equal. This new expression provides a consistent solution that corrects the previous omission and matches (for the special cases) all other previously published bistatic expressions. [J1813]

"Autofocusing of Through-the-Wall Radar Imagery Under Unknown Wall Characteristics"

The quality and reliability of through-the-wall radar imagery is governed, among other things, by the knowledge of the wall characteristics. Ambiguities in wall characteristics smear and blur the image, and also shift the imaged target positions. An autofocusing technique, based on higher order statistics, is presented which corrects for errors under unknown walls. Simulation results show that the proposed technique provides high-quality focused images with target locations in close proximity to true target positions. [J1814]

"Online courses"

First Page of the Article [J1815]

"R. Keith Raney Wins the 2007 IEEE Dennis J. Picard Medal for Radar Technologies and Applications"

R. Keith Raney is the recipient of the 2007 IEEE Dennis J. Picard Medal for Radar Technologies and Applications. A biography for Dr. Raney is provided. [J1816]

"Coherence- and Amplitude-Based Analysis of Seismogenic Damage in Bam, Iran, Using ENVISAT ASAR Data"

The sensitivity of synthetic aperture radar (SAR) and interferometric SAR (InSAR) to surface properties, especially changes in height and roughness, combined with an all-weather capability, makes radar remote sensing a potential tool for mapping urban damage caused by earthquakes. With InSAR, surface displacement has been mapped successfully and in detail, but for urban-damage mapping, results have so far been less conclusive. ENVISAT Advanced SAR images of Bam, Iran, that were acquired before and after the 2003 earthquake were used. Between preseismic and coseismic image pairs, coherence decreased with increasing damage levels. However, contrary to previous studies, earthquake damage caused both increases and decreases in amplitude. Therefore, its absolute value, which correlated with damage level, was used. Individually, coherence difference led to better results than absolute amplitude change, although still with limited accuracy. The combination of both resulted in an overall accuracy of 52%. Since vegetation causes decorrelation, a predisaster Advanced Spaceborne Thermal Emission and Reflection Radiometer image was used to mask out vegetated areas, which improved the accuracy by 4%. The ground-truth map showed damage levels per district instead of per pixel. Therefore, the ratio of pixels classified as "damage" and "nondamage" was calculated for each damage

class of the map, and a clear relation was found. This shows that the aggregation level of the map partly explains the low-accuracy figures of the pixel-based evaluation. Although improvement was made, InSAR techniques for urban-damage mapping do not yet provide the accuracy levels needed for disaster mitigation. However, substantial improvements can be expected from instruments with higher spatial resolution, such as the recently launched Phased Array type L-band SAR and Terra SAR-X [J1817]

"Application of Impedance Loading to Geometric Transition Radar Absorbent Material"

This paper describes a novel, lightweight technique for significantly improving the low-frequency reflectivity performance of conventional geometric transition radar absorbent materials as used typically in anechoic chamber facilities for electromagnetic compatibility testing. The improvement is achieved by the inclusion of impedance-loading elements within the base region of the absorber, and these are implemented in the form of one or more frequency-selective surfaces (FSS). The discussion covers the design of the FSS using computer simulation technology microwave studio, its predicted effect on absorber performance at both normal and oblique incidence, the effect of manufacturing tolerances, and the fabrication and characterization of a prototype-loaded absorber panel. [J1818]

"Locally Linear Regression for Pose-Invariant Face Recognition"

The variation of facial appearance due to the viewpoint (/pose) degrades face recognition systems considerably, which is one of the bottlenecks in face recognition. One of the possible solutions is generating virtual frontal view from any given nonfrontal view to obtain a virtual gallery/probe face. Following this idea, this paper proposes a simple, but efficient, novel locally linear regression (LLR) method, which generates the virtual frontal view from a given nonfrontal face image. We first justify the basic assumption of the paper that there exists an approximate linear mapping between a nonfrontal face image and its frontal counterpart. Then, by formulating the estimation of the linear mapping as a prediction problem, we present the regression-based solution, i.e., globally linear regression. To improve the prediction accuracy in the case of coarse alignment, LLR is further proposed. In LLR, we first perform dense sampling in the nonfrontal face image to obtain many overlapped local patches. Then, the linear regression technique is applied to each small patch for the prediction of its virtual frontal patch. Through the combination of all these patches, the virtual frontal view is generated. The experimental results on the CMU PIE database show distinct advantage of the proposed method over Eigen light-field method. [J1819]

"Real-Time Optimal Mission Scheduling and Flight Path Selection"

We consider a mission in which m UAVs with a capacity limit q each visit n(les mq) targets in a hostile environment in a cooperative manner (and return to where they departed from) such that the cost reflecting operating time and risk exposed is minimized. We first propose a mixed-integer linear programming (MILP) formulation which exactly solves the problem and then propose four alternative MILP formulations which are computationally less intensive and, therefore, suited for real-time purposes, but yield a theoretically guaranteed suboptimal solution. The main contributions of this note are an exact but compact MILP formulation, using a room concept, and four nonexact formulations, each one of which ensures a certain level of solution quality and relatively fast computational time for the considered real-time mission scheduling problem. [J1820]

"Signal-to-Noise and Resolution Enhancement in Ion Mobility Spectrometry Using Correlation Gating Techniques: Barker Codes"

Ion mobility spectroscopy (IMS) is a technology that is ideally suited for the detection of very low levels of analyte due to its extreme sensitivity and ability to speciate. Detection of common military and industrial explosives using IMS is an ideal application, since IMS can be tailored to be sensitive to compounds that form negative ions such as nitrate-laden explosives. However, realization of a miniaturized IMS-based detection system for explosives has been hampered by limitations in resolution of miniaturized IMS tubes and by the need to preconcentrate explosive samples and then rapidly desorb them creating a transient chemical concentration. We have demonstrated a new gating and data processing technique that takes advantage of pulse compression approaches developed for modern radar systems for decreasing granularity in target identification. We will show that closely spaced peaks can be isolated by adding discriminating codes to the gating signal. We will then employ matched filtering for the received ion current signal greatly improving instrument performance. This scheme is most advantageous to small geometry IMS drift cells that suffer from lack of resolution due to their small size but would improve sensitivity and peak location uncertainty in any geometry IMS tube. Specifically, we have demonstrated a 13 fold increase in signal-to-noise ratio and have effectively decreased the uncertainty in the location of the signal peak by a factor of 4.4 using a 13-bit Barker coding pattern to operate our IMS gating. [J1821]

"Automatic Reconstruction of Building Objects From Multiaspect Meter-Resolution SAR Images"

Reconstruction of 3-D objects from multiaspect high- resolution synthetic aperture radar (SAR) images is of great importance for SAR technology applications. In this paper, simple building objects are modeled as cuboids, and an approach for automatic reconstruction of 3-D building objects from multiaspect SAR images in meter resolution is developed. The edge detector of constant false alarm rate and a Hough transform technique for parallel line segment pairs are first employed to extract the parallelogram-like image of the building walls in SAR images. A set of probability density functions is presented to describe the object images and their multiaspect coherence. The maximum-likelihood estimation of an object is then derived from its multiaspect object images. A hybrid priority criterion is defined to evaluate the reliability of the reconstruction result. An automatic reconstruction algorithm is further developed to match object images of different aspects and, finally, to reconstruct the building objects. Besides, an iterative method is proposed for the coregistration of multiaspect building images. Four-aspect simulated images of a virtual scene and four-aspect Pi-SAR images over the campus of Tohoku University, Japan, are investigated. Reconstruction of building objects from their multiaspect images shows the fidelity of the whole process chain and the feasibility of 3-D objects automatic reconstruction from multiaspect SAR images. At last, a practical application that is based on spaceborne meter-resolution SAR is proposed. [J1822]

"Some scattering results computed by surface-integral-equation and hybrid finite-element-boundary-integral techniques, accelerated by the multilevel fast multipole method"

Method-of-moments (MoM) solutions of surface integral equations are especially well suited for scattering computations involving metallic objects. Improved modeling flexibility for dielectric (possibly lossy) and mixed dielectric/metallic bodies is obtained by combining a surface-integral-equation formulation, involving electric and magnetic equivalent surface-current densities, with a volumetric finite-element (FE) model of the dielectric regions. This results in the well-known hybrid FEBI (finite-element-boundary-integral) technique. For many years, hybrid FEBI techniques, as well as stand-alone BI (surface-integral equation, often just termed MoM) techniques, were restricted to relatively small (with respect to a wavelength) geometries. However, with the development of powerful multilevel fast multipole methods/algorithms (MLFMM/MLFMA), it has become possible to compute a larger variety of practical scattering and radiation problems with the hybrid FEBI-MLFMM technique. In this contribution, we give a short review of our hybrid FEBI-MLFMM approach, with a focus on mixed dielectric/metallic geometries and multiple BI domains. We then present a variety of scattering results for metallic and mixed dielectric/metallic objects, together with comparisons with measured RCS (radar cross section) data. Broadband computations are used to derive high-resolution range (HRR) profiles of several configurations. [J1823]

"Texture Features for Antitank Landmine Detection Using Ground Penetrating Radar"

In this paper, we consider the application of texture features for antitank landmine detection in ground-penetrating-radar data in the difficult scenario of very high clutter environments. In particular, we develop a technique for 3-D texture feature extraction, and we compare the results for landmine/clutter discrimination using classifiers that are built on 3-D as well as on 2-D texture feature sets. Our results indicate performance improvements across several different challenging testing scenarios when using the relevance-vector-machine classifiers that are trained on our 3-D feature sets as compared to the performance using the 2-D texture feature sets. [J1824]

"AMTA Corner"

First Page of the Article [J1825]

"Short Courses"

{no data available} [J1826]

"Intellectual Property and Patent Abstracts"

A collection of 12 patents is listed along with abstracts and diagrams where applicable. Also listed are inventors, assignees, and dates filed. Covers some of the following technologies, techniques, theories, and schemes: antenna doe ultra-wide band communications; a low-sidelobe dual-band and broadband flat endfire antenna; a wideband phased array radiator; a dual band slot antenna; antennas for multicarrier communications and multicarrier transceiver; antenna configurations for reduced radar complexity; and a low-profile lens antenna. [J1827]

"Design, optimization, and validation of a planar nine-element Quasi-Yagi antenna array for X-band applications [JAntenna designer's Notebook]"

A planar antenna array, based on nine identical quasi-Yagi elements, is presented in this paper. Contrary to conventional designs, the feeding network is composed of three-way power dividers, which are carefully designed in order to provide synchronized output signals over a wide frequency range. The use of spline-shaped microstrip lines suppresses coupling effects by parallel lines. Thus, signal distortions within the feeding network are minimized. Compared to conventional designs with eight elements, the additional antenna element will enhance the gain of the array, which is between 10.5 dBi and 13 dBi in the X band. The input return loss of the antenna array is below -15 dB over most parts of the relevant spectrum, with a total bandwidth of 45%. The planar antenna array is well suited as a radiating element in linear phased arrays for multifunction radars, including SAR and MTI. Additionally, the suitability of this antenna for phased-array applications is studied by an experimental setup consisting of five antenna plates. [J1828]

"Measurement of electrically large array antennas in small anechoic chambers [JMeasurements Corner]"

A post-processing procedure that yields accurate array-antenna radiation-pattern estimations is described. By resorting to this strategy, measurements of large array antennas inside small anechoic chambers become feasible. The method employs an adequate phase-correction derived from an optical ray approach, under the assumption that the elementary radiators themselves are electrically small and can be measured under far-field conditions inside the relevant anechoic chamber. The effectiveness of the proposed technique is demonstrated by examining the case of a nonuniform linear array antenna. [J1829]

"Maximum-Likelihood Retrieval of Modeled Convective Rainfall Patterns from Midlatitude C-Band Weather Radar Data"

A spatial characterization of the midlatitude meso- scale rain fields from C-band radar measurements is performed by means of a systematic analysis and modeling of convective rain-cell bidimensional shapes and spatial correlation. A large rainfall dataset that is derived from an operational C-band dual-polarized radar, which is placed in S. Pietro Capoflume near Bologna (Italy), has been collected and analyzed for this purpose. Different models of convective rainy horizontal structures are described and compared. Special attention is devoted to the consolidated unimodal models (or unimodal patterns) like Gaucell with a Gaussian rain-rate profile and Excell with an exponential rain-rate profile, and the hybrid models like Hycell and Dexcell based on a proper combination of the previous unimodal models. The new hybrid model Dexell, which is introduced here, is an extension of the Hycell model, which is previously proposed in literature. A pixel-by-pixel model numerical integration is carried out in order to perform a homogeneous comparison between the rain-cell model and the measured features such as peak, average, root mean square, gradient average, and gradient deviation of rain rate. A maximum-likelihood algorithm, which is expressed in terms of the principal component of the previous rain-cell features, is introduced to estimate rain-cell pattern parameters from the available radar data. A detailed sensitivity analysis, which is devoted to find the best behavior in terms of root-mean-square error and correlation coefficient between the modeled and measured rain-cell features, is finally carried out. [J1830]

"InSAR Elevation Bias Caused by Penetration Into Uniform Volumes"

Natural media like cold-land ice, vegetation, and dry sand are subject to a substantial penetration at microwave frequencies. For such media, the synthetic aperture radar (SAR) phase center is located below the surface, and consequently, the surface elevation determined with SAR interferometry (InSAR) is biased downward. For infinitely deep uniform volumes, the elevation bias is often equated with the penetration depth, but in this paper, it is shown that the two quantities generally differ. The interferometric bias is approximately equal to the two-way power-penetration depth if the latter is small compared to the ambiguity height, but for increasing penetration depth, the bias approaches one quarter of the ambiguity height. Consequently, no phase wrapping results even if the penetration depth exceeds the ambiguity height. The ratio of the InSAR elevation bias to the ambiguity height depends only on the ratio of the penetration depth to the ambiguity height, and the bias can be expressed in terms of the InSAR coherence magnitude, which makes it possible to correct the InSAR surface elevation for the bias. The volume depth can be considered infinite if it exceeds the penetration depth by a factor of two to five and if the surface scattering from the top and the bottom of the volume is negligible. [J1831]

"Improvement of Satellite Radar Feature Tracking for Ice Velocity Derivation by Spatial Frequency Filtering"

Outlet glaciers of ice sheets are the primary means of transporting ice from the interior to the oceans, and their

flow velocity is one control that determines the mass balance of ice sheets. Estimates of ice velocities, particularly for remote areas, are commonly based on satellite remote-sensing data. As radar-based systems emit energy at frequencies high enough to penetrate clouds, they can record backscatter signals from surfaces throughout the year. Radar data, which are collected with repeat-pass spaceborne platforms, are therefore good for extracting ice velocities using interferometry for slow-moving ice and the cross-correlation techniques for fast-moving ice. Here, we present an improvement on the cross-correlation technique that enables independent quality checks and enhances the spatial extent of the derived velocity fields. Filtering of ESA European remote sensing satellite scenes, based on a Butterworth high-pass spatial-frequency filter, focuses the cross-correlation technique on smaller, movable surface features, instead of large fixed features. It also allows a nonregional culling based on the signal-to-noise ratio of the velocities, with the effect of increasing the coverage of robust velocity estimates. [J1832]

"Radar Signatures of Sahelian Surfaces in Mali Using ENVISAT-ASAR Data"

This paper presents an analysis of ENSIVAT advanced synthetic aperture radar data acquired over a Sahelian region located in Mali, West Africa. The considered period is 2004-2005 and includes two rainy seasons. Emphasis is put on two ScanSAR modes, namely, the global monitoring (GM) and the wide swath (WS) modes characterized by spatial resolutions of about 1 km and 150 m, respectively. Results show that the WS mode offers better performance in terms of radiometric resolution, radiometric stability, and speckle reduction than the GM mode. The latter is more appropriate for studies at large scale (> 10 times 10 km). In both modes, pronounced angular and temporal signatures are observed for most soil surfaces, and azimuthal effects are observed on markedly orientated rocky surfaces. In contrast, polarization differences (VV/HH) are small during the dry season except on flat loamy soil surfaces. Finally, a relationship is observed between the normalized WS backscattering signal at HH polarization and the surface soil moisture of sandy soils. [J1833]

"Sensitivity of Airborne 36.5-GHz Polarimetric Radiometer's Wind-Speed Measurement to Incidence Angle"

The Helsinki University of Technology's airborne fully polarimetric profiling radiometer at 36.5 GHz has been used for wind-vector measurements over the Gulf of Finland. The results, collected in a series of measurements over a period of two years, are presented in this paper. The Fourier coefficients of the harmonics of the first three modified Stokes parameters (in brightness temperature) have been solved, and their behavior as a function of the measurement incidence angle and the wind speed has been examined, resulting in a linear model in the measurement range. In this paper, we show a clear relationship between the incidence angle and the third modified Stokes parameter (in brightness temperature), which has been used to compensate for aircraft motion during measurements. Furthermore, the sensitivity of the wind-speed measurement to the incidence angle has been studied, and a model for wind-speed retrieval as a function of the harmonic coefficients and incidence angle was developed. [J1834]

"Global Precipitation Map Using Satellite-Borne Microwave Radiometers by the GSMaP Project: Production and Validation"

This paper documents the production and validation of retrieved rainfall data obtained from satellite-borne microwave radiometers by the Global Satellite Mapping of Precipitation (GSMaP) Project. Using various attributes of precipitation derived from Tropical Rainfall Measuring Mission (TRMM) satellite data, the GSMaP has implemented hydrometeor profiles derived from Precipitation Radar (PR), statistical rain/no-rain classification, and scattering algorithms using polarization-corrected temperatures (PCTs) at 85.5 and 37 GHz. Combined scattering-based surface rainfalls are computed depending on rainfall intensities. PCT85 is not used for stronger rainfalls, because strong depressions of PCT85 are related to tall precipitation-top heights. Therefore, for stronger rainfalls, PCT37 is used, with PCT85 used for weaker rainfalls. With the suspiciously strong rainfalls retrieved from PCT85 deleted, the combined rainfalls correspond well to the PR rain rates over land. The GSMaP algorithm for the TRMM Microwave Imager (TMI) is validated using the TRMM PR, ground radar [Kwajalein (KWAJ) radar and COBRA], and Radar Automated Meteorological Data Acquisition System (AMeDAS) precipitation analysis (RA). Monthly surface rainfalls retrieved from six microwave radiometers (GSMaP_MWR) are compared with the gauge-based dataset. Rain rates retrieved from the TMI (GSMaP_TMI) are in better agreement with the PR estimates over land everywhere except over tropical Africa in the boreal summer. Validation results of the KWAJ radar and COBRA show a good linear relationship for instantaneous rainfall rates, while validation around Japan using the RA shows a good relationship in the warm season. Poor results, connected to weak-precipitation cases, are found in the cold season around Japan. [J1835]

"Reconstruction of DEMs From ERS-1/2 Tandem Data in Mountainous Area Facilitated by SRTM

Data"

A new approach is presented in this paper to produce Digital Elevation Model (DEM) in mountainous areas with steep slope using ERS-1/2 tandem data. In order to reduce the impact of phase errors on the Interferometric Synthetic Aperture Radar (InSAR)-generated DEM, an external DEM such as that from Shuttle Radar Topography Mission (SRTM) is utilized in this approach. The proposed algorithm includes two steps: The first step is to model and remove phase trends with a linear regression analysis before converting phase to height; the second step is to filter unreliable height points before interpolating the DEM from the InSAR height map. The critical points are the following: 1) determining the one-to-one correspondence between the interferogram and the SRTM DEM before knowing the InSAR-derived elevation values and 2) estimating the elevation range of every pixel from SRTM DEM. To solve the first problem, an iteratively geocoding algorithm is performed. A DEM interpolation error model solves the second one. For InSAR data processing, the SRTM DEM is not only usable for modeling systematic phase errors but also for filtering gross height errors. The experiments in Zhangbei and the Three Gorges areas in China show that our approach has improved the accuracy of the resulting DEMs significantly without any ground control points. [J1836]

"Sensitivity of the Kurtosis Statistic as a Detector of Pulsed Sinusoidal RFI"

A new type of microwave radiometer detector that is capable of identifying low-level pulsed radio frequency interference (RFI) has been developed. The Agile Digital Detector can discriminate between RFI and natural thermal emission signals by directly measuring other moments of the signal than the variance that is traditionally measured. The kurtosis is the ratio of the fourth central moment of the predetected voltage to the square of the second central moment. It can be an excellent indicator of the presence of RFI. A number of issues that are related to the proper calculation of the kurtosis are addressed. The mean and standard deviation of the kurtosis, in both the absence and the presence of pulsed sinusoidal RFI, are derived. The kurtosis is much more sensitive to short-pulsed RFI-such as from radars-than to continuous-wave RFI. The minimum detectable power for pulsed sinusoidal RFI is found to be proportional to (M3N)-1/4, where Nis the number of independent samples and Mis the number of frequency subbands in the receiver. [J1837]

"Effects of the Antenna Aperture on Remote Sensing of Sea Surface Salinity at L-Band"

Remote sensing of sea surface salinity can be performed by means of microwave radiometry at L-band, but it requires high radiometric accuracy (e.g., on the order of 0.1 K). Since the variability of salinity in the open ocean exhibits large spatial scales and long temporal scales, it is possible to use antennas with large footprints and averaging to meet this goal. However, antennas with large footprints introduce other problems such as variations of the incidence angle and direction of the polarization vectors over the footprint. Examples of these effects are computed here using antennas that are representative of those that will be flown on the Aquarius/SAC-D mission being developed for remote sensing of salinity from space. It is shown that the antenna temperature (i.e., integrated over the antenna pattern) is biased relative to the value at boresight. In part, this is due to change in incidence angles across the field of view. Polarization mixing, because of the variations of the local plane of incidence across the footprint, also induces bias (peculiarly for the third Stokes parameter). Finally, large antenna footprints limit how close to land measurements can be made. [J1838]

"Propagation Corner-In Memorian George W. Haydon"

Recounts the life and career of George W. Haydon, recipient of the Army's Superior Civilian Service Award. [J1839]

"Adaptive Multimodality Sensing of Landmines"

The problem of adaptive multimodality sensing of landmines is considered based on electromagnetic induction (EMI) and ground-penetrating radar (GPR) sensors. Two formulations are considered based on a partially observable Markov decision process (POMDP) framework. In the first formulation, it is assumed that sufficient training data are available, and a POMDP model is designed based on physics-based features, with model selection performed via a variational Bayes analysis of several possible models. In the second approach, the training data are assumed absent or insufficient, and a lifelong-learning approach is considered, in which exploration and exploitation are integrated. We provide a detailed description of both formulations, with example results presented using measured EMI and GPR data, for buried mines and clutter [J1840]

"Characteristics of Tsunami-Affected Areas in Moderate-Resolution Satellite Images"

The massive 2004 Indian Ocean tsunami caused vast devastation along the coastal areas in countries around the Indian Ocean rim. Satellite images of various spatial resolutions could quickly capture the affected areas and

were used for emergency response after the catastrophe occurred. To figure out the extent of affected areas, moderate-resolution satellites (e.g., Terra-ASTER) images are more suitable than high-resolution satellites (e.g., Ikonos) images. Basically, tsunami-affected areas can be observed and detected through land cover changes. Based on the nature of the tsunami attack, we chose the normalized difference vegetation index, soil index, and water index as indicators to help detect changes. This paper first investigates the fluctuations of these indexes and their differences using ASTER images of southern Thailand. The investigation is carried out in two cases: one using only the data acquired after the tsunami, and the other using both data acquired before and after the tsunami. Consequently, the thresholds of index differences are set up for the detection of tsunami-affected areas. In addition, since landform is a significant factor to determine the extent of tsunami runup, Shuttle Radar Topography Mission data are employed to perform geomorphological classification and to assess its relationship with the tsunami-affected areas [J1841]

"A Novel Approach for Disaster Monitoring: Fractal Models and Tools"

In this paper, we present a complete framework to support the monitoring of natural and man-made disasters by means of synthetic aperture radar (SAR) images. The fractal geometry is the most appropriate mathematical instrument in describing the irregularity of a natural observed scene, by means of few effective and reliable parameters. Therefore, fractal concepts can be used to model and identify geometrical changes that occurred in areas hit by disasters. We present an overall framework employing fractal-based models, algorithms, and tools to support the identification of natural area changes due to natural or man-made disasters. Such a framework includes an algorithm used to extract fractal parameters from a 2-D signal, a fractal interpolation tool, and a SAR raw-signal simulator. The combined use of these tools provides an innovative instrument for disaster monitoring applications. In this paper, we implement the fractal framework to obtain a relation between the fractal parameters of a SAR image and those of the relative imaged area. In addition, a case study is discussed, showing the potentiality of our framework for flooding detection [J1842]

"Rapid Damage Detection in the Bam Area Using Multitemporal SAR and Exploiting Ancillary Data"

In this paper, the problem of rapid earthquake damage detection in urban areas using multitemporal synthetic aperture radar data is addressed. It is shown that the combination of intensity and phase features enhances the damage pattern extracted from the data temporal stack using a spatially aware classifier. Moreover, the use of ancillary data, easily available for urban areas, further improves the accuracy by discarding uninteresting parts of the scene and forcing homogeneous classification within city blocks to avoid "class-blurring" effects consequential to the window-based computation of relevant measures. The procedure is validated based on results for the town of Bam, Iran, and compared with ground-based survey maps [J1843]

"The Distinguished Tutorials Program"

{no data available} [J1844]

"Estimation of Forest Fuel Load From Radar Remote Sensing"

Understanding fire behavior characteristics and planning for fire management require maps showing the distribution of wildfire fuel loads at medium to fine spatial resolution across large landscapes. Radar sensors from airborne or spaceborne platforms have the potential of providing quantitative information about the forest structure and biomass components that can be readily translated to meaningful fuel load estimates for fire management. In this paper, we used multifrequency polarimetric synthetic aperture radar (SAR) imagery acquired over a large area of the Yellowstone National Park by the Airborne SAR sensor to estimate the distribution of forest biomass and canopy fuel loads. Semiempirical algorithms were developed to estimate crown and stem biomass and three major fuel load parameters, namely: 1) canopy fuel weight; 2) canopy bulk density; and 3) foliage moisture content. These estimates, when compared directly to measurements made at plot and stand levels, provided more than 70% accuracy and, when partitioned into fuel load classes, provided more than 85% accuracy. Specifically, the radar-generated fuel parameters were in good agreement with the field-based fuel measurements, resulting in coefficients of determination of R2=85 for the canopy fuel weight, R2 =0.84 for canopy bulk density, and R2=0.78 for the foliage biomass [J1845]

"Enhanced ADS-B Research"

Automatic dependent surveillance-broadcast (ADS-B) is gaining acceptance around the world as the next-generation surveillance technology. It can provide surveillance to air traffic controllers to support today's procedures as well as surveillance in the cockpit to support air-to-air applications. Pilots and ground personnel have begun to benefit from this technology but further benefits from technological improvements can still be realized. These improvements include security, increased data capacity, and advanced applications (4D

trajectory and data exchange). To this end research is currently being performed by Sensis Corporation in cooperation with NASA Glenn research center to provide enhancements to the ADS-B UAT (universal access transceiver) data link. The research goal is to encourage user acceptance by improving upon existing capability and usability along with providing a roadmap and demonstrations of future data link capability [J1846]

"MMW Polarimetric Radar Bistatic Scattering From a Random Surface"

This paper explores the nature of bistatic radar scattering from terrain by reporting the results of an investigation involving measurements of the hemispherical pattern of the field scattered by a random soil surface. The measurements were performed by a 35-GHz fully polarimetric radar system with transmitter and receiver modules mounted on separate rotatable arches. The acquired data were analyzed to determine the angular sensitivities of several attributes of the scattered field, including amplitudes and phase differences of the polarized scattering coefficients, and their copolarized and cross-polarized ratios. Generally speaking, the scattering pattern exhibits a weak dependence on the scattering angle thetass(except along the backward direction and forward specular direction), but it exhibits a strong dependence on the azimuth angle phi, particularly for the cross-polarized components. Much of the dependence is attributed to the vectorial definition of polarization in a standard frame of reference. Comparison of the measured data with calculations based on the second-order physical optics model reveals reasonable overall agreement between theory and observations (typically within 4 dB) [J1847]

"A Multitemporal Method for Correction of Tropospheric Effects in Differential SAR Interferometry: Application to the Gulf of Corinth Earthquake"

Tropospheric inhomogeneities can form a major error source in differential synthetic aperture radar interferometry measurements, which are used in slow-deformation monitoring. Indeed, variations of atmospheric conditions between two radar acquisitions produce variations in the signal path of two images and, thus, additional fringes on differential interferograms. These effects have a strong influence on interferograms and must be compensated to obtain reliable deformation measurements. This paper presents a methodological approach to reduce at both global and local scales tropospheric contributions directly from differential interferograms. It first requires refined knowledge of the stable scatterers that can only be obtained from the analysis of a large population of multitemporal interferograms. The correction of global-scale atmospheric contribution exploits the correlation between phase and topography. The correction of local artifacts is based on the correlation between interferograms containing one common acquisition. This technique is validated on a database of 81 differential interferograms covering the Gulf of Corinth (Greece) and used to improve the measurements of ground deformation compared to global positioning system measurements [J1848]

"Microwave surfing-The IMS 2007 Quiz"

{no data available} [J1849]

"Reverberations-The SCR-270 Radar"

The paper discusses the development of SCR-270 radar and the evolution of radar technique. [J1850]

"UWB short-range radar sensing-The architecture of a baseband, pseudo-noise UWB radar sensor"

The pioneers of radio science made their first trials of wireless information transmission and demonstrated localization of a steel vessel by radio waves more than 100 years ago. Back then, the world of radio frequencies was organized in a very simple way. The researchers could use any frequency band. There was no interference by others and no controlling government bodies. Since then, governmental authorities have established tight regulations that have split up the available frequency band into small partitions for exclusive use. This article discusses the architecture of a baseband, pseudo-noise UWB radar and gives some examples of applications [J1851]

"Measurement of microwave power-A review of techniques used for measurement of high-frequency RF power"

Measurement of the signal amplitude of radio frequency (RF) waves is an important function in a wide range of applications. Some of these applications are signal-level adjustment and verification for radar and communication radio and measurements made to control and ensure safety in industrial and home microwave heating processes. Frequencies that are normally considered to be "microwave" are typically those above 1 GHz, although the same power measurement techniques used at 1 GHz are successfully applied at lower frequencies.

Common commercial coaxial RF power instruments will, for example, often be calibrated over a range of 10 MHz to 26.5 GHz, with calibrations at frequencies as low as 9 kHz and as high as 50 GHz used at times. This article introduces and reviews the techniques used for measurement of high-frequency RF power and for establishing traceability of the measurements to national standard units [J1852]

"Developing a Flood Monitoring System From Remotely Sensed Data for the Limpopo Basin"

This paper describes the application of remotely sensed precipitation to the monitoring of floods in a region that regularly experiences extreme precipitation and flood events, often associated with cyclonic systems. Precipitation data, which are derived from spaceborne radar aboard the National Aeronautics and Space Administration's Tropical Rainfall Measuring Mission and from National Oceanic and Atmospheric Administration's infrared-based products, are used to monitor areas experiencing extreme precipitation events that are defined as exceedance of a daily mean areal average value of 50 mm over a catchment. The remotely sensed precipitation data are also ingested into a hydrologic model that is parameterized using spatially distributed elevation, soil, and land cover data sets that are available globally from remote sensing and in situ sources. The resulting streamflow is classified as an extreme flood event when flow anomalies exceed 1.5 standard deviations above the short-term mean. In an application in the Limpopo basin, it is demonstrated that the use of satellite-derived precipitation allows for the identification of extreme precipitation and flood events, both in terms of relative intensity and spatial extent. The system is used by water authorities in Mozambique to proactively initiate independent flood hazard verification before generating flood warnings. The system also serves as a supplementary information source when in situ gauging systems are disrupted. This paper concludes that remotely sensed precipitation and derived products greatly enhance the ability of water managers in the Limpopo basin to monitor extreme flood events and provide at-risk communities with early warning information [J1853]

"A Split-Based Approach to Unsupervised Change Detection in Large-Size Multitemporal Images: Application to Tsunami-Damage Assessment"

This paper presents a split-based approach (SBA) to automatic and unsupervised change detection in large-size multitemporal remote-sensing images. Unlike standard methods that are presented in the literature, the proposed approach can detect in a consistent and reliable way changes in images of large size also when the extension of the changed area is small (and, therefore, the prior probability of the class of changed pixels is very small). The method is based on the following: 1) a split of the large-size image into subimages; 2) an adaptive analysis of each subimage; and 3) an automatic split-based threshold-selection procedure. This general approach is used for defining a system for damage assessment in multitemporal synthetic aperture radar (SAR) images. The proposed system has been developed to properly identify different levels of damages that are induced by tsunamis along coastal areas. Experimental results that are obtained on multitemporal RADARSAT-1 SAR images of the Sumatra Island, Indonesia, confirm the effectiveness of both the proposed SBA and the presented system for tsunami-damage assessment [J1854]

"Transnational news-Microwaves in Europe and China"

{no data available} [J1855]

"Practical matters [Jreview of "Engineering Your Retirement" (Golio, M.; 2006)]"

This book on retirement planning is geared to the engineering mind, but anyone with a minimal set of math skills will find the book useful. The author tackles such topics as managing expenses, investing, health care, taxes, emergency funds, and the question of what to do after you retire. The book is well organized and referenced very well. It also includes a list of Web sites in the Appendix. Readers will find this highly recommended book high on content and low on fluff. [J1856]

"High-Resolution 3-D Flood Information From Radar Imagery for Flood Hazard Management"

This paper presents a remote-sensing-based steady-state flood inundation model to improve preventive flood-management strategies and flood disaster management. The Regression and Elevation-based Flood Information eXtraction (REFIX) model is based on regression analysis and uses a remotely sensed flood extent and a high-resolution floodplain digital elevation model to compute flood depths for a given flood event. The root mean squared error of the REFIX, compared to ground-surveyed high water marks, is 18 cm for the January 2003 flood event on the River Alzette floodplain (G.D. of Luxembourg), on which the model is developed. Applying the same methodology on a reach of the River Mosel, France, shows that for some more complex river configurations (in this case, a meandering river reach that contains a number of hydraulic structures), piecewise regression is required to yield more accurate flood water-line estimations. A comparison with a simulation from

the Hydrologic Engineering Centers River Analysis System hydraulic flood model, calibrated on the same events, shows that, for both events, the REFIX model approximates the water line reliably [J1857]

"Optimum relative speed discretisation for detection of moving objects in wide band SAR"

Here, ground moving target indication (GMTI) using synthetic aperture radar (SAR) is considered. SAR GMTI requires that relative speed between the target and the SAR platform is included in the detection algorithm. A separation between the true relative speed and the relative speed used in the SAR process will cause unfocused targets, and decrease detectability. Blind hypotheses of relative speeds are used in the detection phase of moving targets in SAR. The step size between the hypotheses (or discretisation step) in relative speed involves a trade off between the number of hypotheses to test and detectability. A large number of tests will increase detectability but will also increase computation load and vice versa. The relevance of relative speed increases as the azimuth integration time gets larger. Long integration time is associated with low signature moving target detection in strong clutter environments, or for SAR GMTI at low frequencies. The optimum discretisation of normalised relative speed for moving target detection has been determined. The optimum discretisation is derived from the moving target impulse response. Use of optimum discretisation reduces the computation burden in SAR GMTI and secures the detectability. [J1858]

"MCMC methods for tracking two closely spaced targets using monopulse radar channel signals"

Four techniques to successfully track two closely spaced and unresolved targets using monopulse radar measurements have been discussed, the quality of such tracking being a determinant of successful detection of target spawn. The paper explores statistical estimation techniques based on the maximum likelihood criterion and Gibbs sampling, and addresses concerns about the accuracy of the measurements delivered thereby. In particular, the Gibbs approach can deliver joint measurements (and the associated covariances) from both targets, and it is therefore natural to consider a joint filter. The ideas are compared, and among the various strategies discussed, a particle filter that operates directly on the monopulse measurements seems to be the best. [J1859]

"Subcanceller: adaptive generalised sidelobe canceller with optimum subband decomposition"

This paper presents a subband beamformer with the generalised sidelobe canceller (GSC) as the underlying structure. This new beamformer, referred to as the subcanceller, determines the statistically optimum filter bank succeeding the blocking matrix of the GSC based on the minimum mean-square error criterion. As a consequence, the signals passing through the lower branch of the GSC are decomposed into more appropriate subband components by such filter banks according to the input data statistics to enhance the interference suppression capability. The determination of the filter bank coefficients, however, calls for computationally demanding nonlinear optimisation. To alleviate the computational overhead, an iterative procedure is also proposed, which solves the Rayleigh quotient in each iteration. Furthermore, a detailed performance analysis of the proposed beamformer is conducted, which includes the development expression of the output signal to interference-plus-noise ratio and its implications, and the analysis of the convergence characteristic. Furnished simulations show that the new scheme yields superior interference suppression performance with a faster convergence rate compared with previous studies. [J1860]

"Joint estimation of Doppler centroid and rate for SAR with large range migration"

For synthetic aperture radar (SAR) with large range migration, the estimation accuracy of Doppler rate may be poor without range migration correction (RMC), while inversely the correct RMC needs the accurate knowledge of Doppler parameters. By exploiting the statistical property of SAR range-Doppler domain signal, a novel Doppler parameter estimation method is proposed to solve the above dilemma. Free of a priori knowledge of platform motion including antenna beam pointing direction and flying velocity, the proposed method can realise pulse repetition frequency-ambiguity resolving, clutter-locking and auto-focusing both accurately and jointly. It is also robust to scene contrast. Experimental results based on real RADARSAT data are provided to demonstrate the effectiveness of the proposed method. [J1861]

"REPLY TO COMMENTS-REPLY TO THE COMMENT ON "MULTI-RANGE-RESOLUTION RADAR USING SIDEBAND SPECTRUM""

In this paper proposed a method that translates the high SNR of a target at a closer distance to a better range resolution without sacrificing the maximum detection range. It is a well-known fact that radar range resolution is a constant parameter unrelated to the detection range. This is because range resolution is dependent on the transmitted and received signal. At the same time, the signal-to-noise ratio (SNR) is dependent on the detection range. For example, at a distance of half the maximum detection range, the SNR increases by 12 dB from that of

the maximum detection range and at one-fourth the distance, it increases by 24 dB. [J1862]

"East Ukraine Young Scientist Conference Travel Grant Available; 2006 Awardees Announced"

{no data available} [J1863]

"Polarimetric angular smoothing algorithm for an electromagnetic vector-sensor array"

The polarimetric angular smoothing (PAS) technique for coherent direction-of-arrival (DOA) estimation and adaptive beamforming is explored and enriched by taking into account the cross-correlations among the smoothed subarrays and using non-uniform weights. The PAS using annihilating weights is shown to be free of signal cancellation [which occurs in the conventional spatial smoothing (SS) technique for uncorrelated sources] while effectively suppressing coloured noise with unknown Toeplitz covariance matrix, but may be incompetent for DOA estimation. The PAS technique is still shown to be more attractive than the SS scheme in a very difficult situation that the direct signals and the reflecting signals are of very close DOAs. The penalised Toeplitz-block-Toeplitz scheme is further suggested for more thorough source decorrelation with an L-shaped electromagnetic vector-sensor array to gain improved interference suppression. The analytical expression for the mean-squared error of DOA estimates obtained from the weight-PAS pre-processed root-multiple signal classification is derived and analysed. A hybrid DOA estimator incorporating PAS and integrating some existing techniques is also described. Numerical results are finally given. [J1864]

"COMMENT-COMMENT ON 'MULTI-RANGERESOLUTION RADAR USING SIDEBAND SPECTRUM ENERGY'"

The prevailing pulse compression technique utilises a matched filter receiver in order to achieve the highest attainable output signal-to-noise ratio (SNR), and relies on a judicious choice of transmitted waveform to achieve range response with narrow mainlobe and low sidelobes. As is well known, the magnitude of the frequency response of the matched filter is identical to the magnitude of the spectrum of the transmitted waveform. The logic is to amplify those frequencies where the signal's power spectral density is high and attenuate frequencies dominated by noise. A recently published paper [M. Shinriki et al., 2006] suggests a new pulse compression approach that is the antithesis of the matched filter. Rather than utilising the power in the spectral mainlobe of the transmitted waveform, the suggested mismatched filter attenuates the frequencies occupied by the waveform's spectral mainlobe and enhances the sidelobe frequencies. In this way, the suggested approach squeezes a 1 ms delay resolution out of an unmodulated 5 ms pulse. [J1865]

"Image frequency suppression in frequency-scanned direction-of-arrival estimation systems"

A novel signal processing approach to the problem of image frequency suppression in wide-band frequency-scanned radio frequency (RF) receiving arrays that employ digital signal processing (DSP) techniques to estimate the direction of arrival (DOA) of incoming radiation has been presented. The conventional approach to image rejection in RF receivers is to employ a front-end RF tuner before downconversion to the intermediate frequency. As DOA processing employs a separate receiver channel for each array element, an RF tuner would be needed behind each element. Clearly for scanned systems at microwave frequencies, this is not a viable option where the tuners would generally have to be implemented in RF hardware. The need for RF tuners can be eliminated by downconversion down to baseband and employing I&Q mixers, which provide an intrinsic image rejection capability. Unfortunately, such a solution requires two analog-to-digital (A/D) converters per array element. An alternative approach is to use image rejection mixers in which case only one A/D converter per array element is needed. The approach also requires only one A/D per array element but achieves the image rejection through a DSP implementation. As a result, use of relatively expensive image rejection mixers is avoided without sacrificing performance. Experimental results are presented that validate the theoretical predictions. [J1866]

"Characterization of Zak Space Support of a Discrete Chirp"

General conditions are derived for an (N=KL2)-point discrete chirp with chirp rate a and carrier frequency b to have minimal support on the LtimesKL Zak transform lattice. Earlier, it has been shown that when the normalized chirp parameters amacr= aK, amacr= aK 2, and 2bmacr = 2bK are integers, the last two of the same parity, then the discrete chirp is supported at KL points. Here, this condition is relaxed, by allowing amacr to be a rational number, i.e., amacr = n/d, n, disin Z, (n,d)=1, and requiring only that amacr and bmacrL be integers of arbitrary parity. It is shown that the support of the Zak space chirp satisfying the new condition then increases to dKL points. The results provide foundations for future constructions of sophisticated radar and communications signal processing algorithms. Examples of direct applications of the Zak space conditions in chirp parameter estimation, chirp detection, and chirp de-noising are included [J1867]

"Vehicle Classification Based on the Radar Measurement of Height Profiles"

The problem of classifying road vehicles according to vehicle type is considered. The proposed solution is based on using vehicle height and length and height profiles obtained by a microwave (MW) radar sensor. We show that if the radar sensor satisfies certain requirements, then a precise feature vector can be extracted, and simple deterministic algorithms can be applied to determine the vehicle class. Field trials using a spread-spectrum MW radar sensor system operating on these principles have been carried out. They confirm that accurate classification of a large number of vehicle classes can be reached [J1868]

"Comments on “Water Quality Retrievals From Combined Landsat TM Data and ERS-2 SAR Data in the Gulf of Finland”"

A paper by Zhang, using a feedforward artificial neural network (ANN) for water quality retrievals from combined Thematic Mapper data and synthetic aperture radar data in the Gulf of Finland, has been published in this journal. This correspondence attempts to discuss and comment on the paper by Zhang The amount of data used in the paper by Zhang is not enough to determine the number of fitting parameters in the networks. Therefore, the models are not mathematically sound or justified. The conclusion is that ANN modeling should be used with care and enough data [J1869]

"Conceptual Case for Assimilating Interferometric Synthetic Aperture Radar Data Into the HAZUS-MH Earthquake Module"

The study of the Earth as a system is being adopted widely by geoscientists. Numerical models and simulations are providing the capability to rapidly test hypotheses and make forecasts of complex geophysical behavior. International efforts are seeking to integrate existing and emerging Earth observation systems into a global network, with enhanced data distribution, models, and decision support tools. Remote sensing is poised to fulfil the increasing need for a synoptic framework. However, the desire to improve the connection between scientific research and societal benefits has not been matched with resources and tools required to bridge the gap between research and applications. Natural hazards research and disaster management are a prime example. Here, we present a conceptual case for how interferometric synthetic aperture radar (InSAR) data could make a definitive contribution to understanding earthquake processes while simultaneously supporting policy- and decision-making. InSAR measurements derived from time series of radar observations from Earth orbit uniquely can provide geographically comprehensive maps of surface deformation. Observing system simulations are suggested to evaluate the potential contributions of a future system. Simulations would adopt an open seismic hazard analysis (SHA) framework, OpenSHA, recognizing the need for more physics-based modeling and computational infrastructure. SHA is employed by the HAZUS-MH earthquake module to estimate losses. InSAR measurements of strain accumulation would provide event magnitude recurrence bounds for probabilistic SHA, while coseismic InSAR measurements would add constraints on fault rupture models for deterministic approaches. Moreover, interferograms would be incorporated graphically as proxy seismic risk maps for planning and mitigation [J1870]

"Semcad X Jungfrau Marks the Spot (The Hot Spot)"

Presents a review of Semcad X Jungfrau, a program for simulating electromagnetic fields around the sources of radio-frequency (RF) energy. [J1871]

"Non-parametric techniques for the estimation of spatial spectra in non-stationary environments"

A novel approach to the problem of estimating a spatial spectrum in a non-stationary environment has been presented. The approach adopted relies on the same principle as that which underpins the Wigner distribution. The proposed methodology results in the construction of a new sufficient statistic that can be used in conjunction with a variety of existing array-processing techniques. The resulting schemes are shown to be robust to source motions. Some of the limitations of this approach have been discussed and how they can be overcome is demonstrated. [J1872]

"High-Resolution Estimation of Ranges Using Multiple-Frequency CW Radar"

The problem of ranging multiple vehicles traveling at similar speeds using multiple-frequency continuous-wave (CW) radar is considered. A new method based on the compensation of vehicle movement and MUSIC-based time delay estimator is presented. The method is tested using a commercially available multiple-frequency CW radar sensor in real traffic situations. Test results show that the proposed method makes it possible to estimate the positions of two vehicles moving at similar speeds. Test results also demonstrate that under a given

bandwidth, the multiple-frequency CW radar can provide about ten times higher resolution as compared with the coherent spread spectrum radar [J1873]

"How to See the Unseen City"

This paper presents different methods and equipments used on how to inspect underground infrastructures, networks, sewers, and pipes in some cities around the world. In New York, underground pipes are inspected using an electronic listening equipment as its first line of defense. Maintenance workers dangle a microphone down a manhole and attach it to a water main to assess whether flow has been disturbed by a leak. More detailed checks are conducted from within a pipe, using what is essentially a video camera on wheels. In pipeline lingo, such tools are quirkily known as smart pigs. In addition to capturing a digital video, a pig can perform radar and sonar scans above and below a water line, searching for indentations and holes in the walls as it rolls down in a pipe. It records its locations with odometer wheels and may be equipped with magnetic sensors to check for aberrations in metal pipes. On the other hand, Japan is the exception on the geospatial-information services front, with a national mapping repository known as ROADIC. This underground mapping system consists of utility grids layered over a road map that utilities and builders consult before breaking ground. [J1874]

"Vibration and Rotation in Millimeter-Wave SAR"

Synthetic aperture radar (SAR) provides high-resolution images of static ground scenes, whereas processing of data containing ground object motion results in varying focusing effects. Special cases of such motion are vibration and rotation, which are closely related to each other. Their patterns may be distinctly recognizable in focused SAR intensity images as well as in a time-frequency analysis. Millimeter-wave (mmW) SAR is well suited to image vibration because its wavelength is close to typical vibration amplitudes. Through a thorough motion analysis in a standard SAR system model, we show the effects of rotation and vibration in mmW SAR theoretically and in simulated and real data [J1875]

"Application of DInSAR-GPS Optimization for Derivation of Fine-Scale Surface Motion Maps of Southern California"

A method based on random field theory and Gibbs-Markov random fields equivalency within Bayesian statistical framework is used to derive 3-D surface motion maps from sparse global positioning system (GPS) measurements and differential interferometric synthetic aperture radar (DInSAR) interferogram in the southern California region. The minimization of the Gibbs energy function is performed analytically, which is possible in the case when neighboring pixels are considered independent. The problem is well posed and the solution is unique and stable and not biased by the continuity condition. The technique produces a 3-D field containing estimates of surface motion on the spatial scale of the DInSAR image, over a given time period, complete with error estimates. Significant improvement in the accuracy of the vertical component and moderate improvement in the accuracy of the horizontal components of velocity are achieved in comparison with the GPS data alone. The method can be expanded to account for other available data sets, such as additional interferograms, lidar, or leveling data, in order to achieve even higher accuracy [J1876]

"SAR Polarimetry to Observe Oil Spills"

A study on sea oil spill observation by means of polarimetric synthetic aperture radar (SAR) data is accomplished. It is based on the use of a polarimetric constant false alarm rate filter to detect dark patches over SAR images. Then, the target decomposition theorem is exploited to distinguish oil spills and look-alikes. Experiments are conducted on polarimetric SAR data acquired during the SIR-C/X-SAR mission on October 1994. The data were processed and calibrated at the Jet Propulsion Laboratory, National Aeronautics and Space Administration. Results show that the new polarimetric approach is able to assist classification [J1877]

"Systems Engineering Analysis of a TRMM PR-Like Rainfall Retrieval Algorithm"

Systems engineering constitutes a group of processes and methods to design and implement a system for optimal performance given limited time, technology, or resources. As with any system, it is important to understand which subcomponents are most important and which are less important so that appropriate resource allocations may be made. An example of a complex system is the Tropical Rainfall Measuring Mission (TRMM). Its subsystems include the satellite vehicle, the precipitation radar (PR), the ground validation system, and the retrieval algorithms. Each of these subsystems contributes to the overall success of the mission. Sensitivity analysis (SA) is a method whereby the output response from a model can be linked back to the variability in the input parameters. This paper describes a method of performing SA on a TRMM PR-like (TL) rainfall retrieval algorithm (based on the TRMM 2A25 algorithm) to better describe how the uncertainty in the model output can

be apportioned to the uncertainty in the input factors and gain greater understanding as to the relative importance of each factor. For example, assuming a model with several input factors, if one factor is found to be the dominating cause of model error, and the others contribute relatively little, then resources can be devoted to improving the accuracy of one factor, thereby improving the overall model accuracy. This paper is based on global SA using a variance decomposition technique. Analyses are done and results are presented for factor importance for cases over both ocean and land. Results for the simple TL algorithm considered in this paper show that at low rain rate, the a and b coefficients in the R=aZebrelationship contribute the greatest amount to the output variance. At higher rain rates, above about 8 mm/h, the error from Deltasigmadeg is the greatest contributor to error in algorithm output [J1878]

"Irreducible Polynomials Which Divide Trinomials Over GF (2)"

The simplest linear shift registers to generate binary sequences involve only two taps, which corresponds to a trinomial over GF(2). It is therefore of interest to know which irreducible polynomials f(x) divide trinomials over GF(2), since the output sequences corresponding to f(x) can be obtained from a two-tap linear feedback shift register (with a suitable initial state) if and only if f(x) divides some trinomial t(x)=xm+xa+1 over GF(2). In this paper, we develop the theory of which irreducible polynomials do, or do not, divide trinomials over GF(2). Then some related problems such as Artin's conjecture about primitive roots, and the conjectures of Blake, Gao, and Lambert, as well as of Tromp, Zhang, and Zhao are discussed [J1879]

"Contourlet-based image denoising algorithm using directional windows"

Contourlet is a new effective signal representation tool in many image applications. Proposed is a contourlet-based image denoising algorithm using directional windows which takes advantage of the captured directional information of the images. Experiments show that the proposed algorithm achieves better performance than other contourlet-based image denoising algorithms [J1880]

"Geometrical Variations of Gain Patterns"

This paper studies the effect of the altitude and the elliptical nature of the Earth on projected antenna pattern functions (APFs). These variations can play a significant role in spatial filter algorithms, such as the Backus-Gilbert method. In this paper, a solution for projecting an APF from an arbitrary sensor and platform onto an elliptical Earth is presented. A general time integration of this projection is presented, which is important for dynamically generating the effective antenna pattern functions (EAPFs) in cases where the variations are nonnegligible. It is shown that the elliptical nature of the Earth provides a variation of order 1% in the area of the EAPF. These results suggest that approximating the Earth as a sphere is valid. It is also shown that elliptical orbits should consider the implication of the altitude variation before precomputing EAPFs [J1881]

"A Fusion Scheme for Joint Retrieval of Urban Height Map and Classification From High-Resolution Interferometric SAR Images"

The retrieval of 3-D surface models of the Earth is a major issue of remote sensing. Some nice results have already been obtained at medium resolution with optical and radar imaging sensors. For instance, missions such as the Shuttle Radar Topography Mission (SRTM) or the SPOT HRS have provided accurate digital terrain models. The computation of a digital surface model (DSM) over urban areas is the new challenging issue. Since the recent improvements in radar image resolution, synthetic aperture radar (SAR) interferometry, which had already proved its efficiency at low resolution, has provided an accurate tool for urban 3-D monitoring. However, the complexity of urban areas and high-resolution SAR images prevents the straightforward computation of an accurate DSM. In this paper, an original high-level processing chain is proposed to solve this problem, and some results on real data are discussed. The processing chain includes three main steps, namely: (1) information extraction; (2) fusion; and (3) correction. Our main contribution addresses the merging step, where we aim at retrieving both a classification and a DSM while imposing minimal constraint on the building shapes. The joint derivation of height and class enables the introduction of more contextual information. As a consequence, more flexibility toward scene architecture is possible. First, the initial images (interferogram, amplitude, and coherence images) are converted into higher-level information mapping with different approaches (filtering, object recognition, or global classification). Second, these new images are merged into a Markovian framework to jointly retrieve an improved classification and a height map. Third, DSM and classification are improved by computing layover and shadow from the estimated DSM. Comparison between shadow/layover and classification allows some corrections. This paper mainly addresses the second step, while the two others are briefly explained and referred to already publis- hed papers. The results obtained on real images are compared to ground truth and indicate a very good accuracy in spite of limited image resolution. The major limit of DSM computation remains the initial spatial and altimetric resolutions that need to be made more precise [J1882]

"Adding Sensitivity to the MLBF Doppler Centroid Estimator"

The multilook beat frequency (MLBF) algorithm is the Doppler centroid estimator most commonly used in practice to solve the Doppler ambiguity. However, it still makes errors, notably in medium- or low-contrast scenes. In this paper, we present two ways in which the estimation sensitivity of the MLBF algorithm can be improved. First, we give a more thorough frequency-domain explanation of how the MLBF algorithm works and explain how cross beating and range migration cause estimation difficulties. The first improvement to the algorithm replaces the fast Fourier transform (FFT)-based beat frequency estimator with a more accurate one that uses phase increments. It avoids the FFT limitations of resolution and quantization, especially when the signal is discontinuous in one range cell due to range cell migration or burst mode operation (ScanSAR). A second improvement uses range cell migration correction to straighten the target trajectories before the beat frequency estimator is applied. This has the effect of narrowing the bandwidth of the beat signal and reducing the effect of cross beating. Finally, experiments with RADARSAT-1 data are used to illustrate the improved estimation accuracy of the modified algorithm [J1883]

"Depolarization, Scattering, and Attenuation of Circularly Polarized Radio Waves by Spherically Asymmetric Melting Ice Particles"

The eccentric spheres model and an extended Mie solution are used to formulate scattering of a plane, electromagnetic wave by a single melting ice particle as well as by a horizontal layer of such particles. The incident wave is left-hand circularly polarized, whereas the scattered wave, as a result of depolarization by the spherically asymmetric particles, comprises left-hand and right-hand circularly polarized components. The Stokes parameters of the scattered wave are calculated throughout the melting process. Furthermore, radar observables of backscattering and depolarization, as well as the specific attenuation, across the melting layer are calculated. The numerical application manifests how the internal spherical asymmetry of melting ice particles is imprinted on backscattering, forward scattering, and depolarization. Moreover, it is shown how each part of the melting layer contributes to the attenuation and depolarization of the radio waves crossing that layer [J1884]

"Analysis of the Backscattering Coefficient of Salt-Affected Soils Using Modeling and RADARSAT-1 SAR Data"

Salt significantly changes the backscattering coefficient of wet soil. This is easily observed on RADARSAT-1 synthetic aperture radar (SAR) images acquired over a salty depression located in the Egyptian desert. The aim of this paper is to use backscattering models to understand the behavior of the backscattering coefficient over salt-affected soils and to evaluate the possibility of monitoring the salt content. Simulations conducted over salt-affected soils show a lower sensitivity of these models to soil moisture compared to nonaffected soils. Besides, there is no model suitable to represent the variation of the backscattering coefficient due to changes in soil salinity. These results are discussed with regard to the magnitude of the two components of the dielectric constant (epsiv' and epsiv''). Based on a series of relationships, we propose a parametric formulation that allows us to determine the salinity acting on RADARSAT-1 SAR images without any use of backscattering models [J1885]

"Precision and Accuracy of Satellite Radar and Laser Altimeter Data Over the Continental Ice Sheets"

The unprecedented accuracy of elevations retrieved from the Ice Cloud and Land Elevation Satellite (ICESat) laser altimeter is investigated and used to characterize the range errors in the Environmental Satellite (Envisat) and European Remote Sensing 2 Satellite (ERS-2) radar altimeters over the continental ice sheets. Cross-mission crossover analysis between time-coincident ERS-2-, Envisat-, and ICESat-retrieved elevations and comparisons to an ICESat-derived digital elevation map are used to quantify the radar elevation error budget as a function of surface slope and to investigate the effectiveness of a method to account for the radar altimeter slope-induced error. The precision and accuracy of the elevations retrieved from the ICESat Geoscience Laser Altimeter System and the European Space Agency radar altimeters on ERS-2 and Envisat are calculated over the Greenland and Antarctic ice sheets using a crossover analysis. As a result of this work, the laser precision is found to vary as a function of surface slope from 14 to 59 cm, and the radar precision varies from 59 cm to 3.7 m for ERS-2 and from 28 cm to 2.06 m for Envisat. Envisat elevation retrievals when compared with ICESat results over regions with less than 0.1deg surface slopes show a mean difference of 9plusmn5 cm for Greenland and -40plusmn98 cm over Antarctica. ERS-2 elevation retrievals over these same low surface slope regions differ from ICESat results by -56plusmn72 cm over Greenland and 1.12plusmn1.16 m over Antarctica. At higher surface slopes of 0.7deg to 0.8deg, the Envisat/ICESat differences increase to -2.27plusmn23 m over Greenland and to 0.05plusmn26 m over Antarctica [J1886]

"Decision Fusion of Ground-Penetrating Radar and Metal Detector Algorithms—A Robust Approach"

Numerous detection algorithms, using various sensor modalities, have been developed for the detection of mines in cluttered and noisy backgrounds. The performance for each detection algorithm is typically reported in terms of the receiver operating characteristic (ROC), which is a plot of the probability of detection versus false alarm as a function of the threshold setting on the output decision variable of each algorithm. In this paper, we present multisensor decision-fusion algorithms that combine the local decisions of existing detection algorithms for different sensors. This offers an expedient, attractive, and much simpler alternative to the design of an algorithm that fuses multiple sensors at the data level, especially in cases of limited training data where it is difficult to make accurate estimates of multidimensional probability density functions. The goal of our multisensor decision-fusion approach is to exploit the complimentary strengths of existing multisensor algorithms so as to achieve performance (ROC) that exceeds the performance of any sensor algorithm operating in isolation. Our approach to multisensor decision fusion is based on the optimal signal detection theory using the likelihood ratio. We consider the optimal fusion of local decisions for two sensors: a ground-penetrating radar and a metal detector. A new robust algorithm for decision fusion that addresses the problem in which the statistics of the training data are not likely to exactly match the statistics of the test data is presented. ROCs are presented and compared for field data [J1887]

"On the Extension of Multidimensional Speckle Noise Model From Single-Look to Multilook SAR Imagery"

Speckle noise represents one of the major problems when synthetic aperture radar (SAR) data are considered. Despite the fact that speckle is caused by the scattering process itself, it must be considered as a noise source due to the complexity of the scattering process. The presence of speckle makes data interpretation difficult, but it also affects the quantitative retrieval of physical parameters. In the case of one-dimensional SAR systems, speckle is completely determined by a multiplicative noise component. Nevertheless, for multidimensional SAR systems, speckle results from the combination of multiplicative and additive noise components. This model has been first developed for single-look data. The objective of this paper is to extend the single-look data model to define a multilook multidimensional speckle noise model. The asymptotic analysis of this extension, for a large number of averaged samples, is also considered to assess the model properties. Details and validation of the multilook multidimensional speckle noise model are provided both theoretically and by means of experimental SAR data acquired by the experimental synthetic aperture radar system, operated by the German Aerospace Center [J1888]

"Electromagnetic Scattering From Multilayer Rough Surfaces With Arbitrary Dielectric Profiles for Remote Sensing of Subsurface Soil Moisture"

Radar remote sensing of soil moisture content at low frequencies requires an accurate scattering model of realistic soils, which often involves multilayer rough surfaces and dielectric profiles. In this paper, a hybrid analytical/numerical solution to two-dimensional scattering from multilayer rough surfaces separated by arbitrary dielectric profiles based on the extended boundary condition method (EBCM) and scattering matrix technique is presented. The reflection and transmission matrices of rough interfaces are constructed using EBCM. The dielectric profiles are modeled as stacks of piecewise homogeneous dielectric thin layers, whose scattering matrices are computed by recursively cascading reflection and transmission matrices of individual dielectric interfaces. The interactions between the rough interfaces and stratified dielectric profiles are taken into account by applying the generalized scattering matrix technique. The scattering coefficients are obtained by combining the powers computed from the resulting Floquet modes of the overall system. The bistatic scattering coefficients are validated against existing analytical and numerical solutions. Field-collected soil moisture data are then used for numerical simulations to investigate the penetration capability at different frequencies and to address the potential of low-frequency radar systems in estimating deep soil moisture. In particular, soil moisture profiles during dry ground, wet ground, and wet subsurface layer conditions are examined. The results show that both backscattering coefficients and copolarized phase difference at low frequencies are sensitive to the roughness of subsurface interfaces and deep soil moisture. Also, much larger depth sensitivity can be achieved using copolarized phase difference than scattering coefficients [J1889]

"Optimizing the Area Under a Receiver Operating Characteristic Curve With Application to Landmine Detection"

A common approach to training neural network classifiers in a supervised learning setting is to minimize the mean-square error (mse) between the network output for each labeled training sample and some desired output. In the context of landmine detection and discrimination, although the performance of an algorithm is correlated

with the mse, it is ultimately evaluated by using receiver operating characteristic (ROC) curves. In general, the larger the area under the ROC curve (AUC), the better. We present a new method for maximizing the AUC. Desirable properties of the proposed algorithm are derived and discussed that differentiate it from previously proposed algorithms. A hypothesis test is used to compare the proposed algorithm to an existing algorithm. The false alarm rate achieved by the proposed algorithm is found to be less than that of the existing algorithm with 95% confidence [J1890]

"Improved Multiple Target Tracking via Global Motion Compensation and Optoelectronic Correlation"

Camera motion estimation in image sequences generally focuses on the recovery of the frames when the camera is mounted on a moving platform. Global motion in video sequences is more complex and involves camera operation, camera motion, and other nontarget motions. Global motion compensation is usually handled by compensating the dominant motion using estimation and segmentation techniques. To enhance tracker performance and accuracy, frame recovery operation plays a crucial role by estimating undesired motion. In this paper, a normalized correlation-based regional template-matching (TM) algorithm has been developed to accurately recover frames before the application of the tracking algorithm. Then, a robust multiple-target-tracking system has been developed using a combination of fringe-adjusted joint transform correlator and TM techniques. Joint transform correlation detects a target optoelectronically, while TM technique is performed digitally. To increase the tracking system speed and decrease the effects of clutter, a subframe segmentation and local deviation-based image-preprocessing algorithm has been proposed. The improved performance of multiple-target-tracking system is tested using real-life forward-looking infrared (IR) imagery video sequences obtained from IR sensors mounted on an airborne platform [J1891]

"Effective Solution of 3-D Scattering Problems via Series Expansions: Applicability and a New Hybrid Scheme"

Accurate and reliable evaluation of the electromagnetic field scattered by dielectric objects is a canonical problem in the electromagnetic community. In the framework of integral equation formulations, iterative techniques, and in particular conjugate gradient (CG) schemes, are widely used. However, when the number of parameters grows, CG techniques may become too demanding from a computational point of view. In this paper, we show that many forward scattering problems can be conveniently solved by means of very simple series expansions, which allow a lower computational complexity and memory storage with respect to other iterative schemes. In particular, we consider three different series expansions, namely: 1) the traditional Born series; 2) the contrast source-extended Born series, which is recently introduced by rewriting the traditional source-type integral equations; and 3) a new series, which is a hybridization of the previous ones. Theoretical conditions for the applicability of the series expansions are discussed, and practical tools to foresee that a problem can be solved by means of these simple iterative schemes are provided. Numerical examples are reported for the sake of comparison and to assess performance [J1892]

"Statistical Analysis of High-Resolution SAR Ground Clutter Data"

This paper deals with the problem of modeling high-resolution synthetic aperture radar clutter data from different vegetated areas. We analyzed moving and stationary target recognition (MSTAR) data sets focusing on histograms, moments, and covariance of clutter amplitude, texture, and speckle. The most celebrated statistical models are tested on real data of grass field or wood and trees to validate the goodness of fit of the compound Gaussian model in different scenarios. The results demonstrate that for grass fields, the compound Gaussian model provides a good data fitting. This is not the case for woods images where the speckle is not more Gaussian distributed. Covariance analysis and concluding remarks complete this paper [J1893]

"On the Reduction of the Reconstruction Bias in Synthetic Aperture Imaging Radiometry"

Synthetic aperture imaging radiometers (SAIRs) are powerful instruments for high-resolution observation of planetary surfaces at low microwave frequencies. This paper is concerned with the reconstruction of radiometric brightness temperature maps from SAIR interferometric measurements. Even in the absence of modeling errors and radiometric noise, a systematic error, or bias, has been observed in the reconstructed maps. The origin of this bias is analyzed and an efficient solution is proposed for reducing it. The core reconstruction procedure is not changed, and no additional measurements are needed. Throughout the scientific rationale, particular emphasis is laid on numerical simulations carried out for the Soil Moisture and Ocean Salinity space mission, a project led by the European Space Agency and devoted to the remote sensing of soil moisture and ocean salinity from a low-orbit platform [J1894]

"Spheroidal Mode Approach for the Characterization of Metallic Objects Using Electromagnetic Induction"

We propose a spheroidal mode approach to characterize the electromagnetic induction (EMI) response of buried objects, assumed to be much more conductive than their environment. Both the excitation and the response are formulated as the linear superpositions of basic spheroidal modes. The scattering coefficients characterize objects, regardless of their geometrical complexity and material inhomogeneity, due to the orthogonality of the spheroidal modes. The ill-conditioning encountered in retrieving the scattering coefficients is dealt with by mode truncation and Tikhonov regularization. The approach is tested for both simulated and measured data, and the retrieval results show encouragingly that only few excitation and response modes effectively represent the EMI response of the objects. The proposed approach is therefore promising in the detection and classification of buried objects [J1895]

"Filtering Soil Surface and Antenna Effects From GPR Data to Enhance Landmine Detection"

The detection of antipersonnel landmines using ground-penetrating radar (GPR) is particularly hindered by the predominant soil surface and antenna reflections. In this paper, we propose a novel approach to filter out these effects from 2-D off-ground monostatic GPR data by adapting and combining the radar antenna subsurface model of Lambot with phase-shift migration. First, the antenna multiple reflections originating from the antenna itself and from the interaction between the antenna and the ground are removed using linear transfer functions. Second, a simulated Green's function accounting for the surface reflection is subtracted. The Green's function is derived from the estimated soil surface dielectric permittivity using full-wave inversion of the radar signal for a measurement taken in a local landmine-free area. Third, off-ground phase-shift migration is performed on the 2-D data to filter the effect of the antenna radiation pattern. We validate the approach in laboratory conditions for four differently detectable landmines embedded in a sandy soil. Compared to traditional background subtraction, this new filtering method permits a better differentiation of the landmine and estimation of its depth and geometrical properties. This is particularly beneficial for the detection of landmines in low-contrast conditions [J1896]

"A C-Band Wind/Rain Backscatter Model"

With the confirmed evidence of rain surface perturbation in recent studies, the rain effects on C-band scatterometer measurements are reevaluated. By using colocated Tropical Rainfall Measuring Mission Precipitation Radar, ESCAT on European Remote Sensing Satellites, and European Centre for Medium-Range Weather Forecasts data, we evaluate the sensitivity of C-band sigmadeg to rain. We develop a low-order wind/rain backscatter model with inputs of surface rain rate, incidence angle, wind speed, wind direction, and azimuth angle. We demonstrate that the wind/rain backscatter model is accurate enough for describing the total backscatter in raining areas with relatively low variance. We also show that the rain surface perturbation is a dominating factor of the rain-induced backscatter. Using three distinct regimes, we show under what conditions the wind, rain, and both wind and rain can be retrieved from the measurements. We find that the effect of rain has a more significant impact on the measurements at high incidence angles than at low incidence angles [J1897]

"A Joint Image Coregistration, Phase Noise Suppression, and Phase Unwrapping Method Based on Subspace Projection for Multibaseline InSAR Systems"

As is well known, image coregistration, interferometric phase noise suppression, and phase unwrapping are three key processing procedures of synthetic aperture radar interferometry (InSAR). The three procedures are cascaded in the conventional processing flow of InSAR. Unlike the conventional processing flow, in this paper we propose a joint processing idea to carry out image coregistration, interferometric phase noise filtering, and phase unwrapping simultaneously based on subspace projection for multibaseline InSAR systems. The joint processing method can perform the fine coregistration of all SAR images implicitly by extracting the correlation information in the neighboring pixel sets, suppress the phase noise by utilizing the orthogonality of the signal subspace and the corresponding noise subspace, and optimally estimate the unwrapped interferometric phases (or the terrain heights) by combining the pixel coherence and the baseline diversity of a multibaseline InSAR system. Simulated results are presented to verify the effectiveness of the joint processing method [J1898]

"Bistatic Linear Antenna Array SAR for Moving Target Detection, Location, and Imaging With Two Passive Airborne Radars"

In this paper, we propose a bistatic linear array synthetic aperture radar (BLA-SAR) system for moving target detection, location, and imaging. In the BLA-SAR system, a geostationary satellite is used as a transmitter, and

two airborne linear array radars are used as passive receivers, where the transmitted waveforms from the geostationary satellite may have two different carrier frequencies, two linear array antennas on two different airplanes may be equipped with different spacings, or two airplanes may fly with two different velocities. It is shown that, using the BLA-SAR, not only the stationary clutter can be suppressed but also locations of both slow and fast moving targets can be accurately estimated. Furthermore, an effective BLA-SAR algorithm of moving target imaging is also proposed. Lastly, some numerical experiments are given to demonstrate the effectiveness of the BLA-SAR [J1899]

"Matrix-Group Algorithm via Improved Whitening Process for Extracting Statistically Independent Sources From Array Signals"

This paper addresses the problem of blind separation of multiple independent sources from observed array output signals. The main contributions in this paper include an improved whitening scheme for estimation of signal subspace, a novel biquadratic contrast function for extraction of independent sources, and an efficient alterative method for joint implementation of a set of approximate diagonalization-structural matrices. Specifically, an improved whitening scheme is first developed by estimating the signal subspace jointly from a set of diagonalization-structural matrices based on the proposed cyclic maximizer of an interesting cost function. Moreover, the globally asymptotical convergence of the proposed cyclic maximizer is analyzed and proved. Next, a novel biquadratic contrast function is proposed for extracting one single independent component from a slice matrix group of any order cumulant of the array signals in the presence of temporally white noise. A fast fixed-point algorithm that is a cyclic minimizer is constructed for searching a minimum point of the proposed contrast function. The globally asymptotical convergence of the proposed fixed-point algorithm is analyzed. Then, multiple independent components are obtained by using repeatedly the proposed fixed-point algorithm for extracting one single independent component, and the orthogonality among them is achieved by the well-known QR factorization. The performance of the proposed algorithms is illustrated by simulation results and is compared with three related blind source separation algorithms [J1900]

"A Variance Equality Test for Two Correlated Complex Gaussian Variables With Application to Spectral Power Comparison"

Complex-valued Gaussian distributions occur frequently in signal processing. We derive a simple statistic, independent of any complex-valued correlation, for testing for the equality of variances using a sample drawn from such a bivariate distribution. The percentage points of the distribution are easy to compute. The power of the test is determined and shown to be high even for very small sample sizes when the variables are highly correlated. The new test is used to determine whether the spectral power associated with an ultralow-frequency wave in the solar magnetic field is equal at two different observing spacecraft [J1901]

"Optical Summation of RF Signals"

We present two concepts dedicated to the optical summation of RF signals for radar applications. The first technique relies on a photodiode simultaneously illuminated on its top and back sides. We experimentally demonstrate the summation of two signals covering the whole 25-GHz photodiode bandwidth with amplitude and phase errors below plusmn1dB and plusmn4deg, respectively. The heterodyne beating noise, which occurs in this type of summation device, is also discussed. The second technique is based on a traveling-wave detector array. We experimentally demonstrates the summation of four signals in the whole 25-GHz photodiodes bandwidth. However, the "summation bandwidth" is limited to 10 GHz due to amplitude and phase errors [J1902]

"Phase Unwrapping via Graph Cuts"

Phase unwrapping is the inference of absolute phase from modulo-2pi phase. This paper introduces a new energy minimization framework for phase unwrapping. The considered objective functions are first-order Markov random fields. We provide an exact energy minimization algorithm, whenever the corresponding clique potentials are convex, namely for the phase unwrapping classical Lpnorm, with pges1. Its complexity is KT(n,3n), where K is the length of the absolute phase domain measured in 2pi units and T(n,m) is the complexity of a max-flow computation in a graph with n nodes and m edges. For nonconvex clique potentials, often used owing to their discontinuity preserving ability, we face an NP-hard problem for which we devise an approximate solution. Both algorithms solve integer optimization problems by computing a sequence of binary optimizations, each one solved by graph cut techniques. Accordingly, we name the two algorithms PUMA, for phase unwrapping max-flow/min-cut. A set of experimental results illustrates the effectiveness of the proposed approach and its competitiveness in comparison with state-of-the-art phase unwrapping algorithms [J1903]

"Eigenvector-Based N-D Frequency Estimation From Sample Covariance Matrix"

We propose an algebraic approach for N-D frequency estimation using the eigenvectors of a matrix pencil constructed from the signal subspace of the data sample covariance matrix. Unlike existing eigenvalue-based methods, the proposed algorithm achieves automatic frequency pairing without using joint diagonalization; thus, the computational complexity is reduced. The proposed algorithm remains operational in the presence of identical frequencies in one or more dimensions due to the introduction of weighting factors when constructing the matrix pencil. We also derive the theoretic variance of the estimation error and show that the proposed algorithm is a consistent one [J1904]

"Low-Frequency Dosimetry of Inhomogeneous Magnetic Fields Using the Coil Source Model and the Household Appliance"

In this paper, the magnetic field properties and the dosimetry at ELF (50 Hz) are investigated using a coil model, which is prescribed in the European standard EN50366 (CENELEC) as a substitute source model for real household appliances. The accuracy of magnetic field vectors and values of the induced current density, which is achieved with the coil model, were compared with the results of two test appliances (a drilling machine and a hand mixer) obtained from the equivalent source model. It was demonstrated that the magnetic fields obtained (dominant component and strength) using the coil model and the real appliance show an agreement with each other with a maximum difference of 5 dB. The calculated induced current densities in the numerical human body models (homogeneous and anatomical body models) and the real appliances also show a good agreement with each other with a maximum difference by a factor of 1.6 (by the anatomical body model). Furthermore, the values of both field vectors and induced current density values calculated using the coil model were shown to be higher than those calculated in the case of the real appliances. Based on these results, the applicability of the coil model prescribed in EN50366 confirms that of the two applied test appliances [J1905]

"Range Resampling in the Polar Format Algorithm for Spotlight SAR Image Formation Using the Chirp z -Transform"

Besides an inverse two-dimensional (2-D) Fourier transform, the polar format algorithm (PFA) for the spotlight synthetic aperture radar (SAR) image formation can be normally divided into two cascaded processing stages, which are called the range and azimuth resampling, respectively. This paper focuses on a new implementation of the first stage, i.e., the range resampling, using the chirp z-transform (CZT). The presented algorithm requires no interpolation. It works for the SAR system directly digitizing the echo signal, as well as that employing the dechirp-on-receive approach. The parameters of the CZT, including the frequency spacing and the start frequency, are derived to accommodate the PFA in both cases. Related filtering and compensation procedures are developed for the chirp z-transformed range signal with and without dechirp, respectively, in order to achieve a signal format entirely suitable for the azimuth resampling. Furthermore, incorporating the new algorithm with the existing CZT-based azimuth resampling and focusing algorithm, we can achieve a PFA totally free of interpolation. The presented approach has been validated by point target simulation, and the test is carried out with a very critical relative bandwidth of 30% [J1906]

"Time Delay Estimation via Minimum Entropy"

Time delay estimation (TDE) is a basic technique for numerous applications where there is a need to localize and track a radiating source. The most important TDE algorithms for two sensors are based on the generalized cross-correlation (GCC) method. These algorithms perform reasonably well when reverberation or noise is not too high. In an earlier study by the authors, a more sophisticated approach was proposed. It employs more sensors and takes advantage of their delay redundancy to improve the precision of the time difference of arrival (TDOA) estimate between the first two sensors. The approach is based on the multichannel cross-correlation coefficient (MCCC) and was found more robust to noise and reverberation. In this letter, we show that this approach can also be developed on a basis of joint entropy. For Gaussian signals, we show that, in the search of the TDOA estimate, maximizing MCCC is equivalent to minimizing joint entropy. However, with the generalization of the idea to non-Gaussian signals (e.g., speech), the joint entropy-based new TDE algorithm manifests a potential to outperform the MCCC-based method [J1907]

"Time-Resolved Temperature Measurement of AlGaN/GaN Electronic Devices Using Micro-Raman Spectroscopy"

We report on the development of time-resolved Raman thermography to measure transient temperatures in semiconductor devices with submicrometer spatial resolution. This new technique is illustrated for AlGaN/GaN HFETs and ungated devices grown on SiC and sapphire substrates. A temporal resolution of 200 ns is demonstrated. Temperature changes rapidly within sub-200 ns after switching the devices on or off, followed by a slower change in device temperature with a time constant of ~10 and ~140 mus for AlGaN/GaN devices

grown on SiC and sapphire substrates, respectively. Heat diffusion into the device substrate is also demonstrated [J1908]

"Estimating Snow Accumulation From InSAR Correlation Observations"

Snow accumulation in remote regions, such as Greenland and Antarctica, is a key factor for estimating the Earth's ice mass balance. In situdata are sparse; hence, they are useful to derive snow accumulation from remote sensing observations, such as microwave thermal emission and radar brightness. These data are usually interpreted using electromagnetic models in which volume scattering is the dominant mechanism. The main limitation of this approach is that microwave brightness is not well related to backscatter if the ice sheet is layered. Because larger grain size and thicker annual layers both increase radar image brightness, with the first corresponding to lower accumulation rate and the second to higher accumulation rate, models of radar brightness alone cannot accurately reflect accumulation. Consideration of correlation measurements can also resolve this ambiguity. We introduce an interferometric ice scattering model that relates the interferometric synthetic aperture radar correlation and radar brightness to both ice grain size and hoar layer spacing in the dry-snow zone of Greenland. We use this model and the European Remote Sensing satellite radar observations to derive several parameters related to snow accumulation rates in a small area in the dry-snow zone. These parameters show agreement with four in situcore accumulation rate measurements in this area, whereas models using only radar brightness data do not match the observed variation in accumulation rates [J1909]

"Theoretical Evaluation of Several Possible Along-Track InSAR Modes of TerraSAR-X for Ocean Current Measurements"

The German satellite TerraSAR-X, scheduled for launch in late 2006, will permit high-resolution ocean current measurements by along-track interferometric SAR (along-track InSAR) in various experimental modes of operation, using different sections of its X-band SAR antenna array with a total length of 4.8 m as individual receive antennas. Depending on antenna and receive-chain settings, effective InSAR time lags of about 0.17 to 0.29 ms can be realized in combination with different noise levels, single-look resolutions, swath widths, and incidence angles. We give an overview of the characteristics of the possible InSAR modes and evaluate their suitability for current measurements on the basis of simulated data products. Our results indicate that the quality of interferometric stripmap data from TerraSAR-X will be clearly superior to the quality of the existing data acquired over the Dutch coast during the Shuttle Radar Topography Mission; accurate current retrievals can be expected at effective spatial resolutions on the order of 500 m. However, in modes using a multiplexed single receive chain, the effective swath width of stripmap data will be limited to only 15 km, while dual receive-chain operation offers a swath width of 30 km for stripmap data and promises a reasonable data quality even for ScanSAR data with a maximum swath width of 100 km. Finally, we consider fundamental relations between along-track baseline, instrument noise, and resulting InSAR phase noise to discuss the potential for current measuring performance improvements of TerraSAR-X follow-on satellites [J1910]

"Integration of Ground-Penetrating Radar and Laser Position Sensors for Real-Time 3-D Data Fusion"

Full-resolution 3-D ground-penetrating radar (GPR) imaging of the near surface should be simple and efficient. Geoscientists, archeologists, and engineers need a tool capable of generating interpretable subsurface views at centimeter-to-meter resolution of field sites ranging from smooth parking lots to rugged terrain. The authors have integrated novel rotary laser positioning technology with GPR into such a 3-D imaging system. The laser positioning enables acquisition of centimeter accurate x, y, and z coordinates from multiple small detectors attached to moving GPR antennas. Positions streaming with 20 updates/s from each detector are fused in real time with the GPR data. The authors developed software for automated data acquisition and real time 3-D GPR data quality control on slices at selected depths. Industry standard (SEGY) format data cubes and animations are generated within an hour after the last trace has been acquired. Such instant 3-D GPR can be used as an on-site imaging tool supporting field work, hypothesis testing, and optimized excavation and sample collection in the exploration of the static and dynamic nature of the shallow subsurface [J1911]

"A GPS-Reflections Receiver That Computes Doppler/Delay Maps in Real Time"

This paper describes a new instrument that was specially designed and developed to gather Global Positioning System (GPS) signals after they have been reflected from suitable surfaces (sea, ice, and ground), for Earth remote sensing. The device has been called the GPS open-loop differential real-time receiver (GOLD-RTR). Its main and most innovative feature is its computation and storage, in real time, of complex-valued (I and Q) cross correlations (waveforms) between GPS L1-C/A signals-received directly and after reflection-and the corresponding models of these signals. Particularly, the GOLD-RTR schedules consecutive coherent integration

time slots of 1 ms over which ten parallel correlation channels, with 64 lags each, work simultaneously and continuously with the input raw data sampled at 40 MHz. The total throughput is 10 000 waveforms per second, each waveform being 64 lags long. These real-time correlation resources can be flexibly distributed in several configurations according to the observational requirements, for instance: Doppler/delay maps or up to ten simultaneous reflected waveforms for ten different GPS satellites are examples of what can be done. The further processing of the real-time computed 1-ms waveforms in a flight campaign over the ocean, ice, or ground can be used to obtain geophysical parameters such as sea level and tides, sea surface mean-square slopes, ice roughness and thickness, soil moisture and biomass, or future applications. This paper covers the GOLD-RTR architecture and hardware, signal processing and data storage issues, machine-user interface, laboratory readiness tests, and waveform data samples from the first two jet aircraft campaigns at 9300 m over the sea [J1912]

"A Two-Dimensional Bandwidth Extrapolation Technique for Polarimetric Synthetic Aperture Radar Images"

The resolution of a synthetic aperture radar (SAR) image, in range and azimuth, is determined by the transmitted bandwidth and the synthetic aperture length, respectively. Various superresolution techniques for improving resolution have been proposed, and we have proposed an algorithm that we call polarimetric bandwidth extrapolation (PBWE). To apply PBWE to a radar image, one needs to first apply PBWE in the range direction and then in the azimuth direction, or vice versa . In this paper, PBWE is further extended to the 2-D case. This extended case (2D-PBWE) utilizes a 2-D polarimetric linear prediction model and expands the spatial frequency bandwidth in range and azimuth directions simultaneously. The performance of the 2D-PBWE is shown through a simulated radar image and a real polarimetric SAR image [J1913]

"Target Scattering Decomposition in Terms of Roll-Invariant Target Parameters"

The Kennaugh-Huynen scattering matrix con-diagonalization is projected into the Pauli basis to derive a new scattering vector model for the representation of coherent target scattering. This model permits a polarization basis invariant representation of coherent target scattering in terms of five independent target parameters, the magnitude and phase of the symmetric scattering type introduced in this paper, and the maximum polarization parameters (orientation, helicity, and maximum return). The new scattering vector model served for the assessment of the Cloude-Pottier incoherent target decomposition. Whereas the Cloude-Pottier scattering type alpha and entropy H are roll invariant, beta and the so-called target-phase parameters do depend on the target orientation angle for asymmetric scattering. The scattering vector model is then used as the basis for the development of new coherent and incoherent target decompositions in terms of unique and roll-invariant target parameters. It is shown that both the phase and magnitude of the symmetric scattering type should be used for an unambiguous description of symmetric target scattering. Target helicity is required for the assessment of the symmetry-asymmetry nature of target scattering. The symmetric scattering type phase is shown to be very promising for wetland classification in particular, using polarimetric Convair-580 synthetic aperture radar data collected over the Ramsar Mer Bleue wetland site to the east of Ottawa, Ontario, Canada [J1914]

"Investigation of Time–Frequency Features for GPR Landmine Discrimination"

Ground-penetrating radar (GPR) is capable to detect plastic antipersonnel landmines as well as other subsurface targets. In order to reduce false alarms, an option of automatic landmine discrimination from neutral minelike targets would be very useful. This paper presents a possibility for such discrimination and analyzes it experimentally. The authors investigate time-frequency features of an ultrawideband (UWB) target response for the discrimination between buried landmines and other objects. The discrimination method includes the extraction of an early-time target impulse response, its time-frequency transformation, and the extraction of time-frequency features based on a singular value decomposition of the transformed image. In order to take into account the changes in the UWB target signals, the experimental conditions are completely controlled to focus on the behavior of the target's response with respect to its depth and the horizontal position of the GPR above it. The dependence of the features on the GPR bandwidth is analyzed as well. The Mahalanobis distance is used as a criterion for optimal discrimination. The obtained results define the best features and conditions when the landmine discrimination is successful. For comparison, the discriminant power of the proposed features has been tested on a dataset, acquired during a field campaign in Angola [J1915]

"Accurate Imaging of Multicomponent GPR Data Based on Exact Radiation Patterns"

Scalar migration algorithms developed for three-dimensional seismic data are commonly used for imaging ground-penetrating radar (GPR) data. Yet, radar is a vector phenomenon, such that the GPR amplitudes and phases depend on the antenna orientations and wave propagation paths. To address this issue, vector imaging

algorithms that fully account for the vector characteristics of GPR data are required. All previously developed vector imaging algorithms are based on far-field approximations of radiation patterns. We demonstrate the limited applicability of these algorithms and introduce a computationally efficient practically exact-field method that accounts for the far-, intermediate-, and near-field contributions to the radiation patterns. To compute rapidly the required "exact" radiation patterns, inverse fast Fourier transforms are applied to their horizontal wavenumber-frequency domain formulations, balancing the tradeoff between accuracy and efficiency by an appropriate oversampling in the wavenumber-frequency domain, and taking advantage of vertical wavenumber phase shifting. We include the exact radiation patterns in a multicomponent vector imaging scheme that jointly images copolarized and cross-polarized data. This scheme is tested on synthetic and field data containing dipping planar and near-planar structures. For both suites of data, high-quality multicomponent images with reflection amplitudes that are nearly independent of the antenna and reflector orientations are obtained [J1916]

"On Clutter Rank Observed by Arbitrary Arrays"

This paper analyzes the rank and eigenspectrum of the clutter covariance matrix observed by space-time radar systems with arbitrarily configured arrays and varying look geometry. Motivated by recent applications that suggest use of nonuniform antenna arrays, a generalized theory of clutter rank is derived and demonstrated. First, a one-dimensional effective random process is defined by projecting the measurements obtained by an arbitrary space-time radar system into an equivalent one-dimensional sampling structure. Then, this projection and the Karhunen-Loeve representation of random processes are used to predict clutter rank based on effective aperture-bandwidth product. Simulated results are used to confirm the theory over a wide range of scenarios, and along the way, the well-known Brennan's rule for clutter rank is shown to be a special case of the proposed aperture-bandwidth product [J1917]

"Optimal Sharpness Function for SAR Autofocus"

Phase-error correction through the optimization of an image-domain sharpness function provides one method for the auto-focus of synthetic aperture radar (SAR) imagery. Several ad-hoc sharpness functions have been proposed, implemented, and analyzed, but none of these has been motivated as the solution to a well-defined statistical estimation problem. In this letter, a SAR sharpness function is derived that induces the solution to maximum-likelihood and maximum-posterior estimation for idealized SAR data. Furthermore, a limiting form of the optimal sharpness function is shown to be the popular intensity-squared sharpness [J1918]

"Enhancement of Low-Contrast Curvilinear Features in Imagery"

A new method is described for enhancing low-contrast curvilinear features in imagery that combines directional filtering with Fischler, Tenenbaum and Wolf's F*algorithm for computing minimum cost paths. The method exploits a phenomenon called "the stability of lines over angle." The idea is that when a directionally filtered image contains a line plus noise, minimum cost paths tend to be aligned in the direction of the line with random jumps between parallel paths. When the input image contains noise only, the direction of minimum cost paths resemble random walks with drift. As the direction of the filter changes, minimum cost paths that follow true features persist and are more stable over angle than those that follow noise. Adding them up in an accumulator array over angle produces a larger number of votes along signal paths than along noise paths. This provides a means for enhancing trajectories of low-contrast features. Several examples illustrate the enhancement of forest trails in USGS aerial imagery, linear features on Mars, and roads in synthetic aperture radar imagery [J1919]

"Estimation of Multicomponent Polynomial-Phase Signals Impinging on a Multisensor Array Using State–Space Modeling"

This contribution addresses the problem of estimating the parameters of multicomponent polynomial-phase signals when impinging on a multisensor array. An original approach is proposed based on a state-space modelization of the signal and the application of an extended Kalman filter for the state estimation. The use of a multisensor array allows the exploitation of a spatial information and leads to the consideration of multiple filters with different observation equations. Computer simulations are used to demonstrate the effectiveness of the proposed algorithm [J1920]

"Subsurface Sensing of Buried Objects Under a Randomly Rough Surface Using Scattered Electromagnetic Field Data"

This paper proposes a new inverse method for microwave-based subsurface sensing of lossy dielectric objects embedded in a dispersive lossy ground with an unknown rough surface. An iterative inversion algorithm is employed to reconstruct the geometry and dielectric properties of the half-space ground as well as that of the

buried object. B-splines are used to model the shape of the object as well as the height of the rough surface. In both cases, the control points for the spline function represent the unknowns to be recovered. A single-pole rational transfer function is used to capture the dispersive nature of the background. Here, the coefficients in the numerator and denominator are the unknowns. The approach presented in this paper is based on the state-of-the-art semianalytic mode matching forward model, which is a fast and efficient algorithm to determine the scattered electromagnetic fields. Numerical experiments involving two-dimensional geometries and TM incident plane waves demonstrate the accuracy and reliability of this inverse method [J1921]

"Detection of Antipersonnel Mines by Using the Factorization Method on Multistatic Ground-Penetrating Radar Measurements"

The factorization method (FM) has been applied to measurement data from a multistatic ground-penetrating radar operating in close proximity to the ground, which was used in a measurement campaign on the Joint Research Centre mine test lane in Ispra, Italy. This paper is targeted toward a future hand-held demining system. The according space limits restrict an independent positioning of transmit and receive antennas. Hence, very small multistatic datasets are obtained, representing a difficult case for the reconstruction with the FM [J1922]

"Development of a Tunable Multiband UWB Radar Sensor and Its Applications to Subsurface Sensing"

Development of a new tunable multiband ultra-wideband (UWB) radar sensor is presented. The UWB sensor integrates the transmitter, receiver, and antennas completely in a single package using microwave integrated circuits and operates over multiple pulse durations or frequency bands. The sensor can transmit pulses with duration varying from 450 to 1170 ps and peak power from 200 to 400 mW and can detect signals with a conversion gain of 6.5-9.5 dB and a dynamic range of 50dB over a 5.5-GHz RF bandwidth. It has a range resolution of around 1 in. The sensor performs well through tests of various samples, demonstrating its success for subsurface sensing. The multipulse/multiband feature allows the sensor to achieve both fine-range resolution and long operating range and enhanced target detection and classification [J1923]

"Verification of the Vertical Error in C-Band SRTM DEM Using ICESat and Landsat-7, Otter Tail County, MN"

The Shuttle Radar Topography Mission (SRTM) provided scientists with digital elevation data on a nearly global scale and with highly consistent accuracy. This paper compares elevation values of the C-band SRTM 30-m digital elevation model (DEM) with pointwise elevations from the Ice, Cloud, and land-Elevation Satellite (ICESat) laser altimetry for Otter Tail County, Minnesota. The accuracy of SRTM DEM is measured as a function of land covers and geomorphologic characteristics. The typical mean vertical difference between the SRTM DEM and ICESat elevations in this paper was determined in each classified land-use type and is approximately 1.5 m over bare ground, with the SRTM measuring lower elevations. Significant changes in the SRTM DEM uncertainties have been identified over different surface types classified from Landsat-7 imagery, e.g., bare ground, urban, and forested areas. Based on this result, the difference of the SRTM 30-m DEM and ICESat elevations has been removed from the DEM and made available for improved hydrological applications [J1924]

"A Sharpened Dynamic Range of a Generalized Chinese Remainder Theorem for Multiple Integers"

A generalized Chinese remainder theorem (CRT) for multiple integers from residue sets has been studied recently, where the remainders in a residue set are not ordered. In this correspondence, we first propose a majority method and then based on the proposed majority method we present a sharpened dynamic range of multiple integers that can be uniquely determined from their residue sets [J1925]

"A Keystone Transform Without Interpolation for SAR Ground Moving-Target Imaging"

Synthetic aperture radar (SAR) image formation for a ground moving target necessitates the compensation of the unknown target trajectory. The keystone transform has been employed to remove the linear component of the range migration for the moving target, where interpolation is required. In this letter, a realization of the keystone transform avoiding interpolation is presented. The kernel of this transform, i.e., the range-frequency-dependent azimuth time rescaling, is implemented using only complex multiplications and fast Fourier transforms based on the scaling principle, which has been successfully applied in the equalization of the space-variant range cell migration in SAR processing. In addition, the moving target is coarsely focused according to the SAR geometry and the platform velocity while exploiting the scaling principle. This preliminary focusing is helpful in

the isolation of the moving target from ground clutter, so as to facilitate a more refined processing with respect to each mover. SAR raw data combined with simulated echoes of moving targets are utilized to validate the presented approach [J1926]

"Complex Empirical Mode Decomposition"

A method for the empirical mode decomposition (EMD) of complex-valued data is proposed. This is achieved based on the filter bank interpretation of the EMD mapping and by making use of the relationship between the positive and negative frequency component of the Fourier spectrum. The so-generated intrinsic mode functions (IMFs) are complex-valued, which facilitates the extension of the standard EMD to the complex domain. The analysis is supported by simulations on both synthetic and real-world complex-valued signals [J1927]

"An Adaptive Contoured Window Filter for Interferometric Synthetic Aperture Radar"

An adaptive contoured window filter is proposed to filter off the noise from phase images of interferometric synthetic aperture radar (InSAR) in this letter. The contoured windows can best satisfy the requirement that constrains the phase signal constant inside windows on which low-pass filtering can remove the noise well while the fringe phases are well preserved. The contoured windows are determined by tracing along the local fringe orientation. An algorithm for determining window sizes adaptive to the fringe density is also proposed. The theoretical analysis and experiments prove that the proposed filter can greatly remove decorrelation noise while preserving the fringe phase well, even for those fringes with strong curvatures for InSAR processing [J1928]

"Eigensubspace-Based Filtering With Application in Narrow-Band Interference Suppression for SAR"

Synthetic aperture radar (SAR) has found wide applications in many areas, e.g., battlefield awareness. However, SAR is vulnerable to various kinds of interference, among which narrow-band interference (NBI) is commonly used. In this letter, an eigensubspace-based filtering approach is proposed for NBI suppression in SAR without using passive-sniff data as the reference signal. Moreover, the proposed method can deal with smart or interrupted NBI. Both simulation and experimental results are provided to illustrate the performance of the proposed approach [J1929]

"Robust Array Beamforming With Sidelobe Control Using Support Vector Machines"

Robust beamforming is a challenging task in a number of applications (radar, sonar, wireless communications, etc.) due to strict restrictions on the number of available snapshots, signal mismatches, or calibration errors. We present a new approach to adaptive beamforming that provides increased robustness against the mismatch problem as well as additional control over the sidelobe level. We generalize the conventional linearly constrained minimum variance cost function by including a regularization term that penalizes differences between the actual and the target (ideal) array responses. By using the so-called epsi-insensitive loss function for the penalty term, the final cost function adopts the form of a support vector machine (SVM) for regression. In particular, the resulting cost function is convex with a unique global minimum that has traditionally been found using quadratic programming (QP) techniques. To alleviate the computational cost of conventional QP techniques, we use an iterative reweighted least-squares (IRWLS) procedure, which also converges to the SVM solution. Computer simulations demonstrate an improved performance of the proposed SVM-based beamformer, in comparison with other recently proposed robust beamforming techniques [J1930]

"Tracking Wide-Band Targets Having Significant Doppler Shift"

A method is derived for passively locating wide-band targets (typically acoustic targets) which may be moving at speeds sufficient to produce significant Doppler shift. The method involves a relatively straightforward adaptation of standard beam forming techniques. It is shown that conventional beam forming techniques have less discrimination in the direction of motion of the sources, whereas the proposed technique exhibits no such degradation. The derivative and Hessian of the likelihood function are derived. These may be used for locating the maximum likelihood solution or for deriving a Gaussian approximation to the likelihood function for particle filtering applications. The expressions are applicable for subsonic and supersonic sources. The computation required for implementing a system based on the model is at present prohibitive [J1931]

"Design of High-Order Phase-Lock Loops"

The analysis, and design of third-order, (and higher) phase-locked loops (PLL) is difficult. This paper presents a novel approach to overcome these difficulties by allowing high-order loops to be viewed as a natural extension of lower order ones. This is accomplished by adding nested first-order feedback loops around a basic first-order

loop filter. Our approach will also be related to the concept of PLLs with aided acquisition. The model presented has been implemented and tested in Simulink [J1932]

"Estimation of Two-Dimensional Frequencies Using Modified Matrix Pencil Method"

The problem of multiple two-dimensional (2-D) sinusoidal frequency estimation is considered. A modified matrix pencil method is proposed to simultaneously estimate the frequency pairs in the signal, thereby bypassing the computationally expensive pairing operation as seen in the literature. Simulation results show that the accuracy of the estimates for each frequency from our technique is better than or comparable to that of existing methods and the variance of the estimates are close to the Crameacuter-Rao bound. Simulation results also show that our method provides accurate and consistent frequency estimation results that other methods cannot provide with less or comparable computational complexity [J1933]

"Pulse Design for Time Reversal Method as Applied to Ultrawideband Microwave Breast Cancer Detection: A Two-Dimensional Analysis"

We conduct a two-dimensional study of pulse design for electromagnetic time-reversal (TR) imaging as applied to ultrawideband (UWB) breast cancer detection. We consider the situation when a tumor located in the human breast is surrounded by a large number of small tissue inhomogeneities that create strong signal clutter. When applying the TR algorithm, the excitation pulse should be properly designed such that there are distinguishable differences between the tumor and clutter responses. In this paper, we propose four pulse design criteria for the TR-based tumor detection. The modulated and modified Hermite polynomials (MMHPs) that fit well into the real pulse shapes are used as a general waveform template for the design process. Finally, numerical examples are used to demonstrate the usefulness of the proposed analytical framework. This paper can be a guide in the selection of suitable waveforms for which the tumor response can be enhanced and/or the clutter interference can be suppressed. The investigation is also well suited for applications to surface-penetrating radar using UWB signals [J1934]

"Wideband Antenna Patterns and Impulse Response of Broadband RF Phased Arrays With RF and Photonic Beamforming"

The general expression for a monochromatic antenna pattern is extended to a two dimensional function with dependence on both space and time. Expressions for the wideband antenna pattern in space and the impulse response in time are developed. The effects of random errors in the spatial domain and errors common to all elements with fluctuations in the frequency domain are analyzed. Examples are given, including RF beamformers and elements in finite arrays, but with an emphasis on a photonic beamformer, which shows improved performance relative to its RF counterparts in both the spatial and time domains [J1935]

"Top Downloads in IEEE Xplore [JReader's Choice]"

{no data available} [J1936]

"Grid Computing Yields Earthquake Forecast"

The physical forces that govern seismic events are so complex that scientists have struggled to assemble forecasts on the scale of decades. Now a new statistical technique has enabled John Rundle and his team at the University of California to narrow the forecast window to less than three years. The calculations require a day of supercomputing time, but he and his partners plan to automate research-quality forecasts and make them available online. You can only do this with grid computing. The idea of linking supercomputers into a computational grid to confront big problems isn't a new one, but Rundle and others in Earth science are doing something different. They're linking grids together-effectively, using grids of grids-thanks to a software movement that takes its name from the musical phenomenon known as the mashup [J1937]

"A Two-Dimensional Spectrum for Bistatic SAR Processing Using Series Reversion"

This letter derives the two-dimensional point target spectrum for an arbitrary bistatic synthetic aperture radar configuration. The method described makes use of series reversion, the method of stationary phase, and Fourier transform pairs to derive the point target spectrum. The accuracy of the spectrum is controlled by keeping enough terms in the two series expansions, and is verified with a point target simulation [J1938]

"A Technique for Jamming Bi- and Multistatic SAR Systems"

Bi- and multistatic synthetic aperture radars (SARs) can achieve reduced vulnerability in military systems,

especially in directional responsive jamming, and avoid physical attack to radar platforms. In this letter, a technique for jamming bi- and multistatic SAR systems is proposed, which is implemented with a novel transponder. This technique is based on a delayed retransmission of the received radar signal toward the scene. Unlike conventional delayed jamming, here, the jammer's delay time is random in the whole range interval. Moreover, the jamming signal is not retransmitted to the receiver directly but to the areas with targets that need to be protected against being imaged by radar. By this, it is then possible to jam the radar echoes independent of the receiver location [J1939]

"Accurate Centerline Detection and Line Width Estimation of Thick Lines Using the Radon Transform"

Centerline detection and line width estimation are important for many computer vision applications, e.g., road network extraction from high resolution remotely sensed imagery. Radon transform-based linear feature detection has many advantages over other approaches: for example, its robustness in noisy images. However, it usually fails to detect the centerline of a thick line due to the peak selection problem. In this paper, several key issues that affect the centerline detection using the radon transform are investigated. A mean filter is proposed to locate the true peak in the radon image and a profile analysis technique is used to further refine the line parameters. The thetas-boundary problem of the radon transform is also discussed and the erroneous line parameters are corrected. Intensive experiments have shown that the proposed methodology is effective in finding the centerline and estimating the line width of thick lines [J1940]

"Terrain Moisture Classification Using GPS Surface-Reflected Signals"

In this letter, a novel method of land-surface classification using surface-reflected global positioning system (GPS) signals in combination with digital imagery is presented. Two GPS-derived classification features are merged with visible image data to create terrain moisture classes, defined here as visibly identifiable terrain or landcover classes containing a surface/soil moisture component. As compared to using surface imagery alone, classification accuracy is significantly improved for a number of visible classes when adding GPS-based signal features. Since the strength of the reflected GPS signal is proportional to the amount of moisture in the surface, the use of these GPS features provides information about the surface that is not obtainable using visible wavelengths alone. Application areas include hydrology, precision agriculture, and wetlands mapping [J1941]

"Performance Modeling of Integrated Mobile Prepaid Services"

Prepaid personal communication service users have outnumbered postpaid users. This paper studies the charging issues of an integrated Global System for Mobile Communications (GSM) and General Packet Radio Service (GPRS) prepaid service, where a single prepaid account provides a user both voice and data services. The call setup and charging procedures for GSM and GPRS are presented using the Customized Applications for Mobile network Enhanced Logic network architecture. To reduce the probability of terminating both ongoing voice and data calls, we suggest that no new call be admitted when the user credit is below a threshold. An analytic model has been developed to evaluate the performance of the approach. Computer simulations have also been used to verify the results. The numeric results indicate that the force-termination probability can be significantly reduced by choosing an appropriate threshold of the user credit [J1942]

"Call Completion in Wireless Networks Over Lossy Link"

The call completion characteristics in wireless networks with the presence of an inherently lossy wireless link are presented in this paper. The closed-form formula for the significant performance metric in terms of the call completion probability is developed under the generalized wireless channel model and the general call holding time distribution based on the complex theory and transform techniques (Laplace-Stieltjes transform and z transform). The particular results under the typical wireless channel model and the commonly used call holding time are presented. In order to reflect the unique characteristics of the wireless channel erroneous state, we further introduce the resource occupancy time per call and the completed call holding time per call and present their properties in terms of probability density function and statistical moments. The comparison indicates that different call holding time distributions may lead to a substantial discrepancy. The effects of the first-order as well as second-order statistical moments of the call holding time and the wireless channel state duration upon the performance metrics are discussed [J1943]

"A Simple Signal Processing Architecture for Instantaneous Radar Polarimetry"

This paper describes a new radar primitive that enables instantaneous radar polarimetry at essentially no increase in signal processing complexity. This primitive coordinates transmission of distinct waveforms on orthogonal polarizations and applies a unitary matched filter bank on receive. This avoids the information loss

inherent in single-channel matched filters. A further advantage of this scheme is the elimination of range sidelobes [J1944]

"IMMPDAF Approach for Road-Boundary Tracking"

Robust road-boundary extraction/tracking is one of the main problems in autonomous roadway navigation. Although the road boundary can be defined by various means including lane markings, curbs, and borders of vegetation, this paper focuses on road-boundary tracking using curbs. A vehicle-mounted (downward tilted) 2-D laser-measurement system is utilized to detect the curbs. The tracking problem is difficult because both the vehicle is moving and the target is disappearing, reappearing, and maneuvering in clutter. The interacting-multiple-model probabilistic-data-association filter (IMMPDAF) is proposed to solve the problems after detailed analysis. Track initiation, confirmation, and deletion are performed using the sequential-probability-ratio test. Extensive simulations followed by experiments in a campus environment show that the road-boundary tracking utilizing curbs is possible and robust through IMMPDAF [J1945]

"Observations of Snow Water Equivalent Change on Landfast First-Year Sea Ice in Winter Using Synthetic Aperture Radar Data"

In this paper, we examine the utility of synthetic aperture radar (SAR) backscatter data to detect a change in snow water equivalent (SWE) over landfast first-year sea ice during winter at relatively cold temperatures. We begin by reviewing the theoretical framework for linking microwave scattering from SAR to the thermodynamic and electrical properties of first-year sea ice. Previous research has demonstrated that for a given ice thickness and air-temperature change, a thick snow cover will result in a smaller change in the snow-ice interface temperature than will a thin snow cover. This small change in the interface temperature will result in a relatively small change in the brine volume at the interface and the resulting complex permittivity, thereby producing a relatively small change in scattering. A thin snow cover produces the opposite effect-a greater change in interface temperature, brine volume, permittivity, and scattering. This work is extended here to illustrate a variation of this effect over landfast first-year sea ice using in situ measurements of physical snow properties and RADARSAT-1 SAR imagery acquired during the winter of 1999 in the central Canadian Archipelago at cold (~-26degC) and moderately cold (~-14degC) snow-sea-ice interface temperatures. We utilize in situ data from five validation sites to demonstrate how the change in microwave scattering covaries and is inversely proportional with the change in the magnitude of SWE. These changes are shown to be detectable over both short (2 days) and longer (45 days) time durations [J1946]

"Top 10 Tech Cars 2007"

This paper presents the return of pure electric cars. Tesla Motors, the Tesla Roadster, is powered by 6831 mass-market lithium-ion batteries and costs about $100,00. The Tesla was engineered by England's Lotus, renowned for its small, light sport cars. As with any pure electric car, the key parameters are the batteries' recharge time, energy density and useful life. Unresolved at the moment is the issue of battery life. Laptop batteries usually don't last the 10 years required of major automotive components [J1947]

"A Wireless Hydrocarbon Pollution Measuring and Monitoring System"

The goal of the proposed system is to protect sensitive areas of the country from hydrocarbon pollution with the use of a global system for mobile communications/general packet radio service (GSM/GPRS) accessed from mobile observation points (MOPs). The primary applications of this system are detection of leaks from an underground or aboveground storage tank (UST/AST), monitoring waste water discharge/ monitoring bilge water, monitoring water quality, monitoring groundwater, monitoring oil-water separators, monitoring storm drain effluents, and static soil gas headspace analysis. The basic version of the system is equipped with: a GPS position locator, a contamination probe sensitive to hydrocarbons, and a GSM/GPRS connection with the central www server [J1948]

"Experimental Demonstration of the Corbella Equation for Aperture Synthesis Microwave Radiometry"

The fundamental equation of aperture synthesis microwave radiometry has been recently revised into a new so-called Corbella equation to include antenna coupling effects and the interferometry formulation into a single equation. This equation has been experimentally demonstrated for the first time with a full prototype of the Microwave Imaging Radiometer with Aperture Synthesis. Several tests have been carried out to demonstrate the new visibility equation with different targets. The test results show better agreement with simulations based on the Corbella equation than the old fundamental equation. An initial analysis of the influence of the antenna

pattern characterization errors shows the importance of these errors in the final results according to the new formulation [J1949]

"Analysis of Random Step Frequency Radar and Comparison With Experiments"

Linear stepped frequency radar is used in wide-band radar applications, such as airborne synthetic aperture radar (SAR), turntable inverse SAR, and ground penetration radar. The frequency is stepped linearly with a constant frequency change, and range cells are formed by fast Fourier transform processing. The covered bandwidth defines the range resolution, and the length of the frequency step restricts the nonambiguous range interval. A random choice of the transmitted frequencies suppresses the range ambiguity, improves covert detection, and reduces the signal interference between adjacent sensors. As a result of the random modulation, however, a noise component is added to the range/Doppler sidelobes. In this paper, relationships of random step frequency radar are compared with frequency-modulated continuous wave noise radar and the statistical characteristics of the ambiguity function and the sidelobe noise floor are analyzed. Algorithms are investigated, which reduce the sidelobes and the noise-floor contribution from strong dominating reflectors in the scene. Theoretical predictions are compared with Monte Carlo simulations and experimental data [J1950]

"Impact of Multiresolution Active and Passive Microwave Measurements on Soil Moisture Estimation Using the Ensemble Kalman Smoother"

An observing system simulation experiment is developed to test tradeoffs in resolution and accuracy for soil moisture estimation using active and passive L-band remote sensing. Concepts for combined radar and radiometer missions include designs that will provide multiresolution measurements. In this paper, the scientific impacts of instrument performance are analyzed to determine the measurement requirements for the mission concept. The ensemble Kalman smoother (EnKS) is used to merge these multiresolution observations with modeled soil moisture from a land surface model to estimate surface and subsurface soil moisture at 6-km resolution. The model used for assimilation is different from that used to generate "truth." Consequently, this experiment simulates how data assimilation performs in real applications when the model is not a perfect representation of reality. The EnKS is an extension of the ensemble Kalman filter (EnKF) in which observations are used to update states at previous times. Previous work demonstrated that it provides a computationally inexpensive means to improve the results from the EnKF, and that the limited memory in soil moisture can be exploited by employing it as a fixed lag smoother. Here, it is shown that the EnKS can be used in large problems with spatially distributed state vectors and spatially distributed multiresolution observations. The EnKS-based data assimilation framework is used to study the synergy between passive and active observations that have different resolutions and measurement error distributions. The extent to which the design parameters of the EnKS vary depending on the combination of observations assimilated is investigated [J1951]

"Enhancing target shadows in SAR images"

A method called fixed focus shadow enhancement is proposed. The purpose is to sharpen target shadows in synthetic aperture radar images. The method applies a fixed focus range to a given target, resulting in a sharp target image and a sharp target shadow. Other parts of the radar image, including the background against which the shadow is seen, are smeared [J1952]

"On the Reduction of the Reconstruction Bias in Synthetic Aperture Imaging Radiometry (Corrected) "

Synthetic aperture imaging radiometers (SAIRs) are powerful instruments for high-resolution observation of planetary surfaces at low microwave frequencies. This paper is concerned with the reconstruction of radiometric brightness temperature maps from SAIR interferometric measurements. Even in the absence of modeling errors and radiometric noise, a systematic error, or bias, has been observed in the reconstructed maps. The origin of this bias is analyzed and an efficient solution is proposed for reducing it. The core reconstruction procedure is not changed, and no additional measurements are needed. Throughout the scientific rationale, particular emphasis is laid on numerical simulations carried out for the Soil Moisture and Ocean Salinity space mission, a project led by the European Space Agency and devoted to the remote sensing of soil moisture and ocean salinity from a low-orbit platform [J1953]

"GEOSAT Follow-On Water Vapor Radiometer: Performance With a Shared Active/Passive Antenna"

The GEOSAT Follow-On mission marks the first time that an Earth-orbiting microwave radiometer and radar have shared the same antenna. The antenna design must simultaneously accommodate the radar's high-gain

requirement and the high beam efficiency needed by the radiometer. Guaranteeing sufficiently high isolation between the radar transmitter and the radiometer receivers is also a critical part of the antenna design. The radiometer receiver includes a transmitter blanking circuit to further mitigate possible radar interference. Preflight and on-orbit tests of the antenna and radiometer receivers and an evaluation of end-to-end radiometric accuracy are presented. Together, they demonstrate that the shared-antenna approach can be implemented without compromising radiometric performance [J1954]

"Combining Airborne Photographs and Spaceborne SAR Data to Monitor Temperate Glaciers: Potentials and Limits"

Monitoring temperate glacier activity has become more and more necessary for economical and security reasons and as an indicator of the local effects of global climate change. Remote sensing data provide useful information on such complex geophysical objects, but they require specific processing techniques to cope with the difficult context of moving and changing features in high-relief areas. This paper presents the first results of a project involving four laboratories developing and combining specific methods to extract information from optical and synthetic aperture radar (SAR) data. Two different information sources are processed, namely: 1) airborne photography and 2) spaceborne C-band SAR interferometry. The difficulties and limitations of their processing in the context of Alpine glaciers are discussed and illustrated on two glaciers located in the Mont-Blanc area. The results obtained by aerial triangulation techniques provide digital terrain models with an accuracy that is better than 30 cm, which is compatible with the computation of volume balance and useful for precise georeferencing and slope measurement updating. The results obtained by SAR differential interferometry using European Remote Sensing Satellite images show that it is possible to measure temperate glacier surface velocity fields from October to April in one-day interferograms with approximately 20-m ground sampling. This allows to derive ice surface strain rate fields required to model the glacier flow. These different measurements are complementary to results obtained during the summer from satellite optical data and ground measurements that are available only in few accessible points [J1955]

"A Multiscale Curvature Algorithm for Classifying Discrete Return LiDAR in Forested Environments"

One prerequisite to the use of light detection and ranging (LiDAR) across disciplines is differentiating ground from nonground returns. The objective was to automatically and objectively classify points within unclassified LiDAR point clouds, with few model parameters and minimal postprocessing. Presented is an automated method for classifying LiDAR returns as ground or nonground in forested environments occurring in complex terrains. Multiscale curvature classification (MCC) is an iterative multiscale algorithm for classifying LiDAR returns that exceed positive surface curvature thresholds, resulting in all the LiDAR measurements being classified as ground or nonground. The MCC algorithm yields a solution of classified returns that support bare-earth surface interpolation at a resolution commensurate with the sampling frequency of the LiDAR survey. Errors in classified ground returns were assessed using 204 independent validation points consisting of 165 field plot global positioning system locations and 39 National Oceanic and Atmospheric Administration-National Geodetic Survey monuments. Jackknife validation and Monte Carlo simulation were used to assess the quality and error of a bare-earth digital elevation model interpolated from the classified returns. A local indicator of spatial association statistic was used to test for commission errors in the classified ground returns. Results demonstrate that the MCC model minimizes commission errors while retaining a high proportion of ground returns and provides high confidence in the derived ground surface [J1956]

"Snow-Covered Area Estimation Using Satellite Radar Wide-Swath Images"

Satellite radar-based remote sensing of snow cover during the snow-melt season has been widely studied for different geographical regions, such as mountainous, open, and forested areas. However, a single method has not been found to function well on all regions. The investigations on boreal forest zone have allowed the Helsinki University of Technology (TKK) to develop a snow-covered area (SCA) method that is feasible using spatially limited European Remote Sensing-1/2 Satellite data. This paper investigates the use of wide-swath radar data for boreal forest SCA estimation for the first time. The TKK SCA method is adapted here for HH-polarization Radarsat data. The predominant aspect originated by the use of wide-swath synthetic aperture radar (SAR) data is the large variation in the radar incidence angle. The effect of incidence angle variation on SCA estimation is characterized in this paper. The foundation for operational implementation of the TKK SCA method is also established by an error propagation analysis presented in this paper. The error propagation analysis is compared with accuracy characteristics acquired between SAR and optical SCA evaluation. The performance of forest compensation, which is a key element of the TKK method, was analyzed for the wide-swath radar data. Furthermore, the correlation between the topography and the SCA estimation accuracy was examined in this paper. This paper lays the foundation for operational SCA estimation on boreal forest zone using wide-swath SAR data [J1957]

"Onboard trajectory equipment measurements"

In past years, the onboard trajectory measurements complex (OTMC) was found in flight tests of flight vehicles (FV). The quick-release small-sized complex makes registration of the information of onboard systems, definition of trajectory parameters of FV, the information synchronization of onboard systems, and trajectory parameters. OTMC is used for the solution of the whole set of different tasks on estimation of the characteristics of FV and its onboard equipment. With the help OTMC in flight tests there solved the tasks of estimation: operation and accuracy characteristics of air navigation computing systems, inertial navigational systems, integrated navigational systems; SNS receivers, landing radio engineering systems, accuracy of flights under the standard takeoff patterns and landing, take-off and landing characteristics, accuracy characteristics of radars, corrections of high-altitude, fast-track parameters, systems of early warning of ground proximity etc [J1958]

"Toward Hyperspectral Lidar: Measurement of Spectral Backscatter Intensity With a Supercontinuum Laser Source"

We have tested the use of a supercontinuum laser source in laser-based spectral backscatter measurement. The calibration and first results with the prototype instrument are presented with a discussion of improvements and applications in laser-based hyperspectral remote sensing and laboratory measurements. This technique enables the spectral study of the backscatter effects and the calibration and test measurements for the purpose of airborne laser measurement. We also explore the prospect of using a supercontinuum laser source in a broadband (hyperspectral) lidar [J1959]

"A Novel Method for Removal of Emitter Noise in SAR Images"

Traditionally, interfering emitter signatures have been removed through notched filtering in the range (fast-time) dimension. This works well when a narrowband emitter interferes with a wideband radar pulse; however, when the emitter and radar signal bandwidths are comparable, then this approach fails since the noise is distributed throughout the pulse and the image as well. In cases where the interfering signal is localized in the cross range, joint time-frequency methods can often focus this interference signal, thereby transforming the image. In this transformed image, the interferer is the foreground, and the desired synthetic aperture radar image is blurred and now the background. The focused compressed interferer can be analyzed and censored from the transformed image. Back transformation restores the image with the interference removed. This technique has been fully automated and applied to an Electromagnetics Institute Synthetic Aperture Radar (EMISAR) image contaminated by a nonstationary emitter. The cleansed image is virtually free of the emitter interference [J1960]

"From circuit topology to behavioural model of power amplifier dedicated to radar applications"

A new behavioural model of a power amplifier (PA) at system level is presented, dedicated to radar applications. This model, which is able to take into account output loading impedance mismatch, is based on a similar topology to the PA's circuit. The model, implemented in Agilent Advanced Design System (ADS), is validated for different loading impedances, until VSWR=2 (voltage standing wave ratio), on the PA's bandwidth. This approach permits an extraction, resulting from simple CW measurements or simulations, and easy model implementation. This work has been supported by DGA (French Defense and Security Agency) [J1961]

"On Generalizations of the Engset Model"

The Engset model has been extensively studied and widely used for blocking probability evaluation in telecommunications networks. In 1957, J.W. Cohen considered two generalizations of the Engset model: 1) permitting the distributions of the holding time and interarrival time to differ from source to source; 2) permitting the idle time distribution to depend on whether or not the previous call was successful. He derived the call and time congestions for the first generalization, however, he simply posed the second generalization as a problem. In a leading teletraffic text by Syski, the call and time congestions are approximated for the second generalization, though it appears that Syski has overlooked that his results are in fact an approximation. In this paper, we point out Syski's apparent oversight, we improve the accuracy of his approximation, and we provide an efficient algorithm for its numerical computation and prove its convergence [J1962]

"Tree Detection in Urban Regions Using Aerial Lidar and Image Data"

In this letter, we present an approach to detecting trees in registered aerial image and range data obtained via lidar. The motivation for this problem comes from automated 3-D city modeling, in which such data are used to generate the models. Representing the trees in these models is problematic because the data are usually too sparsely sampled in tree regions to create an accurate 3-D model of the trees. Furthermore, including the tree

data points interferes with the polygonization step of the building roof top models. Therefore, it is advantageous to detect and remove points that represent trees in both lidar and aerial imagery. In this letter, we propose a two-step method for tree detection consisting of segmentation followed by classification. The segmentation is done using a simple region-growing algorithm using weighted features from aerial image and lidar, such as height, texture map, height variation, and normal vector estimates. The weights for the features are determined using a learning method on random walks. The classification is done using the weighted support vector machines, allowing us to control the misclassification rate. The overall problem is formulated as a binary detection problem, and the results presented as receiver operating characteristic curves are shown to validate our approach [J1963]

"Feature-Independent Aperture Evaluator for the Curvilinear SAR"

Curvilinear synthetic aperture radar (SAR), as a more practicable 3-D SAR imaging system, utilizes parametric target feature estimates extracted from the received data to reconstruct the target image. The reconstructed image quality is then impacted by the estimation accuracy of the features. In this letter, through discussing the correlation between the system parameters and the estimation performance of the curvilinear SAR, a conclusion can be drawn on how the overall location accuracy of a target is determined by the correlation between the azimuth and elevation coordinates of the flight path, compactly characterizing the curvilinear aperture. Consequently, a new index, determined only with the aperture parameters, is proposed as an aperture evaluator, which is referred to as the feature-independent aperture evaluator (FAE). FAE can be used for guiding the operational aperture design [J1964]

"Unsupervised Change Detection From Multichannel SAR Images"

Multichannel synthetic aperture radar (SAR) data present a good potential for environmental monitoring and disaster management, owing both to their insensitivity to atmospheric and sun-illumination conditions, and to the improved discrimination capability they may provide as compared to single-channel SAR. However, this requires accurate and possibly automatic techniques to generate change maps from multichannel SAR images acquired from the same geographic area at different times. In this letter, an automatic unsupervised contextual change-detection method is proposed for two-date multichannel SAR images, by integrating a SAR-specific extension of the Fisher transform with a variant of the expectation-maximization algorithm and with Markov random fields. The method is validated by experiments on SIR-C/XSAR data [J1965]

"SABRINA: A SAR Bistatic Receiver for Interferometric Applications"

This letter discusses the implementation of SABRINA, Synthetic Aperture radar Bistatic Receiver for Interferometric Applications. The ground resolution of a fixed-receiver bistatic system is studied, showing that it is comparable to that of a monostatic system. Due to the short distance from target to receiver, large sensitivity is obtained. The noncooperative nature of the bistatic system forces a conservative data-acquisition strategy based on continuously sampling the scattered signal during a temporal window around the predicted satellite overpass time. Also, to be able to synchronize the system in time and in frequency, sampling of a direct signal obtained through an antenna pointed at the satellite is required. Besides the signal processing required to phase-lock the received signal, the bistatic synthetic aperture radar processing needs to take into account the azimuth-dependent phase history. First focused images obtained with the SABRINA-ENVISAT combination are discussed [J1966]

"Multi-step spectral preconditioner for fast monostatic radar cross-section calculation"

A multi-step preconditioning technique suitable for the solution of a sequence of linear systems arising in monostatic radar cross-section (RCS) calculation is presented. This technique is a combination of a prescribed preconditioner and a low-rank update spectral preconditioner in a successive multi-step manner that computes on the fly approximation of the eigenvectors associated with the smallest eigenvalues. Numerical results show that this technique is very effective in monostatic RCS calculation and can reduce simulation time significantly [J1967]

"Active Learning Applied to RCS Computations With Nonuniform Sampling Using Different Objective Functions"

An active learning framework is introduced to reduce the number of frequencies and angles one must consider for wideband monostatic scattering computations or measurements. This method is used to optimally select those frequencies and angles that would be most informative, resulting in nonuniform sampling and often a reduced number of points (vis-agrave-vis uniform sampling). In this paper we focus on jointly two-dimensional optimal sampling in frequency and incident angle thetas for monostatic scattering. The method consists of two basic steps. One step involves estimation of model parameters using a least-square (LS) algorithm. The next

step is to optimally choose the next point (frequency and thetas) for analysis by the computational model or experiment. This new point is selected with the goal of reducing uncertainty in the parametric model (quantified via the Fisher information matrix). Iterating these two steps, a sequence of numerical computations or measurements are performed, each at the most informative point for learning the parameters of the associated simpler parametric model. This idea is demonstrated here in the context of reducing the number of points (frequencies and orientations) at which a computational model must be employed. And in order to avoid repeatedly gathering samplings at the edge of the input space, an alternative objective function is applied which makes the actively selected points closer to a region of interest [J1968]

"Eli Brookner [JExceptional Service Award]"

Describes the career and professional achievements of Eli Brookner, who is the recipient of the IEEE Aerospace and Electronic Systems Society Exceptional Service Award. [J1969]

"The Institution of Engineering and Technology International Conference on Radar Systems-RADAR 2007"

{no data available} [J1970]

"Differential RCS of RFID tag"

The differential radar cross-section (RCS) of an RFID tag is an important parameter which determines the power of the modulated backscattered tag signal. The vector differential RCS of an RFID tag as seen by the reader is analysed and, for the first time, compared with experimental results in UHF band [J1971]

"Textured surface slot antenna with reduced radar cross-section"

Provided is experimental verification that a textured surface slot antenna is capable of producing usable far-field radiation patterns with preferential radiation into the forward half-space, at better than -16 dB return loss. In addition, it is shown that the antenna when connected to a 50 Omega load yields a backscattered return of only -17 dB compared to a matched slot antenna constructed on a perfectly conducting (PEC) ground plane, which returns -3 dB. The gain of the textured slot antenna structure was measured to be 3.35 dBi at 4.77 GHz [J1972]

"Accuracy of Ground Penetrating Radar Horn-Antenna Technique for Sensing Pavement Subsurface"

Ground penetrating radar (GPR) is an intelligent sensor technique that has led to a powerful nondestructive testing (NDT) method for road pavement evaluation. Recent improvements in hardware and, in particular, software processing have contributed to the rapidly expanding popularity and usability of this technique in the pavement engineers community. In the present work, a GPR sensor system mounted on a driving van was used to acquire data from an asphalt pavement. Two different central frequency air-coupled horn antennas were used for data acquisition. The collected radar data was processed and analyzed in order for the accuracy of the antennas to be evaluated. For this purpose, the asphalt layer dielectric values and related thickness values were also estimated. Based on the GPR data analysis results, the performance of the two horn antennas in terms of sensing pavement subsurface is presented and discussed in the paper [J1973]

"Knowledge-Aided Bayesian Detection in Heterogeneous Environments"

We address the problem of detecting a signal of interest in the presence of noise with unknown covariance matrix, using a set of training samples. We consider a situation where the environment is not homogeneous, i.e., when the covariance matrices of the primary and the secondary data are different. A knowledge-aided Bayesian framework is proposed, where these covariance matrices are considered as random, and some information about the covariance matrix of the training samples is available. Within this framework, the maximum a priori (MAP) estimate of the primary data covariance matrix is derived. It is shown that it amounts to colored loading of the sample covariance matrix of the secondary data. The MAP estimate is in turn used to yield a Bayesian version of the adaptive matched filter. Numerical simulations illustrate the performance of this detector, and compare it with the conventional adaptive matched filter [J1974]

"Adaptive Detection With Bounded Steering Vectors Mismatch Angle"

We address the problem of detecting a signal of interest (SOI), using multiple observations in the primary data, in a background of noise with unknown covariance matrix. We consider a situation where the signal's signature is not known perfectly, but its angle with a nominal and known signature is bounded. Furthermore, we consider a

possible scaling inhomogeneity between the primary and the secondary noise covariance matrix. First, assuming that the noise covariance matrix is known, we derive the generalized-likelihood ratio test (GLRT), which involves solving a semidefinite programming problem. Next, we substitute the unknown noise covariance matrix for its estimate obtained from secondary data, to yield the final detector. The latter is compared with a detector that assumes a known signal's signature [J1975]

"Activities of the Taipei Chapter in 2006 [JChapter News]"

{no data available} [J1976]

"Vehicle and Guard Rail Detection Using Radar and Vision Data Fusion"

This paper describes a vehicle detection system fusing radar and vision data. Radar data are used to locate areas of interest on images. Vehicle search in these areas is mainly based on vertical symmetry. All the vehicles found in different image areas are mixed together, and a series of filters is applied in order to delete false detections. In order to speed up and improve system performance, guard rail detection and a method to manage overlapping areas are also included. Both methods are explained and justified in this paper. The current algorithm analyzes images on a frame-by-frame basis without any temporal correlation. Two different statistics, namely: 1) frame based and 2) event based, are computed to evaluate vehicle detection efficiency, while guard rail detection efficiency is computed in terms of time savings and correct detection rates. Results and problems are discussed, and directions for future enhancements are provided [J1977]

"On designing issues of the next generation mobile network"

Next generation mobile network (NGMN) is envisaged to support seamless mobility across disparate access technologies in a transparent manner. The success of NGMN design will depend on its ability to address key design issues, mainly architectural adaptation and modification of service continuity functions (i.e., mobility and resource management) that arise from such interoperability. The solutions presented in this article attempt to resolve these issues by considering an IP-based interworking framework that promotes evolution of individual networks and integration of new technologies [J1978]

"Word Circle Game [JEnigmas, etc]"

{no data available} [J1979]

"Recent Breakthroughs in RF Photonics for Radar Systems"

Radar systems require transmission of very high purity signals. Photonics is now mature enough to achieve analog transmission with very low noise, strong immunity, and wide-bandwidth even in harsh environments. We present our recent developments of optimized optical links dedicated to radar and multifunction systems [J1980]

"CWLFM Radar for Ship Detection and Identification"

Continuous wave lineal frequency modulated (CWLFM) radar presents some interesting advantages for coast surveillance and control as well as low probability of interception (LPI). This paper presents real results obtained with a radar prototype and processed with ISAR techniques. Also, results of an automatic ship identification system applied to simulated ISAR images are exposed. Moreover, radar behavior with unfavorable meteorological conditions is discussed [J1981]

"Interactive Road Situation Analysis for Driver Assistance and Safety Warning Systems: Framework and Algorithms"

Road situation analysis in Interactive Intelligent Driver-Assistance and Safety Warning (I2DASW) systems involves estimation and prediction of the position and size of various on-road obstacles. Real-time processing, given incomplete and uncertain information, is a challenge for current object detection and tracking technologies. This paper proposed a development framework and novel algorithms for road situation analysis based on driving action behavior, where the safety situation is analyzed by simulating real driving action behaviors. First, we review recent development and trends in road situation analysis to provide perspective for the related research. Second, we introduce a road situation analysis framework, where onboard sensors provide information about drivers, traffic environment, and vehicles. Finally, on the basis of the previous frameworks, we proposed multiple-obstacle detection and tracking algorithms using multiple sensors including radar, lidar, and a camera, where a decentralized track-to-track fusion approach is introduced to fuse these sensors. In order to reduce the effect of obstacle shape and appearance, we cluster lidar data and then classify obstacles into two categories: static and

moving objects. Future collisions are assessed by computation of local tracks of moving obstacles using extended Kalman filter, maximum likelihood estimation to fuse distributed local tracks into global tracks, and finally, computation of future collision distribution from the global tracks. Our experimental results show that our approach is efficient for road situation evaluation and prediction [J1982]

"Toward Autonomous Collision Avoidance by Steering"

This paper presents a new automotive safety function called Emergency Lane Assist (ELA). ELA combines conventional lane guidance systems with a threat assessment module that tries to activate the lane guidance interventions according to the actual risk level of lane departure. The goal is to only prevent dangerous lane departure maneuvers. The ELA safety function is based on a statistical method that evaluates a list of safety concepts and tries to maximize the impact on accident statistics while minimizing development and hardware component costs. ELA runs in a demonstrator and successfully intervenes during lane changes that are likely to result in a collision and is also able to take control of the vehicle and return it to a safe position in the original lane. It has also been tested on 2000 km of roads in traffic without giving any false interventions [J1983]

"Oil Spill Detection in Radarsat and Envisat SAR Images"

We present algorithms for automatic detection of oil spills in synthetic aperture radar (SAR) images. The algorithms consist of three main parts, namely: 1) detection of dark spots; 2) feature extraction from the dark spot candidates; and 3) classification of dark spots as oil spills or look-alikes. The algorithms have been trained on a large number of Radarsat and Envisat Advanced Synthetic Aperture Radar (ASAR) images. The performance of the algorithm is compared to manual and semiautomatic approaches in a benchmark study using 59 Radarsat and Envisat images. The algorithms can be considered to be a good alternative to manual inspection when large ocean areas are to be inspected [J1984]

"Frequency Subband Processing and Feature Analysis of Forward-Looking Ground-Penetrating Radar Signals for Land-Mine Detection"

There has been significant amount of study on the use of ground-penetrating radar (GPR) for land-mine detection. This paper presents our analysis of GPR data collected at a U.S. Army test site using a new approach based on frequency subband processing. In this approach, from the radar data that have over 2.5 GHz of bandwidth, we compute separate radar images using the one wide (2 GHz) and four narrow (0.6 GHz) frequency subbands. The results indicate that signals for different frequency subbands are significantly different and give very different performance in land-mine detection. In addition, we also examine a number of features extracted from the GPR data, including magnitude and local-contrast features, ratio between copolarization and cross-polarization signals, and features obtained using polarimetric decomposition. Feature selection procedures are employed to find subsets of features that improve detection performance when combined. Results of land-mine detection, including performance on blind test lanes, are presented [J1985]

"Capabilities of Dual-Frequency Millimeter Wave SAR With Monopulse Processing for Ground Moving Target Indication"

Ground moving target indication (GMTI) for synthetic aperture radar (SAR) provides information on nonstatic objects in radar imagery of a static ground scene. An efficient approach for GMTI is the use of multichannel SAR systems for a space- and time-variant analysis of moving targets. This allows the indication, correction of position displacement, and estimation of radial velocity components of moving targets in a SAR image. All three steps are possible due to a determinable Doppler frequency shift in the radar signal caused by radial target movement. This paper focuses on the millimeter wave (mmW) SAR system MEMPHIS with multichannel amplitude-comparison monopulse data acquisition and the ability to use carrier frequencies of 35 and 94 GHz simultaneously, making it a dual-frequency SAR. This paper includes mmW-specific SAR GMTI considerations, an adaptive algorithm to collect velocity and position information on moving targets with mmW monopulse radar, and a discussion on GMTI blind speed elimination and target velocity ambiguity resolving by dual-frequency SAR. To determine the capabilities of both, system and algorithm, three large-scale experiments with MEMPHIS in different environments are presented [J1986]

"A New Technique for Forecasting Surface Wind Field From Scatterometer Observations: A Case Study for the Arabian Sea"

The possibility of predicting ocean-surface wind field a few days ahead from satellite scatterometer observations in the Arabian Sea has been explored in this paper. The prediction technique is based on a combination of empirical orthogonal function (EOF) analysis and genetic algorithm (GA). The space-time distributed satellite

data (zonal or meridional wind field) have been decomposed into a set of spatial eigenmodes ranked by their temporal variance. The associated temporal amplitude functions have been used by the GA for carrying out forecasts with lead times varying from one to five days. The GA finds the analytical equations that best describe the behavior of the different temporal amplitude functions in the EOF decomposition. Later, the predicted wind field has been generated as a linear combination of the dominant spatial modes weighted by the corresponding predicted amplitudes. The technique has been tested using independent validation data sets. It has been further tested by comparing the forecast fields with buoy data. The performance of GA is comparable to that of persistence forecast for the first two days of forecast, while it is better than that of persistence for three- to five-day-ahead forecasts [J1987]

"Mutual Interference of Millimeter-Wave Radar Systems"

This paper examines the probability that any millimeter-wave radar systems will interfere mutually by considering spatial, temporal, and operational frequency-related overlaps. It examines the nature and magnitude of the interference under different conditions and for different sensor types before concluding that in an overlapping frequency band, the probability that interference will occur is high. It goes on to demonstrate that, though there are some forms of interference that can be identified and controlled, there are others which are impossible to isolate, resulting in degraded target detection performance and tracking [J1988]

"Boundary Element Modeling of the Realistic Human Body Exposed to Extremely-Low-Frequency (ELF) Electric Fields: Computational and Geometrical Aspects"

This paper presents the human exposure assessment to high-voltage extremely-low-frequency (ELF) fields by the three-dimensional (3-D) boundary element method (BEM). The formulation is based on a realistic, anatomically based representation of the human body. The main objective is to analyze the influence of the relative position of the arms with respect to the body on the axial distribution of current density along the body and to determine the most vulnerable regions. Numerical results along head, neck, torso, abdomen, arms, legs, and ankles are presented and discussed in the case of grounded subject standing under power-distribution lines and in the vicinity of power transformer substations [J1989]

"Shift–Scale Complex Correlation for Wide-Angle Coherent Cross-Track SAR Stereo Processing"

Automated synthetic aperture radar (SAR) stereo correspondence becomes increasingly difficult when imaging high-relief terrain utilizing large stereo crossing-angle geometries because high-relief SAR image features can undergo significant spatial distortions, causing a failure of traditional correlation matching. This paper presents eight coherent spotlight-mode cross-track stereo pairs with stereo crossing angles averaging 93.7deg collected over a terrain with slopes greater than 20deg. These stereo pairs suffer from terrain-induced distortions, resulting in a decrease in complex correlation (coherence) when utilizing scanning-window correlation calculations. The search to maximize complex correlation is changed from a shift-only (disparity) search to a shift-and-scale search using the downhill simplex method. This approach is tested against complex imagery with simulated distortions and then employed on the eight wide-angle stereo collects. The resulting digital terrain maps (DTMs) are compared to ground truth. Using a shift-and-scale correlation approach to estimate disparity, the relative height errors decrease, and the number of reliable DTM posts increase [J1990]

"Reconstruction From Antenna-Transformed Radar Data Using a Time-Domain Reconstruction Method"

This paper discusses the reconstruction of the subsurface from radar data using a time-domain reconstruction method. Before the reconstruction is conducted, data preprocessing is carried out. The preprocessing transforms measured data transmitted and received by 3-D dipole antennas into equivalent data excited and received by 3-D ideal electric dipoles and, then, into equivalent data excited and received by 2-D ideal electric dipoles. Distributions of permittivity, conductivity, and permeability are reconstructed from the preprocessed data by a 2-D forward-backward time-stepping waveform inverse scattering technique. Two 2-D examples of permittivity and conductivity reconstruction from synthetic noisy and field borehole radar data are demonstrated to show the effectiveness of the proposed method [J1991]

"February 2007 Distinguished Lectures Program"

{no data available} [J1992]

"Onboard Evolutionary Risk Recognition System for Automobiles—Toward the Risk Map System"

To achieve a system that improves the safety and comfort of the vehicle driving, a recognition system equivalent

to the human recognition ability should be developed. However, the vehicle environment is complicated and involves situations so diverse that a uniform recognition processing approach cannot function sufficiently. For a solution to this problem, we have been studying a comprehensive risk recognition system, which we call the risk map system, with learning capability. As part of this paper, a system has been developed that autonomously obtains the image recognition processing. This paper presents a system as an example that automatically learns through genetic programming to obtain the image processing of pedestrians and vehicles taken by an onboard camera system [J1993]

"Absolute Frequency Stabilization of Diode Lasers Around 0.94 μm"

We report on the frequency stabilization of extended-cavity diode lasers against rotovibrational absorption lines of water vapor at around 0.94 mum, by means of the frequency modulation spectroscopy technique. A minimum frequency instability of ~ 30 kHz has been obtained for integration times in the range from 1 to 100 s [J1994]

"Sea Clutter: Scattering, the K Distribution and Radar Performance (Ward, K.D., et al.; 2006) [JBook Review]"

{no data available} [J1995]

"Ultrawideband Radar Committee (UWBRC) Progress Report [JStandards]"

First Page of the Article [J1996]

"Time-Varying Autoregressive (TVAR) Models for Multiple Radar Observations"

We consider the adaptive radar problem where the properties of the (nonstationary) clutter signals can be estimated using multiple observations of radar returns from a number of sufficiently homogeneous range/azimuth resolution cells. We derive a method for approximating an arbitrary Hermitian covariance matrix by a time-varying autoregressive model of order m, TVAR(m), that is based on the Dym-Gohberg band-matrix extension technique which gives the unique TVAR(m) model for any nondegenerate covariance matrix. We demonstrate that the Dym-Gohberg transformation of the sample covariance matrix gives the maximum-likelihood (ML) estimate of the TVAR(m) covariance matrix. We introduce an example of TVAR(m) clutter modeling for high-frequency over-the-horizon radar that demonstrates its practical importance [J1997]

"Adaptive Radar Detection of Distributed Targets in Homogeneous and Partially Homogeneous Noise Plus Subspace Interference"

This paper addresses adaptive radar detection of distributed targets in noise plus interference assumed to belong to a 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 independent, zero-mean, complex normal ones, sharing either the same covariance matrix (homogeneous environment) or the same covariance matrix up to possibly different (mean) power levels between primary data, i.e., range cells under test, and secondary ones (partially homogeneous environment). The performance assessment has been conducted by Monte Carlo simulation, also in comparison to previously proposed detection algorithms, and confirms the effectiveness of the newly proposed ones [J1998]

"Phase Unwrapping and A Robust Chinese Remainder Theorem"

In the conventional Chinese remainder theorem (CRT), a small error in a remainder may cause a large error in the solution of an integer, i.e., CRT is not robust. In this letter, we first propose a robust phase unwrapping algorithm with applications in radar signal processing. Motivated from the phase unwrapping algorithm, we then derive a type of robust CRT [J1999]

"Binary Weighted Averaging of an Ensemble of Coherently Collected Image Frames"

Recent interest in the collection of remote laser radar imagery has motivated novel systems that process temporally contiguous frames of collected imagery to produce an average image that reduces laser speckle, increases image SNR, decreases the deleterious effects of atmospheric distortion, and enhances image detail. This research seeks an algorithm based on Bayesian estimation theory to select those frames from an ensemble that increases spatial resolution compared to simple unweighted averaging of all frames. The resulting binary weighted motion-compensated frame average is compared to the unweighted average using simulated and experimental data collected from a fielded laser vision system. Image resolution is significantly enhanced as

quantified by the estimation of the atmospheric seeing parameter through which the average image was formed [J2000]

"Radial basis function neural network for pulse radar detection"

A new approach using a radial basis function network (RBFN) for pulse compression is proposed. In the study, networks using 13-element Barker code, 35-element Barker code and 21-bit optimal sequences have been implemented. In training these networks, the RBFN-based learning algorithm was used. Simulation results show that RBFN approach has significant improvement in error convergence speed (very low training error), superior signal-to-sidelobe ratios, good noise rejection performance, improved misalignment performance, good range resolution ability and improved Doppler shift performance compared to other neural network approaches such as back-propagation, extended Kalman filter and autocorrelation function based learning algorithms. The proposed neural network approach provides a robust mean for pulse radar tracking [J2001]

"Radar automatic target recognition using complex high-resolution range profiles"

Radar high-resolution range profile (HRRP) has received intensive attention from the radar automatic target recognition (RATR) community. Usually, since the initial phase of a complex HRRP is strongly sensitive to target position variation, only the amplitude information in complex HRRPs is used for RATR, whereas the phase information is discarded. However, the remaining phase information except for initial phases in complex HRRPs may also contain valuable target discriminant information. RATR using complex HRRPs is discussed. The complex HRRPs' feature subspace within each target-aspect sector is extracted via principal component analysis as the corresponding template during the training phase; while in the test phase we decide that a test sample belongs to the feature subspace which has the test sample's minimum reconstruction error approximation. It is shown that the whole process is independent of the initial phases, but exploits the remaining phase information in 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 [J2002]

"Calling All Chapter The Distinguished Tutoirals Program [JChapter News]"

{no data available} [J2003]

"Multiple models track algorithm for radar with high pulse-repetition frequency in frequency-modulated ranging mode"

When the airborne fire control radar operates with the high pulse-repetition frequency (PRF) in the frequency-modulated ranging mode, the range measurement is ambiguous. Here, the problem of target range estimation and ambiguity resolving is converted to the problem of static multiple models estimation and decision. Frequency and pseudo-range measurements are used to update each model of the target with the probabilistic data association and tracking filter. The method to select the PRF used to detect the target is also suggested according to the state estimates of the survived models. Simulation results demonstrate the improved accuracy and convergence when compared with the conventional methods [J2004]

"Range migration algorithm for airborne squint mode spotlight SAR imaging"

Since the reference signal based on the fixed reference range is used in the range migration algorithm (RMA), the RMA is not available to process an airborne squint-mode spotlight synthetic aperture radar (SAR) data. Thus, the modified reference signal to transform a squint-mode data to a broadside-mode data is introduced on the basis of the coordinate transformation and the extended Taylor approximation. Then, using the principle of the stationary phase, the presented formulation is analysed. Moreover, to compensate curvature errors, the proposed method is extended on the basis of the subarea technique. Finally, the effectiveness of the proposed method is demonstrated by some numerical simulations via a pulsed spotlight SAR simulator [J2005]

"UWB Perimeter Surveillance"

This program will develop an automated and unmanned ultra-wide band (UWB) perimeter surveillance sensor designed to provide detection and tracking of personnel and vehicles at the perimeter of critical areas such as military installations and other such facilities. This effort describes the work being done for the protection of high value assets using a compact system which incorporates two technologies to enhance the probability of detection in stressing environments [J2006]

"Approach for single channel SAR ground moving target imaging and motion parameter estimation"

In recent years, ground moving target imaging in synthetic aperture radar (SAR) has attracted the attention of many researchers all over the world. A novel approach is proposed for the ground moving target imaging and motion parameter estimation using single channel SAR. First, a second-order generalised keystone formatting method is used to compensate for the range curvature. Secondly, the estimated slope of the target echo's envelope is used for the range walk compensation. Thirdly, Doppler parameters of moving targets obtained via spectral analysis are used for the imaging and positioning of ground moving targets. Finally, motion parameters of moving targets can be estimated on the basis of the relationship between Doppler and motion parameters. Both numerical and experimental results are provided to demonstrate the performance of the proposed approach [J2007]

"Comments on 'Cramer-Rao lower bound for tracking multiple targets'"

In a recent paper, Ristic et al., 2004, proposed a simple and exact derivation of the theoretical Cramer-Rao lower bound (CRLB) for tracking multiple targets using intensity maps as measurements. Although the formulation and the theoretical derivations presented in their work are indeed correct, the analysis of the proposed bound and the conclusions that follow are wrong. Here, a correct analysis is presented with the key observation that [as opposed to the claim made in the work of Ristic et al. (2004)], the proposed CRLB reflects the interaction between the targets, even if their motion is independent. The multi-target CRLB is also compared with the error performance of a multi-target state maximum likelihood estimator; a remarkable agreement is observed for high signal-to-noise ratio [J2008]

"Syntactic Modeling and Signal Processing of Multifunction Radars: A Stochastic Context-Free Grammar Approach"

Multifunction radars (MFRs) are sophisticated sensors with complex dynamical modes that are widely used in surveillance and tracking. This paper demonstrates that stochastic context-free grammars (SCFGs) are adequate models for capturing the essential features of the MFR dynamics. Specifically, MFRs are modeled as systems that ldquospeakrdquo a language that is characterized by an SCFG. The paper shows that such a grammar is modulated by a Markov chain representing radar's policy of operation. The paper also demonstrates how some well-known statistical signal processing techniques can be applied to MFR signal processing using these stochstic syntactic models. We derive two statistical estimation approaches for MFR signal processing-a maximum likelihood sequence estimator to estimate radar's policies of operation, and a maximum likelihood parameter estimator to infer the radar parameter values. Two layers of signal processing are introduced in this paper. The first layer is concerned with the estimation of MFR's policies of operation. It involves signal processing in the CFG domain. The second layer is concerned with identification of tasks the radar is engaged in. It involves signal processing in the finite-state domain. Both of these signal processing techniques are important elements of a bigger radar signal processing problem that is often encountered in electronic warfare applications-the problem of the estimation of the level of threat that a radar poses to each individual target at any point in time. [J2009]

"Wireless Power Transmission to a Buried Sensor in Concrete"

The feasibility of sending wireless power to a buried sensor antenna within concrete was studied. A receive patch rectenna with 75.8% conversion efficiency was designed for operation at 5.7 GHz. The received DC power at the rectenna was measured within dry and wet concrete samples with various cover thicknesses and air-gaps. For the rectenna buried within 30 mm of the concrete, the received DC power was 10.37 mW, which was about 70% of the received DC power in free-space. [J2010]

"Results of a Space-Surface Bistatic SAR Image Formation Algorithm"

This paper reports progress in the development of an image formation algorithm suitable for stripmap space-surface bistatic synthetic aperture radar. A description of the proposed algorithm, which is a modification of the standard range-Doppler algorithm, is provided for the case when the transmitter and the receiver have parallel flight paths and unequal velocities. Both simulation and initial experimental results are presented to verify our analysis. [J2011]

"Neural Networks for Improved Tracking"

In this letter, we have developed a neural network (NN) based upon modeling fields for improved object tracking. Models for ground moving target indicator (GMTI) tracks have been developed as well as neural architecture incorporating these models. The neural tracker overcomes combinatorial complexity of tracking in highly cluttered

scenarios and results in about 20-dB (two orders of magnitude) improvement in signal-to-clutter ratio. [J2012]

"Bayesian Analysis of Lidar Signals with Multiple Returns"

Time-correlated single photon counting and burst illumination laser data can be used for range profiling and target classification. In general, the problem is to analyze the response from a histogram of either photon counts or integrated intensities to assess the number, positions, and amplitudes of the reflected returns from object surfaces. The goal of our work is a complete characterization of the 3D surfaces viewed by the laser imaging system. The authors present a unified theory of pixel processing that is applicable to both approaches based on a Bayesian framework, which allows for careful and thorough treatment of all types of uncertainties associated with the data. We use reversible jump Markov chain Monte Carlo (RJMCMC) techniques to evaluate the posterior distribution of the parameters and to explore spaces with different dimensionality. Further, we use a delayed rejection step to allow the generated Markov chain to mix better through the use of different proposal distributions. The approach is demonstrated on simulated and real data, showing that the return parameters can be estimated to a high degree of accuracy. We also show some practical examples from both near and far-range depth imaging. [J2013]

"An Unsupervised Segmentation With an Adaptive Number of Clusters Using the SPAN/H/α/A Space and the Complex Wishart Clustering for Fully Polarimetric SAR Data Analysis"

In this paper, an unsupervised segmentation is proposed for fully polarimetric synthetic aperture radar (SAR) data analysis. The backscattering power SPANcombined with H/alpha/Ais used to obtain the initial cluster centers. We use the Wishart test statistic to perform an agglomerative hierarchical clustering to obtain the segmentation results with different numbers of clusters. The appropriate number of clusters is automatically estimated using the data log-likelihood (Lm), and the resulting images with the estimated number of clusters are the final segmentation results. The experiments show that the SPANhas additional information that is not contained in H/alpha/A, and this information could be useful for the initialization. The number of clusters seems to be a crucial point for the segmentation, which will affect the segmentation performance. It is also shown that the data log-likelihood has the potential ability to reveal the inner structure of fully polarimetric SAR data. [J2014]

"Foreword to the Special Issue on Synthetic Aperture Radar (SAR) Technologies and Techniques"

{no data available} [J2015]

"DEM Control in Arctic Alaska With ICESat Laser Altimetry"

Use of Ice, Cloud, and land Elevation Satellite (ICESat) laser altimetry is demonstrated for control of a digital elevation model (DEM) that is synthesized from repeat-pass ERS-1 and 2 synthetic aperture radar (SAR) imagery using interferomet-ric SAR (InSAR). Our study area is 15 650 km2of the Barrow, AK coastal plain adjacent to the Arctic Ocean; a vast expanse of tundra, lakes, and arctic wetlands of such low relief as to be nearly devoid of terrain features. The accuracy of the ICESat-derived elevation measurements is assessed by comparison with differential global positioning system (DGPS) data acquired along ICESat ground tracks. The ICESat-derived elevations have a mean accuracy, relative to the DGPS elevations, of -0.01 plusmn 0.18 m. ICESat-derived elevations on the Arctic coastal plain provide an excellent source for DEM control. We employ the ICESat-derived ground control points (GCPs) in two distinct InSAR processing steps: 1) selected points are used to perform baseline refinements, which improves the ERS-1 and 2 interfero-grams and 2) the ICESat-derived GCP position data (latitude, longitude, elevation) are then used as control in mosaicking multiple InSAR-derived DEMs. The resulting ICESat-controlled DEM has a mean accuracy of -1.11plusmn 6.3 m relative to an independent standard, which is a commercial airborne InSAR-derived DEM having 0.5 m rms accuracy. This easily meets DTED-2 standards and suggests that DEMs derived using only ICESat altimetry for ground control would meet similar standards in other regions of low relief. [J2016]

"Retrieving 3-D Topography by Using a Single-Antenna Squint-Mode Airborne SAR"

In this paper, a novel method is proposed for retrieving 3-D topography of the ground surface by using a single-antenna squint-mode airborne synthetic aperture radar (SAR). The main idea of the method is based on the fact that the spatial 3-D location of a target can be found as the intersection of the range sphere, the Doppler cone, and the elevation plane of the antenna pattern. An accurate estimation of the Doppler centroid for each resolution cell is required to realize this method. Experimental results obtained with a Ku-band airborne SAR are presented. The method calls for using a precise calibrated attitude determination unit. [J2017]

"ALOS PALSAR: A Pathfinder Mission for Global-Scale Monitoring of the Environment"

The Advanced Land Observing Satellite (ALOS) is Japan's new-generation Earth Observation satellite, launched in January 2006 by the Japan Aerospace Exploration Agency. ALOS carries two optical instruments (Panchromatic Remote-sensing Instrument for Stereo Mapping and Advanced Visible and Near-Infrared Radiometer type 2) and, to maintain Japan's commitment to spaceborne L-band Synthetic Aperture Radar (SAR), the Phased Array L-band SAR (PALSAR). The successor to the SAR onboard the Japanese Earth Resources Satellite (1992-1998), the PALSAR instrument provides enhanced sensor characteristics, including full polarimetry, variable off-nadir viewing, and ScanSAR operations, as well as significantly improved radiometric and geometric performance. As important as the technical improvements and the reason PALSAR here is referred to as a pathfinder mission for global environmental monitoring is the systematic data-acquisition strategy which has been implemented for ALOS. With a priority second only to emergency observations, the PALSAR observation strategy has been designed to provide consistent, wall-to-wall observations at fine resolution of all land areas on the Earth on a repetitive basis, in a manner which has earlier been conceived only for coarse- and medium-resolution instruments. [J2018]

"Evaluation of a New Airborne Microwave Remote Sensing Radiometer by Measuring the Salinity Gradients Across the Shelf of the Great Barrier Reef Lagoon"

Over the last ten years, some operational airborne remote sensing systems have become available for mapping surface salinity over large areas in near real time. A new dual-polarized Polarimetric L-band Multibeam Radiometer (PLMR) has been developed to improve accuracy and precision when compared with previous instrument generations. This paper reports on the first field evaluation of the performance of the PLMR by measuring salinity gradients in the central Great Barrier Reef. Before calibration, the raw salinity values of the PLMR and conductivity-temperature-depth (CTD) differed by 3-6 psu. The calibration, which uses in situ salinity data to remove long-term drifts in the PLMR as well as environmental effects such as surface roughness and radiation from the sky and atmosphere, was carried out by equating the means of the PLMR and CTD salinity data over a subsection of the transect, after which 85% of the salinity values between the PLMR and CTD are within 0.1 psu along the complete transect. From offshore to inshore across the shelf, the PLMR shows an average cross-shelf salinity increase of about 0.4 psu and a decrease of 2 psu over the inshore 20 km at -19deg S (around Townsville) and -18deg S (around Lucinda), respectively. The average cross-shelf salinity increase was 0.3 psu for the offshore 100 km over all transects. These results are consistent with the in situ CTD results. This survey shows that PLMR provided an effective method of rapidly measuring the surface salinity in near real time when a calibration could be made. [J2019]

"Analysis and Focusing of Bistatic Airborne SAR Data"

Bistatic synthetic aperture radar (SAR) processing requires precise knowledge about geometrical parameters of the flown bistatic constellation, whereas estimation of these parameters is even more important than in the monostatic case. As it is impossible to separate the individual semimonostatic parameters from the bistatic raw data, the searched parameters are derived from the tracks of the moving platforms. For this reason, global positioning system (GPS) and inertial navigation system (INS) position and velocity data of transmitter and receiver are combined in an optimal way by a Kalman filter approach. As a consequence of model-based interpolation, we can easily determine varying parameters like Doppler centroid frequency, azimuth velocity, and the bistatic parameters a2and a0referring to the illuminated scene at each time instant. Accurately determined position and velocity of the transmitter and receiver enable a first-order bistatic motion compensation (MC), which is also described in this paper. In verifying our approach, GPS/INS tracks and raw data of a bistatic airborne SAR experiment flown in 2003 were used, where the data were provided by Forschungsgesellschaft fu umlr Angewandte Naturwissenschaften e.V., Wachtberg, Germany. The focusing was done by a scaled inverse Fourier transformation processor for nearly parallel trajectories for transmitter and receiver. This paper focuses on analyzing the trajectories and antenna beams of bistatic missions to obtain accurate processing parameters and MC functions. [J2020]

"Model Limitations and Parameter-Estimation Methods for Agricultural Applications of Polarimetric SAR Interferometry"

Application of polarimetric synthetic aperture radar interferometry to the retrieval of geophysical parameters from vegetated scenes is based on simple direct models of such scenes. The first part of this paper presents an analysis of the correspondence between these simple models, namely, the random volume over ground and the oriented volume over ground (OVoG), and experimental data from samples of two agricultural crops (maize and rice) acquired in controlled conditions. Although an overall agreement between model and data is clear, some discrepancies have been found as a consequence of two assumptions in the model formulation: vertical homogeneity of the vegetation volume and absence of multiple scattering effects inside the volume. This paper presents the shape and location of the visible region of the experimental coherences on the complex plane and

compares it with the feasible region predicted by the model. This comparison has also pointed out the low sensitivity of the direct model to extinction coefficients. In the second part, two different strategies for a complete inversion (i.e., estimation of all model parameters) of the OVoG model are proposed and compared, using the same data set. The first one is based on a combination of geometrical and numerical approaches (genetic algorithms) and the second one on a dual-baseline configuration. In all cases, ground topography is accurately estimated, with a maximum error of 10 cm. Vegetation height estimates are accurate up to 30 cm, with some bands and baseline configurations providing errors below 15 cm. However, results obtained for the extinction coefficients are not stable with frequency and exhibit high variability. [J2021]

"Focusing Parallel Bistatic SAR Data Using the Analytic Transfer Function in the Wavenumber Domain"

In recent years, bistatic synthetic aperture radar (BiSAR) has attracted the attention of many radar researchers. It is well known that the slant range history of BiSAR is the sum of two square-rooted terms, which correspond to the transmitting and receiving slant ranges, respectively. For a point target in the SAR scene, it is quite difficult, if not impossible, to obtain an analytic formula to describe the target echo data in the 2-D frequency domain without any approximation by using the conventional stationary phase method, which makes it very difficult to develop fast-focusing algorithms for BiSAR. In this paper, based on the concept of an instantaneous Doppler wavenumber and by defining a new variable called half quasi-bistatic angle, an analytic formula of the point target response in the spectral domain is developed for BiSAR with parallel trajectory (referred to as parallel BiSAR for simplicity). Relying on a first-order Taylor expansion of the above formula with respect to the parameter called the sum of closest distances on the swath center, a bistatic range migration algorithm is proposed for any azimuth-shift-invariant BiSAR data processing. Simulation results have confirmed the effectiveness of the proposed novel approach. [J2022]

"Inverse Synthetic Aperture Secondary Radar Concept for Precise Wireless Positioning"

In this paper, the novel inverse synthetic aperture secondary radar wireless positioning technique is introduced. The proposed concept allows for a precise spatial localization of a backscatter transponder even in dense multipath environments. A novel secondary radar signal evaluation concept compensates for the unknown modulation phase of the returned signal and thus leads to radar signals comparable to common primary radar. With use of this concept, inverse synthetic aperture radar algorithms can be applied to the signals of backscatter transponder systems. In simulations and first experiments, we used a broadband holographic reconstruction principle to realize the inverse synthetic aperture approach. The movement of the transponder along a short arbitrary aperture path is determined with assisting relative sensors (dead reckoning or inertia sensors). A set of signals measured along the aperture is adaptively focused to the transponder position. By this focusing technique, multipath reflections can be suppressed impressively and a precise indoor positioning becomes feasible. With our technique, completely new and powerful options for integrated navigation and sensor fusion in RF identification systems and wireless local positioning systems are now possible. [J2023]

"Power Optimization for Polarimetric Bistatic Random Mechanisms"

The aim of this paper is to investigate the optimal polarizations (i.e., emitted and received polarizations for which the received power is maximum or minimum) in the general case of random mechanisms observed by a bistatic full-polarimetric radar. We are particularly interested in the methods leading to analytical solution as far as this is possible. It is the reason why the Kennaugh matrix is taken as the starting point of the optimizations. The optimal polarizations corresponding to the monostatic and bistatic deterministic cases are found again as particular cases. [J2024]

"Extreme Compression of Weather Radar Data"

A method for achieving extreme levels of compression of high-volume weather radar data is presented. Weather reflectivity contours, as per National Weather Service or custom thresholds, are processed by tracing their departure from a smoothed version to obtain the local extrema which serve as control points. The control points, which are transmitted in relative coordinates for further compression, are interpolated using a second-degree B-spline to retrieve the contours. The encoding-decoding method is capable of capturing the random undulations inherent in weather contours. It is shown that over two orders of magnitude of compression is possible without perceptible loss of meteorological information. Multiple enhancements to the basic method are quantitatively studied and compared with the existing methods for radar data compression. [J2025]

"Analysis of Polarization Orientation Angle Shifts by Artificial Structures"

In this paper, the polarization orientation angle shifts induced by artificial structures were analyzed and attempted

to combine target orientation information which characterizes an urban area with the polarization orientation angle information extracted by the circular-polarization method. In order to illustrate the characteristic of the polarization orientation angle shifts represented in an urban area, the X-band polarimetric synthetic aperture radar (SAR) datasets of Sendai City acquired by Pi-SAR were used. This paper is based on Kimura's idea that the variation of the polarization orientation angle shifts depends on the artificial structures, particularly for the target rotation angle. We found that the polarization orientation angle shift is also affected by the relative relationship between the target rotation angle and the flight direction. From these results, it is possible to estimate the target rotation angle via computation of the polarization orientation angle shift from polarimetric SAR data. [J2026]

"Radar Target Tracking via Robust Linear Filtering"

In this letter, we provide a robust version of a linear Kalman filter for target tracking based on a measurement conversion technique on the nonlinear radar measurements. We prove that the state estimation error is bounded in a probabilistic sense. We compare our approach with the current state of the art in converted radar measurement-based linear filtering. [J2027]

"Spatially Nonstationary Anisotropic Texture Analysis in SAR Images"

This paper deals with spatial analysis of texture in synthetic aperture radar (SAR) images. A new parametric model for local two-point statistics of the image is introduced, in order to characterize the spatially nonstationary and anisotropic behavior of the image. The texture is first modeled by a nonstationary Gaussian process resulting from the convolution of a Gaussian white noise with a field of anisotropic Gaussian kernel with spatially varying parameters. Hence, under the hypothesis of locally stationary signal, the analytic expression of the local autocovariance is derived. It is then explained how to simulate nonstationary K-distributed random fields by combining the new model with an already existing simulation method. A method for parameter estimation is then introduced. This method, based on the statistical product model, first corrects the speckle contribution to the local autocovariance and estimates the parameters of the model by analyzing the shape of the autocovariance. The algorithm is then evaluated over simulated and experimental data. Stationary simulations permit to show that, for a sufficient sample size, the estimator is unbiased. A test over a nonstationary simulation proves the ability of the algorithm to capture the spatial fluctuations of the texture. Finally, the method is applied to the experimental SAR data, and it is shown that a large amount of spatial information may be retrieved from the data. [J2028]

"Distinguished Tutorials Program"

{no data available} [J2029]

"2008 IEEE Radar Conference"

{no data available} [J2030]

"Multiscale Isotropic Matched Filtering for Individual Tree Detection in LiDAR Images"

This paper addresses the issue of automated tree detection in remote-sensing imagery, particularly in the case of light detection and ranging (LiDAR) height data. The proposed method consists of multiscale isotropic matched filtering using a nonlinear image operator optimized for object detection and recognition. The method provides a robust scale- and orientation-invariant localization of the objects of interest. The local maxima of the matched-filtering operator are located at the potential centers of the objects of interest such as the trees. The tree verification stage consists of feature extraction at the candidate tree locations and comparison with the feature reference values. Experimental examples of the application of this matched-filtering method to LiDAR images of dense forest stands and sparsely distributed trees in residential areas are provided. [J2031]

"SAR Sea-Ice Image Analysis Based on Iterative Region Growing Using Semantics"

Synthetic aperture radar (SAR) has been intensively used for sea-ice monitoring in polar regions. A computer-assisted analysis of SAR sea-ice imagery is extremely difficult due to numerous imaging parameters and environmental factors. This paper presents a system which, with some limited information provided, is able to perform an automated segmentation and classification for the SAR sea-ice imagery. In the system, both the segmentation and classification processes are based on a Markov random-field theory and are formulated in a joint manner under the Bayesian framework. Solutions to the formulation are obtained by a region-growing technique which keeps refining the segmentation and producing semantic class labels at the same time in an iterative manner. The algorithm is a general-segmentation approach named iterative region growing using

semantics, which, in this paper, is dedicated to the problem of classifying the operational SAR sea-ice imagery provided by the Canadian Ice Service (CIS). The classified image results have been validated by the CIS personnel, and the resulting classifications are quite successful using the same algorithm applied to diverse data sets. [J2032]

"Foreword to the Special Issue on Pattern Recognition in Remote Sensing"

The papers in this special section are devoted to pattern recognition in remote sensing applications. [J2033]

"Improving River Flood Extent Delineation From Synthetic Aperture Radar Using Airborne Laser Altimetry"

Flood extent maps that are derived from synthetic aperture radar (SAR) images provide spatially distributed data for validating hydraulic models of river flood flow. The accuracy of such maps is reduced by a number of factors, including variation in backscatter from the different land cover types that are adjacent to the flood, changes in returns from the water surface that are caused by different meteorological conditions, and the presence of emergent vegetation. This paper describes how improved accuracy can be achieved by modifying an existing flood extent delineation algorithm to use airborne laser altimetry [light detection and ranging (lidar)] as well as SAR data. The lidar data provide an additional constraint that water line heights should vary smoothly along the flooded reach. The method was tested on a SAR image of a flood for which contemporaneous aerial photography existed, together with lidar data of the un flooded reach. The water line heights of the SAR flood extent that was conditioned on both SAR and lidar data matched the corresponding heights from the aerial photograph water line significantly more closely than those from the SAR flood extent that was conditioned only on SAR data. For water line heights in areas of low slope and vegetation, the root-mean-square error on the height differences reduced from 221.1 cm for the latter case to 55.5 cm for the former. [J2034]

"A New Application for PolSAR Imagery in the Field of Moving Target Indication/Ship Detection"

Recent analysis of a polarimetric synthetic aperture radar (PolSAR) velocity experiment has shown that azimuth ambiguities can provide useful information for the detection of moving targets with an across-track velocity component in PolSAR images using cross-polarization clutter cancellation. This paper examines this phenomenon using theoretical analysis and simulations and illustrates its application with experimental results. It is shown that, for reciprocal scatterers, the phase difference between HV and VH images is zero, whereas for HV and VH ambiguities, the phase difference is pi. For land applications, clutter cancellation is essential for the detection of moving targets in PolSAR images. For maritime applications, it can be used to distinguish images from ambiguities. However, it is important to note that the underlying physical reasons for the performance of clutter cancellation are entirely different from ground moving target indication along-track interferometric SAR. It is also shown that cross-pol clutter cancellation is related to filtering of a double-rate-sampled single-channel SAR signal. [J2035]

"Supervised Fuzzy-Logic Classification of Hydrometeors Using C-Band Weather Radars"

A model-based fuzzy-logic method for hydrometeor classification using C-band polarimetric radar data is presented and discussed. Membership functions of the fuzzy-logic algorithm are designed for best fitting simulated radar signatures at C-band. Such signatures are derived for ten supervised hydrometeor classes by means of a fully polarimetric radar scattering model. The Fuzzy-logic Radar Algorithm for Hydrometeor Classification at C-band (FRAHCC) is designed to use a relatively small set of polarimetric observables, i.e., copolar reflectivity and differential reflectivity, but a version of the algorithm based on the use of specific differential phase is also numerically tested and documented. The classification methodology is applied to volume data coming from a C-band two-radar network that is located in north Italy within the Po valley. Numerical and experimental results clearly show the improvements of hydrometeor classification, which were obtained by using FRAHCC with respect to the direct use of fuzzy-logic-based algorithms that are specifically tuned for S-band radar data. Moreover, the availability of two C-band rainfall observations of the same event allowed us to implement a path-integrated attenuation correction procedure, based on either a composite radar field approach or a network-constrained variational algorithm. The impact of these correction procedures on hydrometeor classification is qualitatively discussed within the considered case study. [J2036]

"A Self-Initializing PolInSAR Classifier Using Interferometric Phase Differences"

This paper describes an unsupervised classifier for polarimetric interferometric synthetic aperture radar (PolInSAR) data. Expectation maximization is used to estimate class parameters that maximize the likelihood of observations in an input data set for a given number of classes. Polarimetric information, in the form of coherency matrices, and interferometric information, in the form of complex coherences, are taken into account.

Differences in interferometric phase across different polarization states are explicitly modeled to make the classifier sensitive to the vertical structure of the scene under observation, and the distribution over such phase differences is introduced. The classifier is self-initializing, in that it does not rely on decompositions or thresholds. Classification results obtained for real polarimetric interferometric data are presented and discussed. [J2037]

"TanDEM-X: A Satellite Formation for High-Resolution SAR Interferometry"

TanDEM-X (TerraSAR-X add-on for digital elevation measurements) is an innovative spaceborne radar interferometer that is based on two TerraSAR-X radar satellites flying in close formation. The primary objective of the TanDEM-X mission is the generation of a consistent global digital elevation model (DEM) with an unprecedented accuracy, which is equaling or surpassing the HRTI-3 specification. Beyond that, TanDEM-X provides a highly reconfigurable platform for the demonstration of new radar imaging techniques and applications. This paper gives a detailed overview of the TanDEM-X mission concept which is based on the systematic combination of several innovative technologies. The key elements are the bistatic data acquisition employing an innovative phase synchronization link, a novel satellite formation flying concept allowing for the collection of bistatic data with short along-track baselines, as well as the use of new interferometric modes for system verification and DEM calibration. The interferometric performance is analyzed in detail, taking into account the peculiarities of the bistatic operation. Based on this analysis, an optimized DEM data acquisition plan is derived which employs the combination of multiple data takes with different baselines. Finally, a collection of instructive examples illustrates the capabilities of TanDEM-X for the development and demonstration of new remote sensing applications. [J2038]

"A Persymmetric GLRT for Adaptive Detection in Partially-Homogeneous Environment"

This letter deals with the problem of adaptive detection in Gaussian disturbance with unknown but persymmetric structured covariance matrix. A partially-homogeneous environment is considered at the design stage, and a receiver based on the generalized likelihood ratio test (GLRT) is derived. At the analysis stage, the performance of the new receiver is assessed, also in comparison with the unstructured GLRT, showing that the a-prioriinformation on the covariance structure can lead to a noticeable performance improvement. [J2039]

"Petaloid antenna for passive UWB-RFID tags"

An ultra-wideband (UWB) antenna designed with a petal-shaped structure is presented. Its measured impedance bandwidth of 10 dB return loss is from 6.6 to 17.5 GHz whereas the size is just 18times16 mm. The radar cross-section and scattered waveforms of the proposed petaloid antenna are theoretically studied using the finite-difference time-domain (FDTD) method. Its backscattering of antenna mode is comparable to that of structural mode, and the scattering pattern is almost omnidirectional. This antenna is suitable for passive ultra-wideband radio-frequency identification (UWB-RFID) tag applications. [J2040]

"Signal Processing for FMCW SAR"

The combination of frequency-modulated continuous-wave (FMCW) technology and synthetic aperture radar (SAR) techniques leads to lightweight cost-effective imaging sensors of high resolution. One limiting factor to the use of FMCW sensors is the well-known presence of nonlinearities in the transmitted signal. This results in contrast- and range-resolution degradation, particularly when the system is intended for high-resolution long-range applications, as it is the case for SAR. This paper presents a novel processing solution, which solves the nonlinearity problem for the whole range profile. Additionally, the conventional stop-and-go approximation used in pulse-radar algorithms is not valid in FMCW SAR applications under certain circumstances. Therefore, the motion within the sweep needs to be taken into account. Analytical development of the FMCW SAR signal model, starting from the deramped signal and without using the stop-and-go approximation, is presented in this paper. The model is then applied to stripmap, spotlight, and single-transmitter/multiple-receiver digital-beamforming SAR operational mode. The proposed algorithms are verified by processing real FMCW SAR data collected with the demonstrator system built at the Delft University of Technology. [J2041]

"Polarimetric and Interferometric SAR Image Partition Into Statistically Homogeneous Regions Based on the Minimization of the Stochastic Complexity"

In this paper, we show that polarimetric and interferometric SAR (PolInSAR) images can be efficiently partitioned into homogeneous regions with a statistical technique based on minimization of a parameter-free criterion. This technique consists of finding a polygonal partition of the image that minimizes the stochastic complexity, assuming that the image is made of a tessellation of statistically homogeneous regions. The obtained results demonstrate that a global partition in statistically homogeneous regions of PolInSAR images can provide better

results than a partition based on a single characteristic such as polarimetry or interferometry only. [J2042]

"Bistatic Radar Imaging of the Marine Environment-Part II: Simulation and Results Analysis"

We present a bistatic, polarimetric, and real aperture marine radar simulator (MaRS) producing pseudoraw radar signals. The simulation takes the main elements of the environment into account (sea temperature, salinity, and wind speed). Realistic sea surfaces are generated using a two-scale model on a semideterministic basis to incorporate the presence of ship wakes. Then, the radar acquisition chain (antennas, modulation, and polarization) is modeled, as well as the movements of the sensors, on which uncertainties can be introduced, and ship wakes. The pseudoraw temporal signals delivered by MaRS are further processed using, for instance, bistatic synthetic aperture beamforming. The scene itself represents the sea surface as well as ship wakes. The main points covered here are the scene discretization, the ship wake modeling, and the computational cost aspects. We also present images simulated in various monostatic and bistatic configurations and discuss the results. This paper follows its companion paper, where much of the theory used here is recalled and developed in detail. a bistatic, polarimetric, and real aperture marine radar simulator (MaRS) producing pseudoraw radar signals. The simulation takes the main elements of the environment into account (sea temperature, salinity, and wind speed). Realistic sea surfaces are generated using a two-scale model on a semideterministic basis to incorporate the presence of ship wakes. Then, the radar acquisition chain (antennas, modulation, and polarization) is modeled, as well as the movements of the sensors, on which uncertainties can be introduced, and ship wakes. The pseudoraw temporal signals delivered by MaRS are further processed using, for instance, bistatic synthetic aperture beamforming. The scene itself represents the sea surface as well as ship wakes. The main points covered here are the scene discretization, the ship wake modeling, and the computational cost aspects. We also present images simulated in various--monostatic and bistatic configurations and discuss the results. This paper follows its companion paper, where much of the theory used here is recalled and developed in detail. [J2043]

"Radar Conference Awards [Jpresented to Dr. Eli Brookner, Dr. Joseph Guerci, and Dr. Michael Picciolo]"

{no data available} [J2044]

"Society News & Information-Distinguished Tutorials Program"

{no data available} [J2045]

"MIMO Radar with Colocated Antennas"

We have provided a review of some recent results on the emerging technology of MIMO radar with colocated antennas. We have shown that the waveform diversity offered by such a MIMO radar system enables significant superiority over its phased-array counterpart, including much improved parameter identifiability, direct applicability of adaptive techniques for parameter estimation, as well as superior flexibility of transmit beampattern designs. We hope that this overview of our recent results on the MIMO radar, along with the related results obtained by our colleagues, will stimulate the interest deserved by this topic in both academia and government agencies as well as industry. [J2046]

"Vacuum Electronics: Status and Trends"

The vast preponderance of US radar transmitters today use vacuum electronic amplifiers, spanning the spectrum from UHF to EHF. Enhancements to performance, reliability, and cost of ownership are being applied continuously to these systems: routine in-service life extensions mandate continuing vacuum electronics research and development to support system needs for the foreseeable future. In addition, exciting advances in vacuum electronics will provide dramatic improvements in millimeter-wave radar resolution, broadband low-noise power at microwave frequencies, compact high power sources operating at lower voltages, and life-cycle cost improvement. Recent progress in key enabling technologies, e.g., advanced device modeling and micro-fabrication, is expected to continue. This reviews the status and trends of vacuum electronics, with selected applications emphasizing recent advances in device performance in the microwave regime: multiple-beam klystrons (MBKs), microwave power modules (MPMs), and gyro-amplifiers in the millimeter-wave regime. [J2047]

"Multidimensional Frequency Estimation With Finite Snapshots in the Presence of Identical Frequencies"

Recently, an eigenvector-based algorithm has been developed for multidimensional frequency estimation with a single snapshot of data mixture. Unlike most existing algebraic approaches that estimate frequencies from

eigenvalues, the eigenvector-based algorithm achieves automatic frequency pairing without joint diagonalization of multiple matrices, but it fails when there exist identical frequencies in certain dimensions because eigenvectors are not linearly independent anymore. In this paper, we develop an eigenvector-based algorithm for multidimensional frequency estimation with finite data snapshots. We also analyze the identifiability (ID) and performance of the proposed algorithm. It is shown that our algorithm offers the most relaxed statistical ID condition for multidimensional frequency estimation from finite snapshots. More important, we introduce complex weighting factors so that the algorithm is still operational when there exist identical frequencies in one or more dimensions. Furthermore, the weighting factors are optimized to minimize the mean square errors of the frequency estimates. Simulation results show that the proposed algorithm offers competitive performance when compared to existing algebraic approaches but at lower complexity. [J2048]

"Statistical Angular Resolution Limit for Point Sources"

We define a statistical angular resolution limit (ARL) on resolving two closely spaced point sources in a 3-D reference frame, using constraints on the probabilities of false alarm and detection for a hypothesis test. The ARL can be used as a performance measure for sensor arrays in localizing remote sources and is applicable to different measurement models and applications (e.g., radar, sonar, or astronomy). By considering the asymptotic performance of the generalized likelihood ratio test (GLRT), we derive the analytical expression of the ARL and show that it is proportional to the square root of the Cramer-Rao bound (CRB) on the angular source separation, or asymptotically the lower bound on the mean-square angular error (MSAECRB) . Numerical examples illustrate that the proposed ARL is practically computable and achievable with large data samples. Our analytical result can replace the commonly used ad hoc resolution limits in existing literature. [J2049]

"A Beginner's Guide to Interferometric SAR Concepts and Signal Processing [JAESS Tutorial IV]"

Interferometric synthetic aperture radar (IFSAR, also abbreviated as InSAR) employs pairs of high resolution SAR images to generate high quality terrain elevation maps using phase interferometry methods. IFSAR provides an all-weather, day/night capability to generate measurements of terrain elevation on a dense grid of sample points with accuracies of ones of meters. Both spaceborne and airborne IFSAR systems are in use. In this paper we present a tutorial introduction to the concepts, techniques, and applications of IFSAR. After a brief introduction to digital elevation models (DEMs) and digital terrain elevation data (DTED), the fundamental IFSAR equation relating interferometric phase measurements to terrain elevation is derived from simple geometric considerations. The central section of the paper describes the major algorithmic steps required to form an IFSAR terrain map. Finally, variations of IFSAR for mapping terrain elevation or reflectivity changes are briefly described. A Web site at users.ece.gatech.edu/~mrichard/AESSJFSAR.htm provides access to color versions of many of the IFSAR images included in this paper. [J2050]

"Template-Based Target Identification and Confusion Matrices [JAESS Tutorial IV]"

One-dimensional high-range-resolution (HRR) and two-dimensional range-Doppler-imaging (RDI) radar represent possible sensor technologies where template-based techniques can be applied to perform combat identification (CID). The majority of the research reported in these areas consists of empirical studies. This article provides a theoretical basis for understanding some of the fundamental trade-offs associated with these CID techniques, such as the following: What are the relative advantages of RDI over HRR radar or of finer versus coarser resolution in the HRR process? What is the relative advantage of coherent over noncoherent processing? How do target correlations, signal-to-noise ratio (SNR), and target scintillation affect the ability to identify targets? Because confusion matrices are often used to characterize the performance of CID systems, we provide analytical methods for calculating the entries in confusion matrices as a function of the issues cited above. These formulations provide analytical bases to guide system trade-off decisions. The organization of this paper is as follows. We begin with a short overview of HRR and RDI and then explore a number of ways to process the associated target templates that range from an ideal, theoretical approach to an approach that would be more feasible to implement within current-day radars. We first develop analytic template-based methodologies for constructing confusion matrix entries for nonscintillating targets for both coherent and noncoherent processing assumptions. The confusion matrix entries in these cases are conditional probabilities obtained from a simple rule: find the probability that among m (in general, correlated) random variables, each associated with a possible target, that any one is the largest. For the noncoherent case, the successful application of this rule requires the target template values to explicitly include the effects of thermal noise (noise-adjusted templates). We conclude by showing h--ow to calculate theoretically optimum results (e.g., using maximum likelihood techniques) for noncoherent processing of targets that exhibit uncorrelated Swerling 1 scintillation in ail resolution bins as a function of the SNR. This approach allows us to include overall target intensity (e.g., total radar cross section (RCS)) as a further factor in the target decision process. [J2051]

"Cars Get Street Smart [JNews]"

{no data available} [J2052]

"A Multiple-Hypothesis Approach for Multiobject Visual Tracking"

In multiple-object tracking applications, it is essential to address the problem of associating targets and observation data. For visual tracking of multiple targets which involves objects that split and merge, a target may be associated with multiple measurements and many targets may be associated with a single measurement. The space of such data association is exponential in the number of targets and exhaustive enumeration is impractical. We pose the association problem as a bipartite graph edge covering problem given the targets and the object detection information. We propose an efficient method of maintaining multiple association hypotheses with the highest probabilities over all possible histories of associations. Our approach handles objects entering and exiting the field of view, merging and splitting objects, as well as objects that are detected as fragmented parts. Experimental results are given for tracking multiple players in a soccer game and for tracking people with complex interaction in a surveillance setting. It is shown through quantitative evaluation that our method tracks through varying degrees of interactions among the targets with high success rate. [J2053]

"Time Delay Estimation Bounds in Convolutive Random Channels"

We develop bounds on time delay estimation (TDE) in wideband convolutive random channels. The improved Ziv-Zakai bound (ZZB) is adapted to this case, resulting in mean-square error (MSE) bounds that are independent of estimator bias, and avoid regularity conditions. We assume a known transmitted signal, a tapped delay line random channel model, and a uniform prior on the delay. The taps are modeled as Gaussian, including non-zero mean and possible correlation between taps. The channel model may be tuned to a variety of environments through the choice of mean and covariance, and models wideband and ultra-wideband line of sight (LOS) and non-LOS (NLOS) cases. Flat fading is a simple special case with one tap. The channel power delay profile is incorporated through the tap covariance matrix, and results for an exponential power delay profile are given. We derive the ZZB for a given channel realization, and then average over the random channel model. The resulting bound reflects the impact of the random channel, providing an average MSE performance bound, that assumes perfect channel estimates are available to the receiver. Specific cases and examples illustrate the impact of the key system, channel, and signal parameters. [J2054]

"Visual Learning by Evolutionary and Coevolutionary Feature Synthesis"

In this paper, we present a novel method for learning complex concepts/hypotheses directly from raw training data. The task addressed here concerns data-driven synthesis of recognition procedures for real-world object recognition. The method uses linear genetic programming to encode potential solutions expressed in terms of elementary operations, and handles the complexity of the learning task by applying cooperative coevolution to decompose the problem automatically at the genotype level. The training coevolves feature extraction procedures, each being a sequence of elementary image processing and computer vision operations applied to input images. Extensive experimental results show that the approach attains competitive performance for three-dimensional object recognition in real synthetic aperture radar imagery. [J2055]

"Pseudonoise Optical Modulation for Real-Time 3-D Imaging With Minimum Interference"

In optical time-of-flight (TOF) range imaging, harmonic intensity modulation of the illumination source is very common. By detecting the phase delay between emitted and reflected sinusoids, the distance can be measured accurately. However, this harmonic approach does not allow for the concurrent operation of several TOF range cameras because the arbitrary superposition of several differently parametrized sinusoids leads to a sinusoid with incorrect phase. To minimize inaccuracies by multi-camera interference (MCI), pseudonoise (PN) modulated intensity signals are employed for robust TOF range imaging. The time of flight is locally measured by correlating the incident light intensity with two time-shifted versions of the PN sequence, making use of smart demodulation pixels. We derive two fundamental expressions for the basic limitations of TOF measurements using PN sequences. Firstly, the precision of the distance measurement is limited by photon shot noise, and it essentially shows an inverse square root dependence of the number of detected photoelectrons. Secondly, MCI causes an inaccurate distance measurement given as the ratio of two sums. The denominator is the sum of two autocorrelation and two cross-correlation values; the nominator is the sum of one autocorrelation and one cross-correlation value. Due to the lack of a strict mathematical theory of correlation properties of m-sequences, an exhaustive numerical simulation was carried out to obtain expectation values of the distance measurement inaccuracy as a function of the sequence length and the number of interfering cameras. For experimental verification, an image sensor with 176 times 144 demodulation pixels was manufactured with a standard CMOS

process offering a CCD option. Measurements taken with up to five concurrently operating sensors were in excellent agreement with our theoretical predictions concerning achievable distance accuracy. This confirms the aptness of PN techniques for multi-camera optica- l TOF range imaging. [J2056]

"Feature Extraction by Gaussian Mixture With Rigidity Constraint"

The performance of feature-aided tracking (FAT) relies largely on the quality of features extracted from signature sensors. In our previous work, we introduced a new FAT algorithm for tracking with ground moving target indicator (GMTI) and high resolutional range (HRR) measurements, where features were extracted from an HRR sensor using the technique of mixture density estimation. Although satisfactory results were achieved, an additional improvement is expected if a target rigidity constraint is incorporated. In this paper, we exploit the rigidity property of targets to alleviate the inherent local convergence problem of the expectation-maximization algorithm used in mixture density estimation. Simulation results show a performance improvement over the previous FAT algorithm. [J2057]

"High-bandwidth 220 GHz experimental radar"

An experimental radar at 220 GHz has been developed which is capable of delivering an instantaneous bandwidth of 8000 MHz. The solid-state radar uses an FM-CW waveform. The development is based on experience with a 94 GHz broadband measurement radar. The data undergo an ISAR imaging process to derive high-resolution scattering centre distributions for targets measured in tower/turntable configuration. High-resolution processing algorithms have been developed which result in scattering centre distributions with a resolution better than 2 cm at ranges of and exceeding 200 m. The radar will be used for investigations on target signatures of small objects for stand-off detection of concealed weapons and other threat material. [J2058]

"Variable Precision Two-Channel Phase, Amplitude, and Timing Measurements for Radar Interferometry and Polarimetry"

In this paper, we present a time-domain method for estimating the phase, amplitude, and timing of a test signal, referenced either to a theoretical version of the signal, or to another signal undergoing a similar transformation as the measured signal. The use of time-domain basis for this method allows for its direct application to data samples collected by a digital oscilloscope or a dedicated A/D converter, and precludes the need for conversion into in-phase and quadrature components. The estimation process described in this paper is based on a maximum likelihood formulation, which allows for the estimate performance to be related to errors associated with sampling and is shown to achieve the Cramer-Rao lower bound for variance. Measurements such as the ones described in this paper are important for characterizing interferometric and polarimetric radar systems, as well as for determining the number of observations necessary for achieving a given degree of accuracy in the measurement. By including a statistical description of the estimation process, we enable the ability for using the technique for evaluating hypotheses describing the measurement error model. This last point is critical because it creates a mechanism for accepting or rejecting system model scenarios based on the signal-to-noise ratio and the number of digitized samples. [J2059]

"Hybrid CramЙr-Rao Bounds for Crustal Displacement Field Estimators in SAR Interferometry"

This letter focuses on the performance achievable by spaceborne synthetic aperture radar interferometry (InSAR) in the estimation of line-of-sight crustal deformations from acquisitions over a distributed scatterer. Our model is suited for exploiting the hybrid Cramer-Rao bound (HCRB), where the unknowns are both deterministic parameters and stochastic variables. We take into account both target decorrelation and atmospheric phase screen (APS). This approach leads to a viable evaluation of InSAR performance as a function of system configuration, target decorrelation, and APS variance. [J2060]

"ScanSAR-to-Stripmap Mode Interferometry Processing Using ENVISAT/ASAR Data"

Interferometric synthetic aperture radar (InSAR) images of geophysical events such as preeruptive volcano deformation or interseismic strain accumulation are often limited by phase distortions from the superimposed atmospheric signature. Additionally, the approximate monthly repeat cycle of many radar satellites cannot accurately capture rapidly time-varying processes. The Scanning Synthetic Aperture Radar (ScanSAR) mode of the ENVISAT/ASAR instrument permits more frequent revisits of a given area, potentially overcoming both of these limitations. In particular, stripmap mode-to-ScanSAR images provide a denser time series of interferograms than is possible with conventional stripmap-to-stripmap mode InSAR. We present images of ENVISAT/ASAR data acquired over Hawaii in which data acquired roughly weekly in ScanSAR mode are combined with ENVISAT/ASAR conventional stripmap mode data to form interferograms at a much denser temporal spacing. The burst nature of ScanSAR data requires a new processing method to form the interferograms. We use

traditional matched filtering for the range compression. For the azimuth processing, we compute the stripmap mode data on the ScanSAR sampling grid using a variation, consisting of different reference functions, of Lanari's modified SPECAN algorithm that is itself an adaptation of the chirp z-transform to readjust the azimuth pulse spacing. The resulting interferograms faithfully reflect the phase of conventional interferograms, but exhibit fewer looks and coarser resolution than those produced by fully stripmap mode data. For many problems, temporal density of the deformation observations is paramount, and the time series analysis and temporal averaging that were made possible using ScanSAR interferograms far outweigh the loss in looks and resolution. [J2061]

"Bistatic Radar Imaging of the Marine Environment-Part I: Theoretical Background"

We describe in detail the theoretical and practical implementation aspects of a simulation for marine radars which can, in particular, be used in multistatic configurations. Since the simulator is intended to deliver pseudoraw signals, it can be used later as a tool to benchmark and improve postprocessing algorithms such as bistatic synthetic aperture radar focusing algorithms and ship wake detection algorithms. The work is divided into two parts. This paper reviews and recalls theoretical prerequisites necessary in implementing such a simulator. Included are the full derivation of the bistatic radar equation from the transmitter to the receiver, accounting also for the transmit-receive time, a description of the sea state phenomenology, a review of the theory of electromagnetic scattering from the sea surface, and the presentation and validation of the method used in the simulation. A companion paper discusses the practical implementation aspects of the simulator as well as an analysis of our results. [J2062]

"Processing of Bistatic SAR Data From Quasi-Stationary Configurations"

Standard synthetic aperture radar (SAR) processing algorithms use analytically derived transfer functions in the 2D frequency and range/Doppler domains. These rely on the assumption of hyperbolic range histories of monostatic SARs with straight flight paths. For bistatic SARs, the range histories are no longer hyperbolic, and simple analytic transforms do not exist. This paper offers two solutions for bistatic SAR data processing under the restriction of quasi-stationarity, i.e., sufficiently equal velocity vectors of transmitter and receiver. 1) Moderately bistatic configurations can be handled satisfactorily by using hyperbolic range functions with a modified velocity parameter, which is a solution already well known for the accommodation of curved orbits in the monostatic case. This "equivalent velocity" approach is shown to be of surprising range of validity even for pronounced bistatic situations. It is not to be confused with the "equivalent monostatic flight path" approximation, which is shown to be inapplicable for any practical case. 2) With increasing separation of transmitter and receiver, the equivalent velocity approximation deteriorates. To cope with extreme bistatic configurations, a general approach named "NuSAR" is proposed, where the involved transfer functions are replaced by numerically computed ones. This paper describes how the transfer functions are computed from the given orbits and the shape of the Earth surface. In any of these two cases, the bistatic SAR data can be processed by standard SAR processors; only the conventional transfer functions need to be replaced. Neither are there time-domain prefocusing or post focusing steps required nor complicated mathematical expansions involved. The presented algorithms are also applicable to very high resolution wide-swath (or squinted) SARs on curved orbits. [J2063]

"Hybrid-Polarity SAR Architecture"

A synthetic aperture radar (SAR) often is constrained to transmit only one polarization. Within this constraint, two aggressive measurement objectives are 1) full characterization and exploitation of the backscattered field, and 2) invariance to geometrical orientations of features in the scene. Full characterization implies coherent dual-polarization to support the four Stokes parameters. These are rotationally invariant with respect backscatterer orientation if and only if the transmission is circularly polarized. Given that the data products are the Stokes parameters, the receivers can use any orthogonal polarization basis. A SAR in hybrid-polarity architecture (CL-pol) transmits circular polarization and receives two orthogonal mutually coherent linear polarizations, which is one manifestation of compact polarimetry. The resulting radar is relatively simple to implement, and has unique self-calibration features and low susceptibility to noise and cross-channel errors. It is the architecture of choice for two lunar radars scheduled for launch in 2008. Data from a CL-pol SAR yield to decomposition strategies such as the m-delta method introduced in this paper. [J2064]

"Building Recognition From Multi-Aspect High-Resolution InSAR Data in Urban Areas"

The improved ground resolution of state-of-the-art synthetic aperture radar (SAR) sensors suggests utilizing SAR data for the analysis of urban areas. The appearance of buildings in SAR or interferometric SAR (InSAR) data is characterized by the consequences of the inherent oblique scene illumination, such as layover, occlusion

by radar shadow, and multipath signal propagation. Therefore, particularly in dense built-up areas, building reconstruction is often impossible from a single SAR or InSAR measurement alone. But, the reconstruction quality can be significantly improved by a combined analysis of multi-aspect data. In this paper, two approaches are proposed to detect and reconstruct buildings of different size from multi-aspect high-resolution InSAR data sets. Both approaches focus on the recognition of buildings supported by knowledge-based analysis considering the mentioned SAR-specific effects observed in urban areas. Building features are extracted independently for each direction from the magnitude and phase information of the interferometric data. Initial primitives are segmented and afterward projected from slant-range into the world coordinate system. From the fused set of primitives of both flight directions, building hypotheses are generated. The first approach exploits the frequently observed lines of bright double-bounce scattering, which are used for building reconstruction in residential districts. In the case of larger buildings, such as industrial halls, often additional features of roof and facade elements are visible. Therefore, in a second approach, extended buildings are extracted by grouping primitives of different kinds. The two approaches are demonstrated in an urban environment for an InSAR data set, which has spatial resolution of about 30 cm and was taken from two orthogonal flight directions. [J2065]

"Fusion of Support Vector Machines for Classification of Multisensor Data"

The classification of multisensor data sets, consisting of multitemporal synthetic aperture radar data and optical imagery, is addressed. The concept is based on the decision fusion of different outputs. Each data source is treated separately and classified by a support vector machine (SVM). Instead of fusing the final classification outputs (i.e., land cover classes), the original outputs of each SVM discriminant function are used in the subsequent fusion process. This fusion is performed by another SVM, which is trained on the a priori outputs. In addition, two voting schemes are applied to create the final classification results. The results are compared with well-known parametric and nonparametric classifier methods, i.e., decision trees, the maximum-likelihood classifier, and classifier ensembles. The proposed SVM-based fusion approach outperforms all other approaches and significantly improves the results of a single SVM, which is trained on the whole multisensor data set. [J2066]

"Single-Pass Polarimetric SAR Interferometry for Vessel Classification"

This paper presents a novel method for vessel classification based on single-pass polarimetric synthetic aperture radar (SAR) interferometry. It has been developed according to recent ship scattering studies that show that the polarimetric response of many types of vessels can be described by trihedral- and dihedral-like mechanisms. The adopted methodology is quite simple. The input interferometric data are decomposed in terms of the Pauli basis, and hence, one height image is derived for each simple mechanism. Then, the local maxima of these images are isolated, and a 3-D map of scatters is generated. The correlation of this map with the scattering distribution expected for a set of reference ships provides the final classification decision. The performance of the proposed method has been tested with the orbital SAR simulator developed at Universitat Politecnica de Catalunya. Different vessel models have been processed with a sensor configuration similar to the incoming TanDEM-X system. The analysis of diverse vessel bearings, vessel speeds, and sea states shows that the map of scatters matches reasonably the geometry of ships allowing a correct identification even for adverse environmental conditions. [J2067]

"Statistical CLEAN Technique for ISAR Imaging"

Inverse synthetic aperture radar (ISAR) images are frequently used in target classification and recognition applications. Some classifiers often require features that can be more easily obtained by extracting scattering centers from ISAR data rather than by reconstructing ISAR images. An available method for scattering center extraction, namely, the CLEAN technique, was proposed in a recent paper by Yang et al. In this paper, an improvement of this CLEAN technique is proposed that introduces a new method for detecting scattering centers. The proposed technique is based on a Gaussianity test, and its effectiveness is first theoretically proven and then tested on real data. Moreover, a comparison with the technique proposed by Yang et al. is shown. [J2068]

"Least Squares Estimation of Doppler and Polarimetric Parameters for Weather Targets"

Doppler and polarimetric parameters have shown to be of great utility in weather radar applications. Different measurement schemes have been proposed and implemented to obtain Doppler and polarimetric information of the sensed weather target. To date, none of these methods is capable of providing all polarimetric and Doppler parameters of interest for the whole range of temporal correlation conditions. To obtain all parameters, some of the systems require to assume different hypotheses about the Doppler or polarimetric characteristics of the targets. Failure of the assumed hypotheses leads to unacceptable bias and loss of performance of the estimated

parameters. Other methods reach a tradeoff, reducing either the number of polarimetric parameters to be estimated or the maximum measurable range of Doppler parameters. With respect to polarimetric parameter estimation, it has already been shown that alternate transmission of three different polarizations improves polarimetric parameter estimation through decoupling of temporal and polarimetric effects. In this paper, this measurement system is generalized by means of a new data processing algorithm and a least squares estimation to provide joint estimates of all Doppler and polarimetric parameters for all temporal correlation conditions. No hypotheses are required. In fact, this method provides minimum variance unbiased linear estimates of all elements of the polarimetric covariance matrix. It also allows Doppler parameter estimation within their corresponding maximum measurable ranges, which are determined by the radar base pulse repetition frequency. The performance of Doppler parameter estimates is comparable to that reached by nonpolarimetric systems. Implementation of the method requires transmitting three known polarizations. Moreover, phase shifts between them should be either known or measured. [J2069]

"Sea-Ice Deformation State From Synthetic Aperture Radar Imagery-Part I: Comparison of C- and L-Band and Different Polarization"

In this paper, we present a quantitative comparison of L- and C-band airborne synthetic aperture radar imagery acquired at like- and cross-polarizations over deformed sea ice under winter conditions. The parameters characterizing the deformation state of the ice are determined at both radar bands and at different polarizations. The separation of deformed and level ice is based on a target detection technique. The threshold is set such that image pixels with intensities equal to or larger than the highest 2% of the level-ice intensity distribution are classified as deformed ice, independent of the radar configuration and ice conditions. Optical imagery of sufficient quality for comparison is available only in a very few cases. To characterize the deformation state, the areal fraction of deformation features and the average distance between these features are evaluated. The values obtained for both parameters are very sensitive to the radar frequency. Aeral fractions are larger, and average distances are smaller at L-band than at C-band because of the much higher intensity contrast between the deformed and level ice at L-band. The differences between polarizations at one radar band are smaller but not always negligible. In comparison to optical images, it was observed that deformed-ice areas can be distinguished from level ice over their whole length and extension at L-band, whereas at C-band, often, only prominent parts are visible. [J2070]

"On Parameter Identifiability of MIMO Radar"

A multi-input multi-output (MIMO) radar system, unlike a standard phased-array radar, can transmit multiple linearly independent probing signals via its antennas. We show herein that this waveform diversity enables the MIMO radar to significantly improve its parameter identifiability. Specifically, we show that the maximum number of targets that can be uniquely identified by the MIMO radar is up to Mttimes that of its phased-array counterpart, where Mtis the number of transmit antennas. [J2071]

"A Novel Clutter Suppression Algorithm for Landmine Detection With GPR"

In this paper, we propose a new algorithm for the enhancement of plastic-cased antipersonnel mine detection using a video-impulse ground-penetrating radar (GPR). The algorithm is implemented as a nonlinear signal processor, which searches for the presence of a reference waveform in a 1D GPR echo return. The reference waveform represents a class of targets within a certain environment. The processor marks the presence of all responses similar to the reference waveform with a sharp mono-cycle. Simultaneously, responses with different waveforms, which presumably correspond to clutter, are suppressed. The reference waveform and other algorithm parameters are determined from training data sets acquired in a controlled environment. After training, the algorithm can be successfully applied at sites where soil, targets, and measurement scenarios are similar but not identical to those of the training site. The processor is integrated into an automated data processing and mine detection scheme as an additional clutter suppression step. The scheme consists of clutter suppression, synthetic aperture radar focusing, construction of a confidence map, and automated detection in it. The suggested algorithm is tested on experimental data, and its performance is compared against schemes where clutter suppression is organized by means of background removal and the cross correlation with a reference wavelet. The performance comparison is done in terms of receiver operating characteristic curves. It has been found that the suggested algorithm reduces the false alarm rate in about two and a half times in comparison to the cross-correlation-based clutter suppression. [J2072]

"Ultrawideband Synthetic Aperture Radar Landmine Detection"

In this paper, we consider landmine detection using ultrawideband synthetic aperture radar, where the two main challenges are feature extraction and discriminator design. The space-wavenumber processing is proposed to

retrieve the frequency-and aspect-angle-dependent scattering features of suspected objects. In order to reduce the dimensionality of the input feature vector for a discriminator, the sequential forward floating selection method is used to choose efficient features. Based on the obtained feature vector, a fuzzy hypersphere support vector machine is designed to deal with the problem of detecting landmines in an unconstrained environment. The experimental results show that the proposed method can achieve a significant improvement in detection performance for antitank mines. [J2073]

"Surface-Based Polarimetric C-Band Scatterometer for Field Measurements of Sea Ice"

A portable surface-based polarimetric C-band scatterometer for field deployment over sea ice is presented. The scatterometer system, its calibration, signal processing, and near-field correction are described. The near-field correction is shown to be effective for both linear polarized and polarimetric backscatter. Field methods for the scatterometer are described. Sample linear polarized and polarimetric backscatter results are presented for snow-covered first-year sea ice (FYI), multiyear hummock ice, and rough melt pond water on FYI. The magnitude of backscatter signature variability due to system effects is presented, providing the necessary basis for quantitative analysis of field data. [J2074]

"Initial Images of the Synthetic Aperture Radiometer 2D-STAR"

Initial results are presented for the new synthetic aperture radiometer, 2D-STAR, which is a dual-polarized L-band radiometer that employs aperture synthesis in two dimensions. This airborne instrument is the natural evolution of the Electronically Scanned Thinned Array Radiometer, which employs aperture synthesis only in the across-track dimension, and represents a further step in the development of aperture synthesis for remote sensing applications. 2D-STAR was successfully tested in June 2003 and, then, participated in the SMEX03 and SMEX04 soil moisture experiments. A description of the instrument and initial results in the form of first images and a preliminary comparison with changes in soil moisture during SMEX03 are presented here. [J2075]

"Target Detection and Texture Segmentation in Polarimetric SAR Images Using a Wavelet Frame: Theoretical Aspects"

Theoretical aspects of a technique for target detection and texture segmentation in synthetic aperture radar (SAR) imagery using a wavelet frame are presented. Texture measures consist of multiscale local estimates of the following: 1) normalized second moment of the backscattered intensity and 2) variance of the wavelet-frame coefficients. This work is an extension of a method proposed in the image-processing literature. Novel issues, which are considered in the passage to radar imagery, are the influence of speckle on texture measures afforded by the wavelet frame and their dependence on polarization states (polarimetric texture). Regarding speckle, estimators that decouple the influence of speckle over texture are introduced and characterized by their expected value and variance. The response of the wavelet frame to discontinuities, which is an important issue in target detection problems, is addressed in terms of signal-to-speckle-noise ratio. The notion of polarimetric texture is revisited, providing a theoretical model that explains the dependences of texture measures on the polarization states. For one-point statistics, such model calls for a mixture of diverse polarimetric scattering mechanisms within the texture estimator support. For two-point statistics, the difference in spatial correlation properties among the polarimetric channels is called into play. To analyze these effects in polarimetric SAR data, a novel tool is introduced that is called the Wavelet Polarimetric Signature. The tool encapsulates, in graphical form, the dependence on scale and polarization state of the texture measure afforded by the wavelet frame. The theory exposed here underpins a method that has been proven successful and computationally attractive in a selected number of SAR thematic applications. It also sets the stage for the exploitation of novel target detection and textural segmentation capabilities based on polarimetric diversity. [J2076]

"Space-surface bistatic synthetic aperture radar with global navigation satellite system transmitter of opportunity-experimental results"

Progress in the study of space-surface synthetic aperture radar is presented. Global navigation satellite system is considered as the transmitter of opportunity. It highlights the various important issues to successfully obtain an image. The experimental testing of the imaging algorithm is presented and verified using a GLONASS satellite signal. [J2077]

"Study on improving sensitivity of multibroadband receivers"

Proposed is a self-multiplier mixer circuit that has an independent multiplication capability to improve the sensitivity of upper bands, a problem not only with radar detectors but also with similar multi- broadband receivers (i.e. receiver systems that have several reception bands with wide distribution). The circuit's superiority

was verified by designing and producing the front-end for a multi-broadband receiver to be implemented in radar detectors, and its simulation performance was measured. [J2078]

"Superresolution for high-frequency radar"

High-frequency (HF) radars require large-array antennas to achieve narrow beamwidths and are required to discriminate targets with low Doppler shifts compared with microwave radar. Superresolution processing can discriminate signals at separations much less than the beamwidth or conventional Doppler bin width (or conversely, achieve a given minimum resolvable separation with a smaller array or less time-on-target). Simulation results and analysis of real radar data presented here show at least a 2-fold improvement compared with conventional processing, assuming simple theoretical gain manifolds. A novel polarisation-sensitive superresolution algorithm applicable to skywave HF radar is also discussed. [J2079]

"Forward scattering radar power budget analysis for ground targets"

An accurate approach to power budget analysis for forward scattering radar with application to the detection of ground targets is presented. A modification of the range equation is used, and the results of experimental testing for its confirmation are given. [J2080]

"Optimal Array-Pattern Synthesis for Wideband Digital Transmit Arrays"

Some next-generation radio frequency systems are expected to share a common transmit aperture among multiple users across a wide range of frequencies and functions such as radar and communications. The requisite linear architectures and digital signal generation will permit far greater flexibility in the design of array patterns than traditional time-delay steered wideband transmit arrays. Merely replicating the traditional architecture in digital signal processing would generally represent an inefficient use of computational resources; thus, we propose instead to place a finite-impulse response filter per input signal at each element and to directly optimize the resulting wideband array pattern. For this architecture, we present a passband-equivalent transmit-array model and derive expressions for wideband directivity, efficiency, error sensitivity, gain, peak and mean-square sidelobes, mainlobe frequency-response flatness, and polarization. All can be constrained using second-order cone programming, a highly-efficient type of convex optimization. Several examples illustrate the design tradeoffs, including the need to limit undesirable superdirective effects in wideband arrays. The system model and the derivations are general enough to admit almost any array architecture, including arbitrary element locations, nonuniform element responses, and multiple polarizations. [J2081]

"Bistatic Radar Based on DAB Ifluminators: The Evolution of a Practical System"

Digital Audio Broadcasting (DAB) has massive potential for the development of passive bistatic radar. A project to build DAB based radar is described, together with its advantages and disadvantages. Several serious obstacles need to be overcome in order to make the system a reality. Most importantly, these include the removal of direct signal interference and the extraction of the illuminating signal in a form suitable for detections. Progress toward the solution of these problems will be described. In addition, some real aircraft detections are included to prove the viability of a practical system. [J2082]

"35 GHz compact radar using fan beam antenna array for obstacle detection"

A 35 GHz, magnetron-based, compact pulse radar is presented. It contains some novel solutions of four electrically switched slot array antennas having fan beam patterns, solid-state modulator adaptive for the miniature magnetron and digital receiver techniques with advanced processing. It is designed for obstacle and rain detection for collision warning in helicopter applications. [J2083]

"Suppressing HRRP grating lobes in stepped-frequency train of LFM pulses using extended correlation"

Presented is a novel extended correlation method to suppress the grating lobes of the high-resolution range profiles (HRRP) synthesised via the stepped frequency train of LFM pulses (SFT-LFM). By uniformly spacing the nulls of the envelope term to nullify the grating lobes, the method may effectively improve the sidelobe behaviour of SFT-LFM HRRP without loss of the range resolution. Numerical experiments illustrate the effectiveness of the method. [J2084]

"Synthetic Radar-Signal Environment: Computer Generation of Signal, Noise, and Clutter"

Computer simulations are widely used in multi-sensor system tests. Algorithms for detection, tracking,

classification, identification, intent/threat evaluation, etc., are tested either by using measured real data, or with synthetically generated computer data. Real data is expensive to record and can only be available for simple, sample scenarios. Therefore, a synthetic representation of the radar signal environment is essential. How realistic the synthetic data is depends on the physical and statistical understanding of the radar signal environment, and its stochastic modeling based on random-number generation. This tutorial briefly reviews the generation of a synthetic radar-signal environment. [J2085]

"Network Architectures for 4G: Cost Considerations [JWireless Broadband Access]"

As 3G wireless networks evolve toward 4G, various wireless network technology organizations are considering a major redesign of the network architecture. We present a perspective on such a redesign motivated primarily by cost considerations. We examine some tenets for the design of 4G wireless network architectures that are aimed at improving costs in various aspects of the network. One tenet is the maximization of economies of scale by partitioning the functionality among network elements in a way that maximizes the potential domain of applicability of the network elements. Another is reduction of the number of distinct types of network elements needed by flattening the levels of hierarchy in the execution of various functions. We explain our reasoning by illustrating a way of redesigning the current 3GPP network architecture based on these tenets. [J2086]

"The Fifth IASTED International Conference on Antennas, Radar, and Wave Propagation"

{no data available} [J2087]

"Demonstration of an Inverted Stewart Platform Target-Suspension System Using Lightweight, High-Tensile Strings"

This paper presents the design, development, and testing of an inverted Stewart platform for suspending and positioning targets during RF antenna and signature testing. Previous string target-support systems have used multiple-string-attachment-point configurations that do not allow the target roll or pitch to be modified during the azimuthal data collection. This presentation will discuss an in-house development of a scale model target-support system that allows for high-accuracy simultaneous target roll and pitch positioning. The inverted Stewart platform also offers unique stability of the target by damping out the torsional pendulum motion typically encountered in conventional string-support systems. In this paper, we will also discuss the advantages and disadvantages of the string-support concepts, and provide design guidance for building an inverted Stewart-platform support system. [J2088]

"Exposure of Pregnant Dairy Heifers to High-Tension Power Lines [JHealth Effects]"

This article investigates the biological effects and potential health hazards to pregant dairy heifers from exposure to extremely-low-frequency (ELF) electromagnetic fields, in the 50/60 Hz range, particularly those associated with transmission lines. It was found that the EMF exposed cattles gained weight. [J2089]

"Dynamic range improvements and measurements in radar systems"

The extension of the dynamic range performance of existing radar systems is integral to the requirement for current sensors to see deeper into clutter, that is, to detect weak signals (e.g. small targets) in the presence of strong interference (e.g. urban clutter signals). The rationale behind this requirement is that this additional capability greatly enhances the utility of military and commercial systems. Two approaches to improving the dynamic range of modern radar and surveillance receivers are described: (1) linearisation of intermodulation distortion (IMD) using digital post-distortion algorithms and (2) linearisation of IMD using frequency retranslation mixer (FRM). The experimental results presented illustrate that the digital post-distortion and FRM approaches are effective in providing IMD improvements for the hardware and test scenarios measured. The improvements measured ranged from 15 to 35 dB for narrowband signals to 2-6 dB for frequency-modulated continuous wave (FMCW) wideband signals. The digital post-distortion approach provided the greatest performance improvement when the input signals were between the analogue-to-digital converter full range and 20 dB below that level. The improvements measured for the FRM linearisation approach ranged from 20 to 25 dB for the narrowband two-tone tests and 16-18 dB for the wideband FMCW signal chirps. [J2090]

"In the News"

This articles deals with two issues namely: (i) disease surveillance: can AI help detect a bioterrorist attack?, (ii) face recognition test is a multifaceted resource. [J2091]

"Interference suppressing OFDM UWB system with multiple users and MMSE receivers"

In this letter we extend the use of interference suppressing (IS) OFDM UWB system from single user to multiuser scenarios. Multiple access capabilities are obtained by employing Multi-Carrier (MC) CDMA in the transmitter along with MMSE multiuser receivers. We illustrate the performance of the multiuser IS-OFDM UWB system with numerical results obtained from simulations. [J2092]

"MEMS Electronically Steerable Antennas for Fire Control Radars"

Large apertures are of great benefit to applications that are prime powered limited as is found on aerostat and other airborne platforms. Electronically scanned array antennas are often proposed for these applications. However, increasing the aperture area with conventional array technology is met with prohibitive cost, weight, and prime power increases because of the dense spacing of phase shifters and/or active T/R modules. This discusses the recent development of RF MEMS (Microelectromechanical System) switch technology and the use of these switches in a Radanttrade lens configuration for arrays of approximately 10 m2at X-band. A proof-of-concept 0.4 m2MEMS Electronically Steerable Antenna (ESA) containing 25,000 MEMS switches has been successfully designed, fabricated, and tested. The 0.4 m2MEMS ESA was then integrated with an AN/APG-67 radar system to form the MEMS Demonstration Radar System. The MEMS Demonstration Radar System successfully detected both airborne and ground moving targets during a series of extensive radar demonstrations. This is believed to be the first large scale employment of MEMS switches in a scanning antenna and radar system. The low-cost, lightweight, and low power technology demonstrated can enable weight and power constrained platforms with electronic steering. [J2093]

"Derivation of the Norton Surface Wave Using the Compensation Theorem"

This paper presents a tutorial exposition of the derivation of the Norton surface wave using the compensation theorem. Only the case of a vertical electric dipole above an infinite ground plane satisfying an impedance boundary condition is treated. This is the most interesting case in practice, and the one on which applications such as MF AM broadcasting and HF surface-wave radar rely. It is attractive to use the compensation theorem to treat this relatively complex problem. This theorem, itself simply derived starting from Lorentz reciprocity, is easily understood, and the development that follows draws only on ideas already familiar in at least some context to almost all electrical engineers. This makes it for the most part easier to follow than equivalent alternative presentations. While not the first such derivation to have appeared in the literature, and to some extent paralleling these earlier developments to allow direct comparison, the present paper aims to differentiate itself both by being easier to follow and in removing some errors. [J2094]

"Orthogonal Methods for Array Synthesis: Theory and the ORAMA Computer Tool (Sahalos, J.N.; 2006) [JReviews and Abstracts]"

First Page of the Article [J2095]

"Doppler and direction-of-arrival (DDOA) radar for multiple-mover sensing"

A low-cost two-element receiving array concept is investigated for detecting multiple moving targets in indoor surveillance applications. Conventional direction-of-arrival (DOA) detection requires the use of an antenna array with multiple elements. Here we investigate the use of only two elements in the receiver array. The concept entails resolving the Doppler frequencies of the returned signals from the moving targets, and then measuring the phase difference at each Doppler frequency component to calculate the DOA of the targets. Simulations are performed to demonstrate the concept and to asses the DOA errors for multiple movers. An experimental system is designed and constructed to test the concept. The system consists of a two-element receiver array operating at 2.4 GHz. Measurement results of human subjects in indoor environments are presented, including through-wall scenarios. [J2096]

"Stacked Microstrip-Patch Arrays as Alternative Feeds for Spaceborne Reflector Antennas"

The feasibility of using stacked microstrip-patch arrays as feeds for offset reflector antennas is investigated in this paper. It is shown that patch arrays can be used as alternatives to the conventionally used horn feeds, which tend to be bulky. In particular, patch arrays can be of interest for spacecraft applications where reduced size and light-weight feeds are highly desirable. In this paper, patch arrays were tailored to provide radiation characteristics similar to those of horn feeds by varying the element spacing and excitation. A reduction in weight was mainly realized by the planar construction of the patch arrays. A full-wave analysis of the feed array, using finite-difference time-domain (FDTD) and PO-based UCLA reflector-analysis codes, was used to test the results of the proposed feed, operating at 1.413 GHz for radiometer applications, and 1.26 GHz for radar applications. A

dual-polarized and dual-frequency stacked microstrip-patch element was fabricated and tested. It was then demonstrated that a seven-element hexagonal array design seemed to be the best match to the horn feeds for a 12 m offset-reflector antenna. [J2097]

"The Antenna as a Transducer: Simple Circuit and Electromagnetic Models"

Antennas are key elements in electrical engineering. They are the first and most essential parts of a communication/radar system, and basic instruments for electromagnetic compatibility (EMC) tests and measurements. A good design for a transmitting or receiving antenna system or array may reduce the installation and operating costs more than 30-50%. Moreover (up to a certain extent), noise and interference may be eliminated at the front end of the receivers. A communication or radar antenna system basically covers narrow operating bands and operates in the far field. On the other hand, EMC antennas operate over broad bands and use near fields. This tutorial aims to discuss some aspects of these very well-known devices that are often neglected or forgotten, because of their simplicity. [J2098]

"SIMS at sea"

The need for a new 25-knot lifeboat offered the RNLI the opportunity to capitalise on engineering advancements. The author assesses the institution's use of Systems and Integrated Management System (SIMS) to advance information, control and safety. SIMS is a distributed network-based arrangement of computers and data input/output devices designed to assist in the management, operation, control and data recording (mission logging) of this highly advanced rescue vessel. The SIMS system has been designed to make the lifeboat crew's job easier. It allows the removal of non-essential functions from the respective systems and displays on screen the information that the crew need most for both training and operations. Each screen allows the user to view information from all the integrated systems such as navigation and radar. This means that the crew can now stay safely in their seats, removing the possibility of injury that could result from moving about the cabin in heavy seas. It also has five potential power sources, a solid state computer memory which replaces hard drives, a shock mounted rack, waterproof computer boxes, screens and trackballs. The SIMS rack consists of six computers (each capable of running the system by itself) as well as all the other processors required to monitor and run the boat's systems. [J2099]

"Microwave and Radar Week 2008"

{no data available} [J2100]

"AMTA Corner"

First Page of the Article [J2101]

"Chapter Activities [JChapters]"

{no data available} [J2102]

"Chapter Representatives Meeting Recommendations"

{no data available} [J2103]

"UAVSAR: New NASA Airborne SAR System for Research"

NASA's Jet Propulsion Laboratory is currently building a reconfigurable, polarimetric L-band synthetic aperture radar (SAR), specifically designed to acquire airborne repeat track SAR data for differential interferometric measurements. Differential interferometry can provide key deformation measurements, important for studies of earthquakes, volcanoes, and other dynamically changing phenomena. Using precision real-time GPS and a sensor controlled flight management system, the system will be able to fly pre-defined paths with great precision. The expected performance of the flight control system will constrain the flight path to be within a 10 m diameter tube about the desired flight track. The radar will be designed to be operable on a Unpiloted Arial Vehicle (UAV) but will initially be demonstrated on a NASA Gulfstream III. The radar will be fully polarimetric, with a range bandwidth of 80 MHz (2 m range resolution), and will support a 16 km range swath. The antenna will be electronically steered along track to assure that the antenna beam can be directed independently, regardless of the wind direction and speed. Other features supported by the antenna include elevation monopulse and pulse-to-pulse re-steering capabilities that will enable some novel modes of operation. The system will nominally operate at 45,000 feet (13,800 m). The program began as an Instrument Incubator Project (IIP) funded by NASA Earth Science and Technology Office (ESTO). [J2104]

"Time to Nominate Fellows-AESS Board of Governors/Warren D. White Award/Nathansen Award for Radar [JSociety News& Information]"

{no data available} [J2105]

"Mechanical and electromechanical properties of pmnt single crystals for naval sonar transducers"

PMNT single crystals in the relaxor-ferro-electric lead magnesium niobate (PMN)-lead titanate (PT) system provide significant advantage for underwater sonar transducers. Compared to lead zirconate titanate (PZT) ceramics, the large electromechanical coupling factor provides significant increases in transducer bandwidth. The superior strain energy density generates higher source level across the band, and the lower Young's modulus allows considerably smaller transducers. These payoffs occur even when PMNT crystals are subject to navy operating conditions such as uniaxial mechanical compressive stresses up to 42 MPa, electric fields up to 1.2 MV/m, and a temperature range from 5 to 50degC. The impact of navy-relevant electric fields and mechanical stresses on crack propagation and failure of piezoelectric single crystals is investigated. The compressive, flexural, and tensile strength of PMNT crystals is reported and discussed with respect to conventional PZT ceramics and the operating conditions of a typical naval transducer. [J2106]

"Null phase-shift polarization filtering for high-frequency radar"

In order to effectively cancel the interference in polarization filtering, the parameters of the polarization filter should timely adapt to the variation of the polarization of the interference, which may impact the amplitude and phase of the desired signal that passes through the same polarization filter during the coherent integration time (CIT) and render the enhancement of the signal integration a failure. To avoid this, a null phase-shift polarization (NPSP) filter is proposed, which is composed of a linear polarization transformer (LPVT), a conventional single-notch polarization (SNP) filter and an amplitude/phase compensation device (A/PCD). The interference, which has polarization different from those of the desired target signal, can be suppressed completely while the target signal remains without distortion. Some applications of high-frequency (HF) radars for suppressing the radio interference are introduced. Simulation results from the experimentally derived data indicate that the improvement of the signal-to-interference ratio (SIR) can be expected to be more than 28 dB. The proposed NPSP filter is effective in HF radar or other coherent systems. [J2107]

"High Fidelity Circular Array Simulation"

This describes a unique approach to performing high fidelity UHF circular array simulations on a High Performance Computer (HPC). Traditional airborne surveillance simulations have been limited in either spatial or temporal fidelity due to the expensive software and hardware requirements. Recently, advances have been made which provide the rapid deployment of high fidelity scenarios through a modular visual programming environment on an HPC. Based on the visual programming environment Khoros, the Radar Analysis Simulation Tool (RAST-K) is a flexible simulation for quickly prototyping airborne surveillance configurations containing radar system features, point targets, and USGS maps. Additionally, RAST-K has been ported to a Linux cluster to simulate realistic flight scenarios. As these scenarios involve changing characteristics between Coherent Processing Intervals (CPIs), additional interfaces were developed to control platform, target, and environmental attributes, as well as partition the simulations across the resource of processors. This paper will discuss these topics by providing an overview of the RAST-K simulation and its use in the simulation of a circular UHF antenna configuration. After which, the simulation of realistic flight scenarios through the use of the HPC is discussed, along with relevant results. [J2108]

"Nominations Wanted-AESS Board of Governors/Warren D. White Award/Nathansen Award for Radar [JSociety News& Information]"

{no data available} [J2109]

"Reconfigurable Fresnel-Zone-Plate-Shutter Antenna with Beam-Steering Capability"

A reconfigurable Fresnel-zone-plate (FZP) antenna, capable of dynamic beam scanning, is introduced. The FZP consists of a series of thin metal shutters, which discretize the antenna aperture into a number of reconfigurable transparent and opaque zones. The shutters are individually controlled to focus the beam at a desired location. Beam scanning of at least +40deg from broadside with a small degradation in gain is possible in one plane using this design. This paper examines the effects of zone discretization on the ideal radiation patterns using full-wave numerical modeling. These effects are then verified by the measurements of a prototype antenna designed at 23 GHz. [J2110]

"Parametric Rao Test for Multichannel Adaptive Signal Detection"

The parametric Rao test for a multichannel adaptive signal detection problem is derived by modeling the disturbance signal as a multichannel autoregressive (AR) process. Interestingly, the parametric Rao test takes a form identical to that of the recently introduced parametric adaptive matched filter (PAMF) detector for space-time adaptive processing (STAP) in airborne surveillance radar systems and other similar applications. The equivalence offers new insights into the performance and implementation of the PAMF detector. Specifically, the Rao/PAMF detector is asymptotically (for large samples) a parametric generalized likelihood ratio test (GLRT), due to an asymptotic equivalence between the Rao test and the GLRT. The asymptotic distribution of the Rao test statistic is obtained in closed form, which follows an exponential distribution under the null hypothesis H0and, respectively, a noncentral Chi-squared distribution with two degrees of freedom under the alternative hypothesis H1. The noncentrality parameter of the noncentral Chi-squared distribution is determined by the output signal-to-interference-plus-noise ratio (SINR) of a temporal whitening filter. Since the asymptotic distribution under H0is independent of the unknown parameters, the Rao/PAMF asymptotically achieves constant false alarm rate (CFAR). Numerical results show that these results are accurate in predicting the performance of the parametric Rao/PAMF detector even with moderate data support. [J2111]

"Gating Functions for Multipath Mitigation in GNSS BOC Signals"

A new multipath mitigation technique is proposed for binary offset carrier (BOC) signals in global navigation satellite systems (GNSS) using the concept of gating function originally conceived for the GPS coarse-acquisition (C/A) code. Specially-tailored pulses are utilized to diminish the number of false-lock points of the code discriminator response and to improve the multipath mitigation capability. The code loop includes only four real correlators (two extra correlators are required for the simplified bump-jumping algorithm with BOC(n,n) signals). Results obtained with BOC(n,n) and BOC(2n,n) signals show that this technique eliminates the multipath ranging errors for reflected rays with relative delays typically above twenty percent of the spreading code chip duration, thus comparing favorably with the conventional receiver correlation techniques. [J2112]

"Outside the bandwith-Power of plurality, a tecnololimerick"

{no data available} [J2113]

"Measurement of human heartbeat and respiration signals using phase detection radar"

This article introduces a low-cost phase detection radar aimed at measuring the human heartbeat and respiration signals without any physical connections to the human body. A continuous-wave radar targeting the chest will detect the phase difference, resulted by the time-varying target position of the heartbeat, between the transmitted signal and the reflected signal. We have tested the developed radar to measure the heartbeat and respiration signals at a distance of about 40cmfrom the chest. [J2114]

"New Method of Chaotic Polyphase Sequences Design"

A new polyphase sequences synthesis method based on chaotic maps is presented. The correlation properties of sequences designed using this method are analyzed and proved to be almost perfect. The phase alphabet size can be any positive non-zero even, and the alphabet elements can be chosen arbitrarily by users. Simulation results show the effectiveness of this polyphase sequences design method. [J2115]

"Framework and Taxonomy for Radar Space-Time Adaptive Processing (STAP) Methods"

The goal of radar space-time adaptive processing (STAP) is to detect slow moving targets from a moving platform, typically airborne or spaceborne. STAP generally requires the estimation and the inversion of an interference-plus-noise (I+N) covariance matrix. To reduce both the number of samples involved in the estimation and the computational cost inherent to the matrix inversion, many suboptimum STAP methods have been proposed. We propose a new canonical framework that encompasses all suboptimum STAP methods we are aware of. The framework allows for both covariance-matrix (CM) estimation and range-dependence compensation (RDC); it also applies to monostatic and bistatic configurations. Finally, we discuss a taxonomy for classifying the methods described by the framework. [J2116]

"Householder Multistage Wiener Filter for Space-Time Navigation Receivers"

Space-time (ST) processing in navigation receivers is attractive technology because it provides a sufficient number of degrees of freedom for cancelling a large number of wideband and narrowband jammers simultaneously. Low complexity reduced-rank receiver structures are particularly appealing because the number

of filter coefficients can be much larger than the rank of the ST signal model. This paper proposes a new Householder-based multistage Wiener filter (HMSWF) structure for estimating the coefficients of an ST navigation receiver. Both floating point and fixed point arithmetic implementations are considered. The computational complexity of the HMSWF compares favorably with the other MSWF methods reported in literature. Furthermore, the use of Householder transformations at each stage ensures unitary blocking and numerically robust behavior even in finite-precision implementations. Simulations studies verify that the proposed ST navigation receiver based on the HMSWF outperforms other MSWF methods in the antijamming (A,J) task. [J2117]

"Correspondence-Optimum Radar Signal for Detection in Clutter"

It is shown that in order to maximize the detectability of a radar target in clutter whose Doppler is unknown and is uniformly distributed over the Doppler bandwidth a simple CW or narrowband signal is optimal. The optimality criterion is the average deflection coefficient, with the averaging being over target Doppler frequency. Most remarkably the result does not depend on the clutter spectrum but holds for any distribution of clutter energy with frequency. [J2118]

"Wavelet-Based Despeckling of SAR Images Using Gauss-Markov Random Fields"

In this paper, a wavelet-based speckle-removing algorithm is represented and tested on synthetic aperture radar (SAR) images. The SAR image is first transformed using a dyadic wavelet transform. The noise in the wavelet-transformed image is modeled as an additive signal-dependent noise with Gaussian distribution. The distribution of a noise-free image in a wavelet domain is modeled as a generalized Gauss-Markov random field (GGMRF). An unsupervised stochastic model-based approach to image denoising is represented. If the observed area is homogeneous, the parameters of the Gaussian distribution and GGMRFs are estimated from incomplete data using mixtures of wavelet coefficients. An expectation-maximization algorithm is used to estimate the parameters of both noisy and noise-free images. The unknown parameters are estimated using image and noise models that are defined in the wavelet domain for heterogeneous areas. Different inter-and intrascale dependences of wavelet coefficients were used to estimate the unknown parameters. The represented wavelet-based method efficiently removes noise from SAR images. [J2119]

"Refraction and Dispersion Effects Compensation for UWB SAR Subsurface Object Imaging"

It is a trend to use airborne or vehicle-borne ultrawideband synthetic aperture radar (UWB SAR) to quickly detect subsurface objects, i.e., landmines or minefields, over large areas from a safe standoff distance. The traditional image formations without considering the refraction and dispersion of electromagnetic wave will lead to locating error and defocusing for subsurface objects. In this paper, an efficient refraction and dispersion effects compensation method is proposed, which can be integrated with the traditional three-stage automatic target detection framework for detection of subsurface landmines. The compensation method can focus and correctly locate multiple objects buried in different soils with different depths over large areas, which satisfies the operating requirement of an airborne or vehicle-borne UWB SAR system. The proposed method is proved efficient for subsurface object imaging by the field data collected by a UWB SAR system. [J2120]

"A Multiple Conditional Random Fields Ensemble Model for Urban Area Detection in Remote Sensing Optical Images"

With complex building composition and imaging condition, urban areas show versatile characteristics in remote sensing optical images. It demonstrates that multiple features should be utilized to characterize urban areas. On the other hand, since levels of development in neighboring areas are not statistically independent, the features of each urban area site depend on those of neighboring sites. In this paper, we present a multiple conditional random fields (CRFs) ensemble model to incorporate multiple features and learn their contextual information. This model involves two aspects: one is to use a CRF as the base classifier to automatically generate a set of CRFs by changing input features, and the other is to integrate the set of CRFs by defining a conditional distribution. The model has some distinct merits: each CRF component models a kind of feature, so that the ensemble model can learn different aspects of training data. Moreover, it lets the ensemble model search in a wide solution space. The ensemble model can also avoid the well-known overfitting problem of a single CRF, i.e., the many features may cause the redundancy of irrelevant information and result in counter-effect. Experiments on a wide range of images show that our ensemble model produces higher detection accuracy than single CRF and is also competitive with recent results in urban area detection. [J2121]

"Focused 70-cm Wavelength Radar Mapping of the Moon"

We describe new 70-cm wavelength radar images of the lunar near-side and limb regions obtained via a

synthetic-aperture-radar patch-focusing reduction technique. The data are obtained by transmitting a circularly polarized pulsed waveform from the Arecibo telescope in Puerto Rico and receiving the echo in both senses of circular polarization with the Robert C. Byrd Green Bank Telescope in West Virginia. The resultant images in both polarizations have a spatial resolution as fine as 320 m 450 m near the lunar limb. The patch-focusing technique is a computationally efficient method for compensating for range migration and Doppler (azimuth) smearing over long coherence times, i.e., 983 s, which is needed to achieve the required Doppler resolution. Three to nine looks are averaged for speckle reduction and to improve the signal-to-noise ratio. At this long wavelength, the radar signal penetrates up to several tens of meters into the dry lunar surface materials, thus revealing details of the bulk loss properties and decimeter-scale rock abundance not evident in multispectral and other remote-sensing data. Application of the new radar images to the analysis of basalt flow complexes in Mare Serenitatis shows that the long-wavelength radar data are sensitive to differences in both flow age and composition, and may be particularly useful for studies of smaller deposits that do not have robust crater statistics. The new 70-cm lunar radar data are archived at the National Aeronautics and Space Administration Planetary Data System. [J2122]

"Detection of Depth Changes of a Metallic Target Buried in a Frequency-Dependent Lossy Halfspace Using the E-Pulse Technique"

The extinction pulse (E-pulse) technique has been widely applied to the problem of free-space radar target identification. In this paper, the possibility of applying the same E-pulse technique to a subsurface target recognition scheme is investigated. In particular, the detection of depth changes of a metallic target is considered with numerical examples that determine the depth of a hip prosthesis model buried inside representative human tissue. [J2123]

"New Adaptive Algorithm for Delay Estimation of Sinusoidal Signals"

In this letter, we address the problem of adaptively estimating the time delay of a noisy sinusoid received at two spatially separated sensors. By choosing the sampling frequency equal to four times the signal frequency, a simple adaptive algorithm for direct delay estimation is derived. Algorithm convergence in mean and mean square error is proved. Computer simulations are also included to demonstrate the effectiveness of the proposed method. [J2124]

"Urban-Target Recognition by Means of Repeated Spaceborne SAR Images"

The relative low resolution (~25 m times 5 m on the ground) of spaceborne C-band synthetic aperture radar (SAR) data as acquired, for example, by European Space Agency sensors ERS and Envisat, can be significantly increased (up to submeter precisions) by processing coherently long series of images. Moreover, by analyzing the amplitude of the radar signal and by exploiting polarization diversity, the main radar characteristics of urban targets can be estimated, and a system for automatic recognition of a set of scattering structures can be developed. In this paper, we study the variation of the amplitude of the received radar signal as a function of the acquisition geometry [normal baseline and Doppler centroid (DC)] to retrieve the extension of the targets in range and azimuth. The dependence of the radar amplitude on temperature at the time of acquisition has been discovered to be very useful to identify extended resonating targets. Dihedrals are discriminated from specular or trihedral reflectors through the phase of Envisat alternating polarization (AP) acquisitions. By means of all gathered radar measurements, the bases for the development of a system for the automatic recognition of six main typologies of urban SAR targets (ground-level and elevated backscatterers, simple and resonating dihedrals, poles and trihedrals) have been laid. Radar data are then combined with in situ surveys and aerial photos, allowing a first assessment of the methodology in urban area. [J2125]

"Current Measurements in Rivers by Spaceborne Along-Track InSAR"

The global monitoring of river discharges is a technologically challenging problem, with important applications in a variety of disciplines. Due to the limited availability and/or quality of river runoff data from many regions, an increasing use of remote sensing techniques is highly desirable. Altimeter specialists have already demonstrated water level retrievals in rivers from available data. The along-track interferometric synthetic aperture radar [along-track InSAR (ATI)] capabilities of state-of-the-art imaging radars on satellites such as the German TerraSAR-X, which was launched on June 15, 2007, also permit high-resolution line-of-sight surface current measurements. In this paper, we evaluate the potential of current measurements in rivers by spaceborne ATI on the basis of fundamental theoretical considerations, existing spaceborne InSAR data from the shuttle radar topography mission (SRTM), and simulated TerraSAR-X data. We show that an SRTM-derived line-of-sight surface current field in the Elbe river, Germany, agrees well with numerical hydrodynamic model results. The data quality is sufficient to resolve characteristic lateral variations of the currents in the river around a pronounced main flow

channel. Assuming that the flow direction is usually aligned with the river bed, even a quasi-2D total surface current field can be derived. Simulations indicate that TerraSAR-X was even better suited for current measurements in rivers. Depending on width, surface roughness, and relative flow direction of a river, current estimates with an accuracy better than 0.1 m/s were possible with an effective spatial resolution of a few hundred meters to kilometers. [J2126]

"Explicit Expressions for the Bias and Variance of the ML Estimated Gumbel Distribution Parameters"

Explicit expressions are derived for the bias and the variance of the maximum likelihood (ML) estimator of the Gumbel distribution. [J2127]

"Propagation Corner"

First Page of the Article [J2128]

"A V-Band CMOS Injection-Locked Oscillator Using Fundamental Harmonic Injection"

A V-band CMOS injection-locked oscillator (ILO) based on a cross-coupled oscillator configuration containing nMOS and pMOS devices is implemented by using 0.18 mum CMOS process. This ILO has a free-running output frequency around 60 GHz while the double push-push technique was used as a frequency multiplier. It also has a wide output locking bandwidth of up to 3.64 GHz (from 59.36 to 63 GHz) as injecting a signal near 15 GHz with the fundamental injection-locked behavior. Controlling the output frequencies by the injected signals, the output signal has a phase noise of 108 dBc/Hz at a 1 MHz offset with consuming only 9.8 mW dc power under a 2 V supply. [J2129]

"Online Extrinsic Parameters Calibration for Stereovision Systems Used in Far-Range Detection Vehicle Applications"

This paper presents a high-accuracy online calibration method for the absolute extrinsic parameters of a stereovision system that is suited for far-distance, vision-based vehicle applications. The method uses as prior knowledge the intrinsic parameters and the relative extrinsic parameters (relative position and orientation) of the two cameras, which are calibrated using offline procedures. These parameters remain unchanged if the two cameras are mounted on a rigid frame (stereo rig). The absolute extrinsic parameters define the position and orientation of the stereo system relative to a world coordinate system. They must be calibrated every time after mounting the stereo rig in the vehicle and are subject to changes due to static load factors for the used car setup. The proposed method is able to perform online the estimation of the absolute extrinsic parameters by driving the car on a flat and straight road, parallel with the longitudinal lane markers. The edge points of the longitudinal lane markers are extracted after a 2-D image classification process and reconstructed by stereovision in the stereo-rig coordinate system. After filtering out the noisy 3-D points, the normal vectors of the world coordinate system axes are estimated in the stereo-rig coordinate system by 3-D data fitting. The output of the method is the height and the orientation of the stereo cameras that are relative to the world coordinate system. [J2130]

"Instructions for AP-S and URSI Authors"

{no data available} [J2131]

"Monitoring system for thermal barrier coatings with RF radar measurement"

A monitoring principle able to identify damage on the thermal barrier coating of gas turbine blades and vanes is presented. The principle is applicable to in-service turbine monitoring. It is based on the resonant quarter wavelength effect of thin layers, which causes phase shift and attenuation of the reflected signal. The reflectivity is derived theoretically and evaluated by laboratory measurements. It was evident that especially the phase information is adequate to distinguish coated areas from those where coating has already been spalled off. [J2132]

"Real-time sparse frequency waveform design for HFSWR system"

High frequency surface wave radar (HFSWR) systems operate in heavily congested high frequency (HF) band. It is very difficult to find continuous clear channels for the wideband HFSWR systems. Presented is a real-time sparse frequency waveform design approach. [J2133]

"SRMF-CLEAN Imaging Algorithm for Space Debris"

A single-range matching filtering (SRMF)-CLEAN imaging algorithm for space debris is proposed in this paper. The proposed algorithm can successfully incorporate the prior moving information of the space debris into the imaging process. Since the SRMF algorithm can improve the resolution and imaging speed effectively, and the disturbance of the point spread function can be cancelled by the modified CLEAN algorithm, the high resolution images of space debris can be obtained by SRMF-CLEAN method effectively. Studies and simulations confirm the validness of the proposed algorithm. [J2134]

"Novel Airborne Real-Time Survey System"

Although satellite imaging is widely used today, an airborne survey system is still more efficient and effective under certain circumstances. Airborne survey can successfully detect and transmit target information in real time that is useful and critical for related agencies, such as environmental management, natural-disaster monitor and control, etc. Using a real-time synthetic-aperture-radar image processing approach based on a distribution system, image data are synchronized with a global positioning system; a satellite-communication system of data transmission is designed and implemented; and a novel image-compression method, which is wavelet-based, is developed. The main idea of the proposed system is based on a function-distribution personal computer (PC) system: Data preprocessing, post processing, and extraction of images, data processing, image display, and image printing, are performed by different PCs. The method of image transmission proposed here is based on the satellite communication system. The proposed system has the advantage of low cost (both hardware prototype and maintenance) and rapid processing speed (only in several seconds; the disaster images from the air are processed and transmitted to the Disaster Reduction Center and to other users by the satellite communication system). The system has been applied to a real-time disaster monitor (such as a forest fire, a flood, etc.), real-time target tracking, large-scale topographic mapping, environmental survey, etc. [J2135]

"Waveform Design for MIMO Radars"

We consider the problem of waveform design for multiple input/multiple output (MIMO) radars, where the transmit waveforms are adjusted based on target and clutter statistics. A model for the radar returns which incorporates the transmit waveforms is developed. The target detection problem is formulated for that model. Optimal and suboptimal algorithms are derived for designing the transmit waveforms under different assumptions regarding the statistical information available to the detector. The performance of these algorithms is illustrated by computer simulation. [J2136]

"Pulse Compression Sidelobe Reduction by Minimization of Lp -Norms"

Most modern radar systems make extensive use of pulse compression techniques. This paper presents a technique for the design of mismatched receive finite impulse response (FIR) filters based on the minimization of Lp-norms of the sidelobes. The goal of the minimization process is to reduce the range sidelobe levels of the convolution of the transmit pulse and the receive filter. A closed-form solution is derived for the least-squares case (which is equivalent to the L2-norm) and an expression for the optimization of the higher order norms is developed. The solutions for the higher order norms have to be obtained by means of iterative numerical methods. The effect of using receive filters which are longer than the transmit pulses is also investigated. Results are presented for linear FM transmit waveforms having time-bandwidth products ranging from 10 to 100 in combination with selected values of the norm order ranging from 2 to 200. Receive filter lengths up to three times the transmit pulse lengths are investigated. Results are presented which highlight the tradeoffs between sidelobe level, mismatch loss and mainlobe width. The effect of Doppler shift on the sidelobe response of these receive filters is also investigated. [J2137]

"On Bistatic Inverse Synthetic Aperture Radar"

The use of multiple radar configurations can overcome some of the geometrical limitations that exist when obtaining radar images of a target using inverse synthetic aperture radar (ISAR) techniques. It is shown here how a particular bistatic configuration can produce three view angles and three ISAR images simultaneously. A new ISAR signal model is proposed and the applicability of employing existing monostatic ISAR techniques to bistatic configurations is analytically demonstrated. An analysis of the distortion introduced by the bistatic geometry to the ISAR image point spread function (PSF) is then carried out and the limits of the applicability of ISAR techniques (without the introduction of additional signal processing) are found and discussed. Simulations and proof of concept experimental data are also provided that support the theory. [J2138]

"Radar Pulse Compression Repair"

This correspondence presents an adaptive approach for range sidelobe mitigation for use by future radar systems as well as in-service radar systems in which the precompressed received signal may not be readily available or it may not be feasible to replace the current pulse compression system. The approach, denoted as pulse compression repair (PCR), utilizes a previously developed adaptive technique to operate on the match filtered output treating the resulting waveform autocorrelation as if it were the transmitted waveform thus "repairing" the effects of range-sidelobe masking that are induced by matched filtering. Illustrative results are presented comparing PCR with the matched filter and the CLEAN algorithm which demonstrate significant performance advantages for PCR as well as robustness to Doppler mismatch and system errors. [J2139]

"Suboptimum CFAR detectors based on singular-value decomposition"

The realisation of a constant false-alarm rate (CFAR) detector is dealt with, based on an estimation of the clutter covariance matrix and its singular-value decomposition for selecting the type of detector structure to be used. Some results show the performance of this hybrid CFAR detector. [J2140]

"Effect of Apodization on SAR Image Understanding"

This paper investigates the effect of apodization on the statistical properties of synthetic aperture radar (SAR) images and its impact on the capability of extracting information from homogeneous regions of apodized SAR images. The statistical model for the pixel complex amplitude of the apodized image is derived in terms of both probability density function and statistical moments. Knowledge of the statistical properties is then used to develop appropriate schemes for parameter estimation and supervised classification of homogeneous regions with different radar cross sections in apodized SAR images. The performance analysis shows that the new techniques (properly derived for the apodized case) provide information extraction capabilities only slightly worse than those provided by the conventional techniques applied to the nonapodized case. This allows us to conclude that the use of nonlinear apodization yields sidelobe level reduction and main lobe resolution preservation that can be traded with the small losses above. A full characterization of the estimation and classification performance of these new techniques shows that nonlinear apodization globally introduces a performance degradation comparable to a reduction of the number of looks of a factor of 1.455 for a homogeneous region. [J2141]

"Analysis of microDopplers from human gait using reassigned joint time-frequency transform"

The Doppler spectrogram of a moving human is characterised by microDoppler returns due to the dynamic movements of the different body parts. The reassigned joint time-frequency transform is applied to study these distinct microDoppler features. Reassigned spectrograms generated from a simulation model and measured data are presented and analysed. [J2142]

"Electromagnetic and microwave absorption properties of (Co 2+ -Si 4+) substituted barium hexaferrites and its polymer composite"

The electromagnetic (EM) and microwave absorption properties of (Co2+-Si4+)substituted barium hexaferrite compositions BaCox2+Fey+2Six+y4+Fe12-2x-2y+3O19(x=0.9and y=0.0, 0.05, and 0.2) and its polymer composites prepared from hexaferrite, polyaniline, and carbon powders dispersed in polyurethane matrix have been investigated at the microwave frequency range of the Xband (8.2-12.4 GHz). The hexaferrite compositions were synthesized by solid-state reaction technique, whereas polyaniline, by chemical route. The permeabilities of a ferrite are drastically reduced at higher gigahertz frequencies. The permittivities, however, can be enhanced by appropriate choice of composition and processing temperature. In the present ferrite composition, silicon content is taken in excess so as to convert some of the Fe3+ions to Fe2+ions. This conversion has been shown to enhance EM and absorption properties. Mossbauer spectroscopy on the samples establishes that addition of excess Si4+converts some of the Fe3+to Fe2+. The sintered ferrites have shown resonance phenomena, but the composites do not. The EM parameters epsilon ', epsilon ", mu ', and mu "were measured using a vector network analyzer (Agilent-, model PNA E8364B). These measured EM parameters were used to determine the absorption spectra at different sample thicknesses based on a model of a single layered plane wave absorber backed by a perfect conductor. The sintered ferrite composition (x=0.9and y=0.05) showed the best absorption properties [a minimum reflection loss of -17.7 to -14.3 dBover the whole frequency range of the Xband (8.2-12.4) for a sample thickness of just 0.8 mm], and it is used in the composite absorbers in powder form along with other constituents. The optimized composite absorber has shown dielectric constant epsilon ' 11.5, dielectric loss epsilon " 2.3, and a minimum reflection loss of -29 dBat 10.97 GHzwith the -20 dBbandwidth over the frequency range of 9.7-12.2 GHzfor a sample thickness of 2.0 mm. The magnetic parameters mu 'and mu "for the composite remained nearly 1 and 0, respectively, throughout the measured frequency range. Both sintered ferrite and composite absorbers can fruitfully be utilized for suppression of electromagnetic interference and

reduction of radar signatures (stealth technology). [J2143]

"There Are No Further Counterexamples to S. Piccard's Theorem"

In 1977, G. S. Bloom, in the J. Combinatorial Theory, showed that Sophie Piccard's ldquotheoremrdquo had counterexamples for six-mark rulers. Subsequent research into finding additional counterexamples has focused on a variety of computer algorithms, such as searching the space of rulers with relatively few marks in an attempt to find another counterexample. Recent analytic effort has made use of Golomb's ldquopolynomial method,rdquo which made strides in eliminating specific types of rulers which cannot contain counterexamples. The question as to whether other larger length ruler counterexamples exist, however, was left unanswered. In this correspondence, a geometric manipulation of the ldquopolynomial methodrdquo is used to demonstrate that no additional counterexamples are possible. [J2144]

"Fractional Chirp Scaling Algorithm: Mathematical Model"

In this paper, the new fractional chirp scaling algorithm (FrCSA) is mathematically derived and analyzed from high-resolution SAR imaging point of view. The FrCSA is based on the use of the fractional Fourier transform within the chirp scaling algorithm (CSA). The performance of the FrCSA is compared to that of the classical CSA that is based on the fast Fourier transform (FFT). Simulation results for airborne SAR systems show that the FrCSA offers enhanced signal-to-noise ratio (SNR), better focusing capabilities, sharpened main lobe with extra power concentration, and greater side-lobe reduction ratio (SLRR) and all of these, without the need for any additional focusing or enhancement techniques that are required in the classical FFT-based CSA. [J2145]

"A Large-Scale Systematic Evaluation of Algorithms Using Ground-Penetrating Radar for Landmine Detection and Discrimination"

A variety of algorithms for the detection of landmines and discrimination between landmines and clutter objects have been presented. We discuss four quite different approaches in using data collected by a vehicle-mounted ground-penetrating radar sensor to detect landmines and distinguish them from clutter objects. One uses edge features in a hidden Markov model; the second uses geometric features in a feed-forward order-weighted average network; the third employs spectral features as its basis; and the fourth clusters edge histograms. We present the results of a large-scale cross-validation evaluation that uses a diverse set of data collected over 41 807.57 m2of ground, including 1593 mine encounters. Finally, we discuss the results of that ranking and what one can conclude concerning the performance of these four algorithms in various settings. [J2146]

"Scale Model Experimental Validation and Calibration of the Half-Space Green's Function Born Approximation Model Applied to Cross-Well Radar Sensing"

Efficient forward models that describe the physical nature of the geophysical problem are desired for subsurface sensing and reconstruction of a contrasting contaminant pool volume. An analytical model to approximate sensing with radar is developed and implemented in the frequency domain in terms of the half-space lossy dyadic Green's function. The Born approximation is employed as a linear forward model, which will eventually be used for tomographic inversion for object detection. The forward model is compared with measurements generated by a cross-well radar (CWR) experiment in a controlled soil test tank using broadband borehole antennas. Soil parameter (dielectric constant and loss tangent) variance with frequency is represented by a quadratic polynomial. Calibration for soil parameters is performed via CWR data using an iterative nonlinear parameterized inversion technique. With the appropriate calibration, good agreement is obtained with wideband experimental measurements for several different borehole antenna placements, confirming the accuracy of the model. [J2147]

"The Multitarget Monopulse CRLB for Matched Filter Samples"

It has recently been found that by jointly processing multiple (sum, azimuth-, and elevation-difference) matched filter samples, it is possible to extract and localize several (more than two) targets spaced more closely than the classical interpretation of radar resolution. This paper derives the Cramer-Rao lower bound (CRLB) for sampled monopulse radar data. It is worthwhile to know the limits of such procedures; and in addition to its role in delivering the measurement accuracies required by a target tracker, the CRLB reveals an estimator's efficiency. We interrogate the CRLB expressions for cases of interest. Of particular interest are the CRLB's implications on the number of targets localizable: assuming a sampling-period equal to a rectangular pulse's length, five targets can be isolated between two matched filter samples given that the target's signal-to-noise ratios (SNRs) are known. This reduced to three targets when the SNRs are not known, but the number of targets increases back to five (and beyond) when a dithered boresight strategy is used. Further insight to the impact of pulse shape and

of the benefits of oversampling are given. [J2148]

"Real-Time Tree-Foliage Surface Estimation Using a Ground Laser Scanner"

The optimization of most pesticide and fertilizer applications is based on overall grove conditions. In this paper, we propose a measurement system to estimate the foliage surface of a tree crop. The system is based on a ground laser scanner that estimates the volume of the trees and then extrapolates their leaf area using simple and fast algorithms to allow true real-time operation. Tests with pear trees demonstrated that the relation between the volume and the foliage can be interpreted as linear with a coefficient of correlation (R) of 0.81, and the foliage surface can be estimated from this volume with an average error less than 6%. [J2149]

"On the CFAR Property of GLRT-Based Direction Detectors"

Direction detection is aimed at discriminating, over multiple "snapshots," between a disturbance-only hypothesis and a useful-signal plus disturbance alternative with useful signals modeled in terms of a common (i.e., over different snapshots) direction of the signal subspace. We will show that generalized-likelihood ratio test (GLRT)-based direction detectors, designed assuming Gaussian noise with unknown covariance matrix plus deterministic interference, belonging to a preassigned sub- space of the observables, possess the constant false alarm rate property with respect to the unknown covariance matrix of the noise. [J2150]

"On Probing Signal Design For MIMO Radar"

A multiple-input multiple-output (MIMO) radar system, unlike a standard phased-array radar, can choose freely the probing signals transmitted via its antennas to maximize the power around the locations of the targets of interest, or more generally to approximate a given transmit beampattern, and also to minimize the cross-correlation of the signals reflected back to the radar by the targets of interest. In this paper, we show how the above desirable features can be achieved by designing the covariance matrix of the probing signal vector transmitted by the radar. Moreover, in a numerical study, we show that the proper choice of the probing signals can significantly improve the performance of adaptive MIMO radar techniques. Additionally, we demonstrate the advantages of several MIMO transmit beampattern designs, including a beampattern matching design and a minimum sidelobe beampattern design, over their phased-array counterparts. [J2151]

"Fundamental and Higher Mode Inversion of Dispersed GPR Waves Propagating in an Ice Layer"

Dispersion of ground-penetrating radar (GPR) waves can occur when they are trapped in a layer. In this paper, we analyze the modal propagation of GPR pulses through a layer of ice that is overlying water. Dispersed transverse electric (TE) waves that are trapped in the waveguide have larger amplitudes than the critically refracted waves that travel through air, whereas the transverse magnetic (TM) critically refracted waves traveling through air are more dominant than the trapped dispersed TM waves. This can be explained by the leaky waveguide behavior of the ice layer. The reflection coefficients for the waves incident on the ice-water interface show that the TM modes are more leaky than the TE modes. Still, clear dispersion is observed in both cases, which depends on the permittivity and thickness of the ice. Similar to inversion of dispersed Rayleigh waves, these parameters can be estimated by calculating phase-velocity spectra, picking dispersion curves, and inverting the dispersion curves using a combined local and global minimization procedure. Synthetic data show several higher order modes of which separate and combined inversions return the input modeling parameters accurately. Experimental data acquired on a frozen lake show strong dispersion for the TE and TM modes. The phase-velocity spectra of the field data show three TE and four TM modes of which separate and combined inversion of different modes return similar values for the ice thickness and known permittivity of ice. Due to the more leaky behavior of the TM modes, the TE inversion is better constrained and more suitable for inversion. [J2152]

"Accurate Determination of Underground GPR Wavefront and B-Scan Shape From Above-Ground Point Sources"

While the determination of the wavefront shape radiated by ground-penetrating radar (GPR) in contact with the ground is trivial, the refraction of rays at the ground surface from a point source in the air makes accurate determination of the transmitted wavefront challenging. Impulse GPRs usually have their emitters in air, transmitting waves through a quasi-planar interface into the soil. The waves radiated initially in air can be approximated as circular, but once they enter the soil half-space, they propagate with a wavefront shape that resembles a hyperbola. The exact shape is derived and shown to be well approximated by a hyperbola with specific parameters depending on the relative dielectric constant of the half-space epsiv' (= n2), the height of the source h, and the propagation time from source to wavefront multiplied by the wave velocity in the half-space p. A correction formula is provided to reduce the error between the approximate hyperbola and the exact

shape. In addition, an equation for the shape of the B-scan contour of a point scatterer is derived. [J2153]

"Observations, Modeling, and Applications of ERS-ENVISAT Coherence Over Land Surfaces"

European Remote Sensing satellite (ERS) ENVISAT coherence is a new repeat-pass interferometric synthetic aperture radar product characterized by a very short repeat-pass interval between acquisitions (28min). In this paper, we investigate the properties of two 28-mins coherence images acquired over the regions of Paris, France, and Prague, Czech Republic, as well as a 35-day coherence image from Prague. Bare soils showed higher coherence compared to forests and urban areas. The range of coherence was larger for 28-min pairs, perpendicular baseline closer to 2km, and stable weather conditions between acquisitions. Coherence modeling shows that because of the long baseline: 1) significant surface decorrelation occurs when slopes are not accounted for in the common-band filtering and for variation of topography in the resolution cell and 2) volume decorrelation is significant. Temporal decorrelation seems to be relevant for vegetation even at the 28-min interval time scale. Observations and modeled coherence were found to be in good agreement. Land cover classification using coherence and backscatter has been tested for the Paris scene for mapping the four major classes. The classification accuracy was 86% when an edge-eroded version of the reference land cover map was used. It decreases to 68% when the full land cover map was used as reference because of local mismatches between the coherence image and the land cover map, and the reduced common band in range. The high coherence difference between forests and bare fields suggests the possibility to use the ERS-ENVISAT coherence for forest/nonforest mapping and estimation of biophysical properties of short vegetation. Coherence, decorrelation, ENVISAT Advanced Synthetic Aperture Radar (ASAR), European Remote Sensing satellite (ERS), land cover, synthetic aperture radar interferometry (InSAR). [J2154]

"Improving GPR Image Resolution in Lossy Ground Using Dispersive Migration"

As a compact wave packet travels through a dispersive medium, it becomes dilated and distorted. As a result, ground-penetrating radar (GPR) surveys over conductive and/or lossy soils often result in poor image resolution. A dispersive migration method is presented that combines an inverse dispersion filter with frequency-domain migration. The method requires a fully characterized GPR system including the antenna response, which is a function of the local soil properties for ground-coupled antennas. The GPR system response spectrum is used to stabilize the inverse dispersion filter. Dispersive migration restores attenuated spectral components when the signal-to-noise ratio is adequate. Applying the algorithm to simulated data shows that the improved spatial resolution is significant when data are acquired with a GPR system having 120 dB or more of dynamic range, and when the medium has a loss tangent of 0.3 or more. Results also show that dispersive migration provides no significant advantage over conventional migration when the loss tangent is less than 0.3, or when using a GPR system with a small dynamic range. [J2155]

"Unsupervised Classification of Scattering Mechanisms in Polarimetric SAR Data Using Fuzzy Logic in Entropy and Alpha Plane"

The eigenvalue-eigenvector-based approach for understanding the scattering mechanisms of polarimetric synthetic aperture radar (POLSAR) data leads to noisy classification results due to arbitrarily fixed zone boundaries in the H/alpha macr plane. In this paper, a new classification scheme that can address the inherent vagueness of class boundaries in the H/alpha macr plane was tested in order to improve the unsupervised classification of the microwave scattering mechanism by introducing concepts related to fuzzy sets. A 2-D fuzzy membership function was developed for the fuzzification of the 2-D H/alpha macr plane. The proposed fuzzy H/alpha macr classifier is composed of three steps: fuzzification of the H/alpha macr plane, iterative refinement of membership degrees using the c-means algorithm, and defuzzification for the final decision process. The performance of this new approach for the L-band NASA/Jet Propulsion Laboratory's Airborne SAR data obtained during the PACRIM-II experiment was shown to be consistently improved. This new classification technique can be applied to POLSAR data without any a priori information. The fuzzification of the zone boundaries can be further applied to the interpretation of the POLSAR data, e.g., multifrequency classification, retrieval of bio- and geophysical parameters, etc. In order to propose another implementation of the fuzzy boundary representation, we exploited the combination of the H/alpha macr state space and anisotropy information. [J2156]

"Localization of the Interfaces of a Slab Hidden Behind a Wall"

In this paper, a 1-D inverse-scattering problem laying within the framework of through-wall imaging is addressed. In particular, the problem of localizing the interfaces of a slab hidden behind an obstacle, another slab whose electromagnetic features and thickness are known, is considered. To this end, an approximate linear mathematical relationship between the scattered field and the unknown slab-interface positions is stated. Such an approximate relationship arises from neglecting the multiple-reflections between the two unknown slab's

interfaces and between the slab and the obstacle. The unknown locations of the slab's interfaces are represented as the support of Dirac-delta functions, and the problem is cast as the inversion of a linear integral operator whose inversion is achieved by means of the Truncated-Singular-Value-Decomposition (TSVD) inversion scheme. The effect of the parameters of the obstacle on the inversion algorithm and the performances achievable by the solution approach are assessed by exploiting synthetic data. Furthermore, a comparison with the reconstructions obtained under the Born approximation and with the time-backscattered field is achieved. Finally, results obtained by employing experimental data collected owing to a stepped-frequency ground-penetrating radar system are also presented. [J2157]

"A Novel Direction-Finding Algorithm for Directional Borehole Radar"

A directional borehole radar system has been developed for the purpose of 3-D imaging of subsurface targets in a single-hole measurement. The radar system is equipped with a uniform circular array consisting of four dipole antennas as a receiver in order to realize azimuth bearing sensitivity. We propose a new direction-finding (DF) algorithm that is suitable for directional borehole radar measurement, and we apply this algorithm to actual field measurement data. This algorithm is based on the Adcock DF antenna principle where the complex time series (analytic signal) expression, the optimization, and the filtering procedure are incorporated to provide more accurate estimation. The algorithm was first verified in a transmission measurement in boreholes with a cross-hole configuration (15 m apart from each other) by estimating a direction of the incident wave from a transmitter to the receiver. Finally, the algorithm was applied to single-hole measurement data to demonstrate the ability to detect the 3-D location of a subsurface tunnel which was located 5.5 m from the borehole. The result showed fairly good agreement with the actual location of the tunnel, i.e., to an azimuth estimation error of within 10deg. [J2158]

"A Novel Directional Borehole Radar System Using Optical Electric Field Sensors"

A directional borehole radar system using an array antenna connected to passive optical electric field sensors was developed and evaluated by laboratory and field experiments. This system uses a single dipole antenna for a transmitter and a four-dipole element circular array for a receiver. The received signals are transmitted through optical fibers from optical electric field sensors. The receiver array measures the phase differences between four dipole antennas and estimates the azimuth direction of the incoming reflection wave. The accuracy of the phase measurement was first evaluated in a laboratory test and then tested in a field experiment. To compensate for the sensitivity differences among the sensors, we propose an in situcalibration technique. The dominant operating frequency of the system is 70 MHz. Subsequently, we used borehole radar for subsurface measurements in a vertical borehole in granite. Estimation of the azimuth orientations of subsurface fractures was successfully demonstrated. [J2159]

"GPR Without a Source: Cross-Correlation and Cross-Convolution Methods"

Several formulations exist for retrieving the Green's function from cross correlation of (passive) recordings at two locations. For media without losses, these known formulations retrieve Green's functions from sources on a closed boundary. Until recent, these formulations were only developed for acoustic waves in fluids and elastodynamic waves in solids. Now, Green's function representations for electromagnetic (EM) waves in matter exist and can be exploited for passive ground-penetrating radar (GPR) applications using transient or ambient noise sources, either natural or man-made. We derive general exact EM Green's function retrieval formulations based on cross correlations and cross convolutions of recorded wave fields. For practical applications, simplified forms are derived that directly apply to field recordings due to unknown uncorrelated noise or transient sources. Only naturally present sources are needed, which allows for all kinds of applications of ldquoGPR without a source.rdquo We illustrate the consequences of using the simplified forms for Green's function retrieval with 2-D numerical examples. We show that in dissipative media, the Green's function is most accurately retrieved using the cross-convolution method when the sources are located on a sufficiently irregular boundary. [J2160]

"Online Sensor Modeling Using a Neural Kalman Filter"

Sensor-measurement systems rely upon knowledge of the functional dynamics between system states and the measured outputs. Errors in sensor measurements come from a variety of sources. While there are well-known techniques to compensate for those errors that result from such issues as noise and sensor-accuracy limitations, other types, such as those that are more deterministic, can result in biases that are not easily compensated for in standard systems. A modification of an adaptive tracking technique based on the neural extended Kalman filter is proposed as a technique to provide for online calibration for the sensor models. Previously, the technique has been applied to tracking problems and successfully improved the motion model of a target when a maneuver occurs. In this new application of the technique, the sensor dynamics are learned rather than the target

dynamics. [J2161]

"Adaptive cancellation method for geometry-induced nonstationary bistatic clutter environments"

This paper describes and characterizes a new bistatic space-time adaptive processing (STAP) clutter mitigation method. The approach involves estimating and compensating aspects of the spatially varying bistatic clutter response in both angle and Doppler prior to adaptive clutter suppression. An important feature of the proposed method is its ability to extract requisite implementation information from the data itself, rather than rely on ancillary-and possibly erroneous or missing-system measurements. We justify the essence of the proposed method by showing its ability to align the dominant clutter subspaces of each range realization relative to a suitably chosen reference point as a means of homogenizing the space-time data set. Moreover, we numerically characterize performance using synthetic bistatic clutter data. For the examples considered herein, the proposed bistatic STAP method leads to maximum performance improvements between 17.25 dB and 20.75 dB relative to traditional STAP application, with average improvements of 6 dB to 10 dB. [J2162]

"Adaptive detection of range spread targets with orthogonal rejection"

In this paper we consider the problem of detecting range spread targets in the presence of Gaussian disturbance with unknown covariance matrix. To this end we resort to the modified generalized likelihood ratio test (MGLRT) and devise a robust detector, the orthogonal rejection MGLRT (OR-MGLRT), capable of deciding whether some observations contain a useful target or if they contain a signal belonging to the orthogonal complement of the useful subspace. Hence we investigate the possibility of exploiting the new algorithm as the second stage of a double threshold receiving structure, obtained cascading the MGLRT and the OR-MGLRT. At the analysis stage, we assess the performance of the new double threshold decision rule, both in the matched and mismatched signal cases, also in comparison with previously proposed receivers. The results show that the new test allows for a wide range of compromises between the detection and the rejection performance. [J2163]

"Reiterative median cascaded canceler for robust adaptive array processing"

A new robust adaptive processor based on reiterative application of the median cascaded canceler (MCC) is presented and called the reiterative median cascaded canceler (RMCC). It is shown that the RMCC processor is a robust replacement for the sample matrix inversion (SMI) adaptive processor and for its equivalent implementations. The MCC, though a robust adaptive processor, has a convergence rate that is dependent on the rank of the input interference-plus-noise covariance matrix for a given number of adaptive degrees of freedom (DOF), N. In contrast, the RMCC, using identical training data as the MCC, exhibits the highly desirable combination of: 1) convergence-robustness to outliers/targets in adaptive weight training data, like the MCC, and 2) fast convergence performance that is independent of the input interference-plus-noise covariance matrix, unlike the MCC. For a number of representative examples, the RMCC is shown to converge using ~ 2.8Nsamples for any interference rank value as compared with ~ 2Nsamples for the SMI algorithm. However, the SMI algorithm requires considerably more samples to converge in the presence of outliers/targets, whereas the RMCC does not. Both simulated data as well as measured airborne radar data from the multichannel airborne radar measurements (MCARM) space-time adaptive processing (STAP) database are used to illustrate performance improvements over SMI methods. [J2164]

"A mean track approach applied to the multidimensional assignment problem"

The primary contribution of this paper is the introduction of a new preprocessing method to eliminate unlikely observation-to-track pairs with medium size target-measurement spacings before filter gating is carried out. The proposed method follows a track-oriented approach, with the different track hypotheses being contained in target trees. A mean track is computed for each target tree to capture as much variability as possible from the track hypotheses which are in the tree. Each newly received measurement is first gated with the mean track; only if the outcome of the test is positive, the measurement is gated with all the track hypotheses in the tree. The experimental results support the theoretical claims in the paper and show that a significant reduction in the number of observation-to-tracking pairing tests is achieved. [J2165]

"Analytic performance bounds on estimates of scattering center parameters"

Cramer-Rao bounds (CRBs) on the estimates of the main scattering center parameters, i.e., the position, intensity and geometry type, are presented in analytic forms. The resolution limit for wideband radar and the SNR threshold for the correct identification of the geometry type parameter of scattering centers are further deduced. Though the results are obtained from the CRB matrix for damped exponentials (DE) after many approximations and simplifications, their validity and adaptability for geometric theory of diffraction (GTD) based scattering center model have been verified both numerically and experimentally. [J2166]

"Highly Sensitive Focus Monitoring on Production Wafer by Scatterometry Measurements for 90/65-nm Node Devices"

RENESAS factories are starting to use scatterometry for inline focus measurement. This paper presents the development of the method used for nondestructive, high accuracy, and high-speed focus measurement on production wafers. Focus change results in a subtle variation of the photoresist shape, and this phenomenon is parameterized by using a new eight-layer model. Partial least squares regression methods are used to calculate focus from scatterometry measurement results. The measurement error for a focus variation of 0.1 mum is within 30 nm. This method enables the focus offset to be corrected more frequently without increasing the aligner machine downtime and reduces the depth of focus required because of aligner fluctuation. With it, we will be able to get sufficient focus margins for mass production of devices beyond the 65-nm-node devices. [J2167]

"Low elevation sea-surface target tracking using IPDA type filters"

When detecting a target using radar in the presence of multipath fading, the signal to noise ratio (SNR) at receiver can be dramatically reduced at certain ranges due to multipath signal cancellation, which leads to a significant drop of the detection probability at those ranges. The detection of a low elevation sea-surface target (LESST) is one example. For target tracking, this special case contrasts to the usual situation where we may often assume a constant probability of detection. Automatic target tracking requires a measure of track quality to discriminate between true and false tracks. This track quality measure should take both the existence of target and the SNR of the sensor into account, and be consistent with tracking performance. This paper investigates automatic target tracking using the integrated probabilistic data association (IPDA) type filters in the presence of multipath fading. Several existing single-scan probabilistic data association (PDA)-based filters, which calculate the probabilistic measure of track quality while estimating the track state, are evaluated in the scenario of tracking a nonmaneuvering LESST in the presence of both multipath fading and clutter. In addition, a variable Markov chain (VMC) IPDA tracker (IPDA-VMC), which has joint merits of both IPDA and the IPDA with a three state Markov chain (IPDA-M2), has been designed and evaluated here. In the derivation of track quality measure of both IPDA-M2 and 1PDA-VMC, the possibility that a target is present but is temporarily unable to be detected has been explicitly considered. A tracker using this track quality measure for false track discrimination has significantly improved LESST tracking performance. A simulation study verifies that both IPDA-M2 and IPDA-VMC have better capability to handle the LESST tracks and have an improved tracking performance over other PDA-based tracking algorithms under consideration. [J2168]

"Performance analysis of passive low-grazing-angle source localization in maritime environments using vector sensors"

We consider the problem of passive estimation of source direction-of-arrival (DOA) and range using polarization-sensitive sensor arrays, when the receiver array and signal source are near the sea surface. The scenario of interest is the case of low-grazing-angle (LGA) propagation in maritime environments. We present a general polarimetric signal model that takes into account the interference of the direct field with the field reflected from smooth and rough surfaces. Using the Cramer-Rao bound (CRB) and mean-square angular error (MSAE) bound, we analyze the performance of different array configurations, which include an electromagnetic vector sensor (EMVS), a distributed electromagnetic component array (DEMCA), and a distributed electric dipole array (DEDA). By computing these bounds, we show significant advantages in using the proposed diversely polarized arrays compared with the conventional scalar-sensor arrays. [J2169]

"An Autonomous Unmanned Ground Vehicle for Non-Destructive Testing of Fiber-Reinforced Polymer Bridge Decks"

The use of fiber-reinforced polymer (FRP) composite bridge decks is increasing in many civil engineering applications because of its many useful properties. The traditional reinforced concrete bridge decks have steel reinforcing bars embedded in concrete. Because of the use of deicing salt on the bridges to melt snow and ice in winter, the reinforcing bars tend to corrode, thus reducing the life span of the reinforced concrete bridge decks by half (from about 50 yr to about 25 yr). The FRP composite decks are made of noncorrosive material and offer a higher strength-to-weight ratio as compared to the reinforced concrete decks. It is highly important that engineers know how to detect subsurface defects that can form in FRP decks, which may cause serious structural degradation and endanger structural integrity. Both infrared thermography (IRT) and ground penetrating radar (GPR) have shown promise in the field of non-destructive detection of defects. Instead of performing both analysis methods individually, it would be more cost effective for someone to conduct both IRT and GPR at the same time. Research at West Virginia University has produced an unmanned ground vehicle (UGV) that will acquire data from both GPR and IRT systems to create a combined defect map of the FRP bridge deck to better

analyze the results. Thus, the proposed UGV enables rapid data acquisition from the FRP bridge deck in an automated and non-destructive fashion, which minimizes human error. The UGV also incorporates data analysis algorithms, which help in producing a detailed map showing the layout of defects on the bridge deck. [J2170]

"An Alternative Model for Target Position Estimation in Radar Processors"

In this paper, we analyze the target position estimation errors induced by conventional radar signal processors, which assume a point-target model in matched filtering-based detection and tracking. As we demonstrated through simulations, the performance degradation under the point-target assumption can be significant for high-resolution radars, where targets extend across several detection cells. One of the main contributions of this paper is to provide an alternative model for reflections from extended targets and clutter. We model the events of backscatters from illuminated targets and clutter as a nonhomogenous Poisson process. The corresponding maximum likelihood estimator and the Cramer-Rao lower bound have been derived. Typical target detection process has been simulated and the validity of the model has been verified by using the Kullback-Leibler distance. It has been shown that the new method significantly reduces target position estimation errors compared to the peak picking method. [J2171]

"A Whole-Head SQUID System in a Superconducting Magnetic Shield"

Sensitivity of a SQUID system in a superconducting magnetic shield is studied. The SQUID sensors are made of SNS(superconductor/normal metal/superconductor) junctions. Sensitivities of the SQUID system of SNS junctions in a superconducting magnetic shield are more than 100 times better than those of the same SQUID system in a magnetically shielded room of permalloy. The best sensitivity of the SQUID system of SNS junctions is 0.9 fT/(Hz)-1/2at 100 Hz in a superconducting magnetic shield. We performed a experiment of somatosensory evoked magnetic held of human brains to study the N20 component at 20 ms after stimulation. We estimated locations in the brain of the evoked current dipoles for N20 by a extension of a radar theory named MUSIC(multiple signal classification approach). The locations of the evoked current dipole for N20 estimated by MUSIC is confirmed exactly the same as the locations of the current dipole estimated by the traditional iterative least-squares fitting. This is the best agreement between the MUSIC estimation and the conventional estimation of current dipoles to our knowledge. [J2172]

"Noncoherent Constant False-Alarm Rate Schemes With Receive Diversity for Code Acquisition Under Homogeneous and Nonhomogeneous Fading Circumstances"

In this paper, we address the cell averaging (CA), greatest of (GO), and smallest of (SO) constant false-alarm rate (CFAR) processors for code acquisition in a homogeneous and a nonhomogeneous environment. The performance characteristics of the CA, GO, and SO processors are analyzed and compared when receiving antenna diversity is employed in the pseudonoise code acquisition of direct-sequence code-division multiple-access systems. From the simulation results, it is observed that the GO CFAR scheme has the best performance in a nonhomogeneous environment and has almost the same performance as the CA CFAR scheme in a homogeneous environment. [J2173]

"An Implementation of Synthetic Aperture Focusing Technique in Frequency Domain"

A new implementation of a synthetic aperture focusing technique (SAFT) based on concepts used in synthetic aperture radar and sonar is presented in the paper. The algorithm, based on the convolution model of the imaging system developed in frequency domain, accounts for the beam pattern of the finite-sized transducer used in the synthetic aperture. The 2D fast Fourier transform (FFT) is used for the calculation of a 2D spectrum of the ultrasonic data. The spectrum is then interpolated to convert the polar coordinate system used for the acquisition of ultrasonic signals to the rectangular coordinates used for the presentation of imaging results. After compensating the transducer lobe amplitude profile using a Wiener filter, the transformed spectrum is subjected to the 2D inverse Fourier transform to get the time-domain image again. The algorithm is computationally attractive due to the use of 2D FFT. The performance of the proposed frequency-domain algorithm and the classical time-domain SAFT are compared in the paper using simulated and real ultrasonic data. [J2174]

"Bipolar waveform generator for time limited response when driving RC loads"

A method is presented whereby a compact circuit generates bipolar VHF waveforms of which the relative duration and amplitude of the positive and negative half cycles are adjustable. This facilitates fine timing of the waveform for a time limited response when driving resistor-capacitor loads. Performance is verified by measurements on a system functioning as a ground penetrating radar system where the antenna presents such an equivalent load. [J2175]

"Autonomous Navigation: Achievements in Complex Environments"

During the past decade, an explosion of interest in the estimation of an autonomous robot's location state and that of its surroundings, known as simultaneous localization and map building (SLAM), is evident. The goal of an autonomous vehicle performing SLAM is to build a map incrementally by using the uncertain information extracted from its sensors, while simultaneously using that map to localize itself with respect to a reference coordinate frame. To demonstrate the state of the art in autonomous navigation, this article focuses on outdoor research work within complex, semi-structured environments with an array of vehicles, using RADAR and laser range finders. Two classes of sensors that we use to get information are proprioceptive sensors and exteroceptive sensors. This paper focuses on sensor data interpretation, information extraction, and data association. [J2176]

"Superconducting High-Resolution Low-Pass Analog-to-Digital Converters"

HYPRES has developed a high-resolution, dynamically programmable analog-to-digital converter (ADC) for radar and communications applications. The ADC uses the phase modulation-demodulation low-pass architecture and on-chip digital filtering. Detailed experimental results at 20 GHz clock frequency of the ADC chip fabricated with a 1 kA/cm2Nb process are presented and discussed. In addition to the standard ADC configuration, different ADC modifications are described. In the multi-rate ADC, the modulator sampling frequency is the twice the clock frequency for the time-interleaved digital filter. In addition to the standard parallel-output ADC, a serial output ADC and its interface to room temperature electronics are developed. This serial ADC chip fabricated with the advanced HYPRES 4.5 kA/cm2process operated up to 34 GHz clock. As a major step toward commercialization of superconducting electronics, an ADC chip was successfully packaged on a cryocooler where it showed reduced performance up to 11.52 GHz clock. [J2177]

"A HTS Bandpass Filter for a Meteorological Radar System and Its Field Tests"

This paper presents recent progress of a high temperature superconducting (HTS) filter designed for a meteorological radar system (wind profiler) and its field tests results. The filter was designed to exhibit a ten-pole quasi-elliptic response with a fractional bandwidth of 0.35% in L band. It was fabricated using double-sided YBCO films on a 50-mm-diameter, 0.5-mm-thick MgO substrate. A HTS subsystem was assembled by connecting the filter with a cryogenic low noise amplifier (LNA), fixing them on a cryocooler and enclosing in a cryopackage. With the HTS subsystem substituting the corresponding conventional part (the conventional subsystem) of the wind profiler, two stages of experiments including field test were carried out. The first stage experimental results showed that while employing the HTS subsystem the sensitivity of the wind profiler improves 3.7 dB and the anti-interference ability improves 48.4 dB. The second stage experiment-field test results showed the improvement visually through the wind charts and wind profiles obtained in the field trial. [J2178]

"Cloud Optical Depth Retrievals From Solar Background "Signals" of Micropulse Lidars"

Pulsed lidars are commonly used to retrieve vertical distributions of cloud and aerosol layers. It is widely believed that lidar cloud retrievals (other than cloud base altitude) are limited to optically thin clouds. Here, we demonstrate that lidars can retrieve optical depths of thick clouds using solar background light as a signal, rather than (as now) merely a noise to be subtracted. Validations against other instruments show that retrieved cloud optical depths agree within 10%-15% for overcast stratus and broken clouds. In fact, for broken cloud situations, one can retrieve not only the aerosol properties in clear-sky periods using lidar signals, but also the optical depth of thick clouds in cloudy periods using solar background signals. This indicates that, in general, it may be possible to retrieve both aerosol and cloud properties using a single lidar. Thus, lidar observations have great untapped potential to study interactions between clouds and aerosols. [J2179]

"Adjustment of Discrepancies Between LIDAR Data Strips Using Linear Features"

Despite the recent developments in light detection and ranging systems, discrepancies between strips on overlapping areas persist due to the systematic errors. This letter presents an algorithm that can be used to detect and adjust such discrepancies. To achieve this, extracting conjugate features from the strips is a prerequisite step. In this letter, linear features are chosen as conjugate features because they can be accurately extracted from man-made structures in urban area and more easily extracted than the point features. Based on such a selection strategy, a simple and robust algorithm is proposed that is generally applicable for extracting such features. The algorithm includes methods that can be used to establish observation equations from similarity measurements of the extracted features. Then, several transformations are selected and used to adjust the strips. Following the transformation, the fitness of linear features is tested to determine whether the

discrepancies have been resolved; the results are then evaluated statistically. The results demonstrate that the algorithm is effective in reducing the discrepancies between the strips. [J2180]

"Family of uncorrelated binary ZCZ sequence pairs with mismatched filtering"

A family of uncorrelated binary sequence pairs of length N=4(pm+1) with zero correlation zone (ZCZ) (N/4) -1 and mismatched filtering is proposed. The sequence pairs are derived from almost- perfect binary and ternary sequences and possess energy efficiency close to 1 as N becomes large. They can be used in quasi-synchronous code division multiple access and radar systems to reduce interference. [J2181]

"A Discrete Wavelet Transform Approach to Multiresolution Complex SAR Image Generation"

We present a signal processing approach using discrete wavelet transform (DWT) for the generation of complex synthetic aperture radar (SAR) images at an arbitrary number of dyadic scales of resolution. The method is computationally efficient and is free from significant system-imposed limitations present in traditional subaperture-based multiresolution image formation. Problems due to aliasing associated with biorthogonal decomposition of the complex signals are addressed. The lifting scheme of DWT is adapted to handle complex signal approximations and employed to further enhance the computational efficiency. Multiresolution SAR images formed by the proposed method are presented. [J2182]

"On the Existence of Coverage and Integration Time Regimes in Bistatic SAR Configurations"

Bistatic synthetic aperture radar (SAR) is an extension of traditional monostatic SAR, which increases the flexibility in designing SAR missions. We describe a scheme for the computation of integration time and azimuth coverage of bistatic SARs based on space-time diagrams. A classification of bistatic SAR configurations is introduced in terms of size and velocity on the ground of antenna footprints. Bistatic SAR regimes are also identified. [J2183]

"Feature Evolution for Classification of Remotely Sensed Data"

In a number of remote-sensing applications, it is critical to decrease the dimensionality of the input in order to reduce the complexity and, hence, the processing time and possibly improve classification accuracy. In this letter, the application of genetic algorithms as a means of feature selection is explored. A genetic algorithm is used to select a near-optimal subset of input dimensions using a feed-forward multilayer perceptron trained by backpropagation as the classifier. Feature and topology evolution are performed simultaneously based on actual classification results (wrapper approach). [J2184]

"A Low-Power High-Resolution Broad-Band Radar Using a Pulse Compression Technique for Meteorological Application"

A new high-resolution Ku-band Doppler radar for meteorological applications has been developed. With the new system design, the radar can accurately measure the radar reflectivity factor with 4-m resolution over a range from 40 m to several kilometers for 100-mW power using a pulse compression technique. Details of the system design, signal processing algorithm, and data acquisition procedures are described. To demonstrate the accuracy of the system, the radar reflectivity measurements are compared with the Joss-Waldvogel disdrometer measurements, and fairly good agreement is shown. The ability of the system to capture the backscattered signal and Doppler spectrum from rain volume at low altitude with high resolution is demonstrated for both convective- and stratiform-type rain events. [J2185]

"Knab Sampling Window for InSAR Data Interpolation"

Interferometric synthetic aperture radar processing requires interpolating a slave image onto a master one. Since the signals requiring interpolation are limited in both time and bandwidth, the Knab sampling window provides an almost optimal and viable interpolation kernel. Its performance in terms of coherence preservation and interferometric phase error as a function of the number of retained samples and oversampling factor are shown. [J2186]

"The Distinguished Tutorials Program [JSociety News & Information]"

{no data available} [J2187]

"Analysis of radar micro-Doppler signatures from experimental helicopter and human data"

This paper highlights the extraction of micro-Doppler (m-D) features from radar signal returns of helicopter and human targets using the wavelet transform method incorporated with time-frequency analysis. In order for the extraction of m-D features to be realised, the time domain radar signal is decomposed into a set of components that are represented at different wavelet scales. The components are then reconstructed by applying the inverse wavelet transform. After the separation of m-D features from the target's original radar return, time-frequency analysis is then used to estimate the target's motion parameters. The autocorrelation of the time sequence data is also used to measure motion parameters such as the vibration/rotation rate. The findings show that the results have higher precision after the m-D extraction rather than before it, since only the vibrational/rotational components are employed. This proposed method of m-D extraction has been successfully applied to helicopter and human data. [J2188]

"Radar target classification using multiple perspectives"

The problem of radar target classification is examined for the case when more than one perspective or viewing angle of the target is available to the sensor. Using full-scale target signature measurements as the source data, it is shown how, for the first time, multiple perspectives enhance the classification performance. Indeed this is the case even if only one additional perspective is available for exploitation. Further, we explore the classification performance both as a function of the number of perspectives and of the signal to noise ratio. Three approaches to high range resolution profile multi-perspective classification have been implemented. This removes any possible bias that could be introduced by a single individual classifier. The results show, for all three, a consistent improvement in the classification performance, as the number of perspectives is increased. The techniques employed also provide considerable insight into the classification process highlighting the degree of complexity of this extremely challenging problem. [J2189]

"Parameters localisation of coherently distributed sources based on sparse signal representation"

A robust and low-complexity parameters estimation method, which combines TLS-ESPRIT and sparse signal representation (SSR) to estimate the parameter of coherently distributed sources is presented. The central direction-of-arrivals are estimated by TLS-ESPRIT based on approximate rotational relationship between two identical uniform linear arrays (ULAs), and angular spreads are given by basis selection method using SSR. Hence the method is a low-complex estimator that does not need a search in one or two-dimensional parameter space. And it owns more robustness in estimating angular spread than one-dimensional distributed source parameter estimator (DSPE). In addition, our method can estimate parameters of the sources with different angular signal distribution functions, which DSPE cannot work. The simulation results prove the effectiveness of our method. [J2190]

"Bounding the performance of sidescan sonar automatic target recognition algorithms using information theory"

Modern sidescan sonars provide the ability to image the seafloor with increasingly high resolution. With this comes a corresponding increase in complexity of determining the performance of the sensor, with focus shifting from simple signal detection theory to assess the capability for automatic target recognition (ATR) algorithms to discriminate between different objects based on the shape of the projected acoustic shadows on the seafloor. This paper uses information theory to place bounds on the performance of ATR algorithms which use features based on an object's shadow as a classification cue. Information is used to compute different bounds on the performance of any classification method. The technique is applied to a simple classification task namely to discriminate between circular and square shapes. The effect of sensor characteristics, such as contrast and resolution, are computed. An example is given where the bounds on performance for a sidescan sonar with given characteristics under some environmental conditions are computed. The performance is then analysed as a function of the shapes being classified by changing the circular shape to a superellipse. Although high-frequency imaging sonar is examined here, the method could be applied to other types of monochromatic imagery that contains multiplicative noise. [J2191]

"IET RADAR 2007"

{no data available} [J2192]

"2008 IEEE Radar Conference"

{no data available} [J2193]

"Instantaneous frequency estimation based on directionally smoothed pseudo-Wigner-Ville

distribution bank"

In the cases of low signal-to-noise ratios (SNRs), estimating the instantaneous frequency (IF) curves of signals of interest is an interesting topic with many practical applications. Most of the existing methods are based on quadratic time-frequency (TF) distributions, which, however, yield a number of outliers in the cases of low SNRs. In this paper, we construct a new family of TF distributions, namely, the joint distributions, to estimate the IF curves in order to reduce outliers in the cases of low SNRs. The construction of the joint distributions is based on the definition of the directionally smoothed pseudo-Wigner-Ville distributions (DSPWVD) and pointwise adaptive weight averaging of a bank of DSPWVDs with different directions. The segments of the IF curve whose directions are close to that of the DSPWVD can be highlighted by each DSPWVD and the entire IF curve will be enhanced by the joint TF distribution. Simulation results show that the IF estimator based on the joint distributions outperforms that using quadratic TF distributions and the adaptive optimal adaptive kernel distribution in the cases of low SNRs. [J2194]

"A Quadrature Radar Topology With Tx Leakage Canceller for 24-GHz Radar Applications"

A quadrature radar topology with a Tx leakage canceller is presented. The canceller is composed of four branch-line hybrid couplers, a 90deg delay line, and a Wilkinson combiner. It has high Tx-to-Rx isolation and wide bandwidth characteristics. The isolation is 35.27 dB at 24 GHz and does not drop below 30 dB over a 2-GHz bandwidth. Given that the isolation of the branch-line hybrid coupler is 21.5 dB, the enhancement of the isolation is expected to be 13.77 dB. A quadrature Doppler radar front-end with the canceller was implemented. The noise level in the mixer output is lower by 9 dB compared with that of a conventional quadrature radar. This radar can measure speed as low as 0.76 mm/s, which correspond to a 0.12-Hz Doppler shift. It is also able to detect signs of the Doppler shift from a moving target due to its quadrature topology. [J2195]

"A New Algorithm for Sparse Aperture Interpolation"

A new algorithm for filling sparse aperture synthetic aperture radar (SAR)/inverse SAR (ISAR) data, which applies for widely gapped apertures, is proposed in this letter. An Estimating Signal Parameter via Rotational Invariance Techniques(ESPRIT)-based parametric approach is first used to estimate the power distribution with the sparse data. With the estimated power spectrum as prior information, by minimizing a weighted norm as a constraint, the full aperture data can be estimated. Although the algorithm is proposed for the sparse aperture interpolation in SAR/ISAR, it can be applied to other gapped data spectral estimation problems as well. Both numerical and experimental examples are provided to demonstrate the performance of the proposed algorithm. [J2196]

"Radio Echo Sounding of Pine Island Glacier, West Antarctica: Aperture Synthesis Processing and Analysis of Feasibility From Space"

Airborne radio echo sounding of the West Antarctic Ice Sheet over Pine Island Glacier was performed in the austral summer of 2004/2005 under the National Science Foundation's West Antarctic Ice Sheet Initiative. The British Antarctic Survey flew its newly developed 150-MHz ice-sounding radar over Pine Island Glacier and collected approximately 35 000 km of sounding data. The synthetic aperture radar (SAR) technique was applied to process those data in order to enhance radar signatures from the bed. As a matter of fact, airborne ice-sounding radar systems are generally affected by surface clutter returns, masking the echoes of internal layers and ice-bedrock transition at a large depth. Focused and unfocused (Doppler filtering) SAR techniques were compared, and their respective advantages/disadvantages were analyzed. Enhancement of bedrock detection at a large depth (> 2000 m) through SAR processing is demonstrated. Finally, a simulation analysis was performed for assessing the feasibility of ice-sheet sounding from space. It is shown that the gain in bed detection threshold is marginal in the satellite sounding geometry. Airborne radar, Antarctica, ice sounding, satellite remote sensing, subglacial topography, synthetic aperture radar (SAR) processing, West Antarctic Ice Sheet. [J2197]

"Measurement of Layer Thickness and Permittivity Using a New Multilayer Model From GPR Data"

The conventional method, i.e., the common middle point (CMP) method, has been used for many years for estimating the depth and permittivity of layered media from ground-penetrating radar (GPR) data. However, the CMP method results in noticeable errors in thickness and permittivity readings with the increase of antenna separation. To improve the measurement accuracy, a new mathematical model is presented, covering GPR measurement in one- and two-layer cases. In this model, we first check all the possible wave paths when the GPR signal propagates in the multilayer environment. We not only consider the effects from the air-ground interface but also introduce a ray-path-searching process in the GPR measurement using Fermat's shortest path law. The shortest path is then used in the process of GPR data inversion in order to calculate the depth and permittivity of each layer. Finally, we use the transmission-line matrix (TLM) method to simulate the propagation

of a GPR signal in the multilayered formation. A time-sequence image that was produced by the finite-difference time-domain method has also been used to explain this presented model. By comparing the numerical simulation results with the measured results, it is found that the estimated layer thickness and permittivity by the new model agree well with the simulated results. It proves that the new model is more accurate and closer to the real measured situation. [J2198]

"Foreword to the Special Issue on Subsurface Sensing Using Ground-Penetrating Radar (GPR)"

The 17 papers in this special issue focus on subsurface sensing using ground-penetrating radar (GPR). These papers describe new approaches to subsurface sensing, including developments in electromagnetic wave propagation imaging/inversion of GPR data and antenna/radar technologies. Associated applications range from glaciology to pavement evaluation to landmine detection. [J2199]

"Fitting a Two-Component Scattering Model to Polarimetric SAR Data From Forests"

Two simple scattering mechanisms are fitted to polarimetric synthetic aperture radar (SAR) observations of forests. The mechanisms are canopy scatter from a reciprocal medium with azimuthal symmetry and a ground scatter term that can represent double-bounce scatter from a pair of orthogonal surfaces with different dielectric constants or Bragg scatter from a moderately rough surface, which is seen through a layer of vertically oriented scatterers. The model is shown to represent the behavior of polarimetric backscatter from a tropical forest and two temperate forest sites by applying it to data from the National Aeronautic and Space Agency/Jet Propulsion Laboratory's Airborne SAR (AIRSAR) system. Scattering contributions from the two basic scattering mechanisms are estimated for clusters of pixels in polarimetric SAR images. The solution involves the estimation of four parameters from four separate equations. This model fit approach is justified as a simplification of more complicated scattering models, which require many inputs to solve the forward scattering problem. The model is used to develop an understanding of the ground-trunk double-bounce scattering that is present in the data, which is seen to vary considerably as a function of incidence angle. Two parameters in the model fit appear to exhibit sensitivity to vegetation canopy structure, which is worth further exploration. Results from the model fit for the ground scattering term are compared with estimates from a forward model and shown to be in good agreement. The behavior of the scattering from the ground-trunk interaction is consistent with the presence of a pseudo-Brewster angle effect for the air-trunk scattering interface. If the Brewster angle is known, it is possible to directly estimate the real part of the dielectric constant of the trunks, a key variable in forward modeling of backscatter from forests. It is also shown how, with a prioriknowledge of the forest height, an estimate for th- e attenuation coefficient of the canopy can be obtained directly from the multi-incidence-angle polarimetric observations. This attenuation coefficient is another key variable in forward models and is generally related to the canopy density. [J2200]

"Walled LTSA Array for Rapid, High Spatial Resolution, and Phase-Sensitive Imaging to Visualize Plastic Landmines"

We propose a walled linearly tapered slot antenna (LTSA) array to visualize plastic landmines. Previously, we reported an adaptive nonlinear visualization system based on a complex-valued self-organizing map (CSOM) that deals with complex amplitude texture in reflection images at multiple frequencies. The system distinguishes landmines from clutter by paying attention to textural features obtained by high spatial resolution and wideband reflection measurement. Because the system employed a mechanical scan of a pair of horn antennas, the measurement required a long time. An array antenna can reduce the time. The antenna element to be used there should therefore be compact and wideband. This paper reports the design and fabrication of a walled LTSA array visualization system. The antenna element has a 14 times 28 mm aperture size, and works at the 8-12 GHz frequency band. Because the structure is a simple combination of glass epoxy substrates and metal plates, we can easily fabricate low-cost and lightweight arrays. Electrical switches realize a high-speed scanning of 12 times 12 = 144 elements in total. We also report the results of a visualization experiment, in which plastic landmines are clearly visualized with the array in combination with the adaptive CSOM processing. Detection of landmines at frequencies of 10 GHz is only likely to be possible for targets buried a few centimeter deep or where the soil attenuation is very low. This might be a severe limitation of applicability of the method, as in field conditions soil attenuations of 10 dB or considerably more are commonly encountered, requiring the radar to operate at frequencies below 2-3 GHz. The best solution may be a multisensor system comprising these complementary high- and low-frequency radars. [J2201]

"Microwave Observatory of Subcanopy and Subsurface (MOSS): A Mission Concept for Global Deep Soil Moisture Observations"

The Microwave Observatory of Subcanopy and Subsurface (MOSS) is a mission concept for a spaceborne

synthetic aperture radar (SAR) system that provides global observations of soil moisture under substantial vegetation cover (exceeding 20 kg/m2) and at useful depths (1-5 m). The concept was developed and a number of new required technologies were demonstrated through a National Aeronautics and Space Administration Earth Science Technology Office Instrument Incubator Program project. This very high frequency (VHF)/ultrahigh frequency (UHF) polarimetric SAR is designed to provide 7-10-day observations of soil moisture at 1-km resolution. The rapid repeat cycle mandates swath widths in the range of 300-400 km, which must be realized by a 30-m-long antenna. Conventional array implementations would result in a mass of more than 4000 kg, whereas with the technology proposed and demonstrated in this project, the total antenna mass is less than 500 kg. The antenna concept is a dual-stacked patch array feed illuminating a 30-m mesh reflector to synthesize the long apertures and achieve the wide swath. The feed system prototype was fabricated and its performance demonstrated. Other major project components were: (1) system-level SAR and mission design; (2) demonstration of science data and products, using a tower-based VHF/UHF radar; (3) spacecraft and mesh reflector antenna mechanical design; (4) developing mitigation strategies for ionospheric effects; and (5) assessing frequency interference effects. Experimental science data were generated from the tower radar for soil moisture profiling in Arizona and for forest penetration in Oregon. The soil moisture products were demonstrated through an integrated inversion-processing algorithm. This paper summarizes the results from the MOSS project and demonstrates the feasibility of the spaceborne mission. [J2202]

"Thin-Pavement Thickness Estimation Using GPR With High-Resolution and Superresolution Methods"

In the field of civil engineering, sounding the top layer of carriageways, i.e., the pavement layer, is classically performed using standard ground-penetrating radar (GPR), whose resolution is bandwidth dependent. The layer thickness is deduced from both the time delays of backscattered echoes and the known dielectric constant of the medium. This paper focuses on superresolution and high-resolution techniques, which serve to improve the time resolution of GPR signals, and presents a parametric technique and five subspace methods, namely, estimation of signal parameters via rotational invariance techniques (ESPRIT), multiple-signal classification (MUSIC) algorithm, Min-Norm, and their polynomial versions root-MUSIC and root-Min-Norm. The performance of these algorithms will be compared in terms of resolution power as well as root-mean-square error on the estimated thickness. The paper also presents the results of computer tests and radar measurements in the far field. [J2203]

"Wave Interferometry Applied to Borehole Radar: Virtual Multioffset Reflection Profiling"

Based on wave-interferometry principles, we describe a procedure to synthesize monostatic and multioffset borehole radar reflection data from cross-hole radar tomography data. The procedure is equivalent to placing multiple transmitting sources in the receiving hole and conducting wide-angle reflection and refraction surveys. The procedure is illustrated using transmission and reflection data generated by numerical simulation of electromagnetic waves for a simple fracture model. The numerically simulated reflection data compare favorably with the reflection data synthesized using the wave-interferometry method. An experimental test of this procedure is also applied to a piece of field data from a pair of boreholes in crystalline igneous bedrock. The results demonstrate the potential of practical use of wave-interferometry methods for extracting reflection information from cross-hole radar tomography data. [J2204]

"MoM Analysis of Dipole Antennas in Crosshole Borehole Radar and Field Experiments"

In this paper, we propose a method-of-moments (MoM) analysis that includes the borehole effects on crosshole borehole radar, and we verify that the MoM represents the crosshole borehole radar data correctly. We derive the far-field approximation of an electric field radiated by an electric point source. In this derivation, we assume that the point source is in a cylindrically layered medium, while the observed electric field is in another cylindrically layered medium. The equations that are derived are used as a transfer function to connect the two impedance matrices-one for the transmitting antenna and the other one for the receiving one. In these matrices, the influence of the scattered field by the borehole is included completely. We conducted field experiments in granite with a controlled borehole medium in order to investigate the influence of the borehole. In this paper, we estimated the relative amplitude and the group delay of the received signals between the water-filled borehole case and the air-filled borehole case. This paper showed that the estimated amplitude and delay depend on the frequency and that the proposed MoM could predict these frequency dependencies. [J2205]

"Interconversion Between Truncated Cartesian and Polar Expansions of Images"

In this paper, we propose an algorithm for lossless conversion of data between Cartesian and polar coordinates, when the data is sampled from a 2-D real-valued function (a mapping:) expressed as a particular kind of

truncated expansion. We use Laguerre functions and the Fourier basis for the polar coordinate expression. Hermite functions are used for the Cartesian coordinate expression. A finite number of coefficients for the truncated expansion specifies the function in each coordinate system. We derive the relationship between the coefficients for the two coordinate systems. Based on this relationship, we propose an algorithm for lossless conversion between the two coordinate systems. Resampling can be used to evaluate a truncated expansion on the complementary coordinate system without computing a new set of coefficients. The resampled data is used to compute the new set of coefficients to avoid the numerical instability associated with direct conversion of the coefficients. In order to apply our algorithm to discrete image data, we propose a method to optimally fit a truncated expression to a given image. We also quantify the error that this filtering process can produce. Finally the algorithm is applied to solve the polar-Cartesian interpolation problem. [J2206]

"On the Effect of a Random Access Protocol on the Performance of the Session-Based Data Subsystem in GSM/GPRS"

Research into mixed services in mobile cellular networks is highly topical. Session-based applications (e.g., Web browsing) form significant and increasing data traffic in cellular networks. In such mixed services, random access (RA) protocols impose significant effects in performance metrics of the new data users. To date, analytical facility has been limited by the absence of closed-form models for the RA protocols that exist in time-division multiple access (TDMA) cellular networks with mixed voice (as circuit switched) and data with finite number of sessions (as packet switched). In this novel paper, we research an RA protocol based on S-Aloha with data as a session for mobile TDMA cellular networks and present an analytical framework. This work is germane to Global System for Mobile Communications/General Packet Radio Service systems. This paper begins with a general model description of a voice and data subsystem, and an explanation of its admission schemes. As well as the model, an analytical framework based on equilibrium point analysis is derived, and an algorithm is then formulated to complement the analytical framework. Using this novel analytical framework, together with the associated algorithm, performance metrics of the system such as throughput, mean access delay, and mean delay in the queue are obtained. Stability conditions are also highlighted. Numerical results are corroborated using simulation. [J2207]

"Tornadic Time-Series Detection Using Eigen Analysis and a Machine Intelligence-Based Approach"

The research Weather Surveillance Radar-1988 Doppler locally operated by the National Severe Storms Laboratory in Norman, OK, has the unique capability of collecting massive volumes of Level I time-series data over many hours, which provides a rich environment for evaluating our new postprocessing algorithms. In this letter, an approach of identifying tornado vortices in Doppler spectra is proposed and investigated using eigen analysis, cluster estimation, and fuzzy logic technique. [J2208]

"Spatially Variant Apodization for Squinted Synthetic Aperture Radar Images"

Spatially variant apodization (SVA) is a nonlinear sidelobe reduction technique that improves sidelobe level and preserves resolution at the same time. This method implements a bidimensional finite impulse response filter with adaptive taps depending on image information. Some papers that have been previously published analyze SVA at the Nyquist rate or at higher rates focused on strip synthetic aperture radar (SAR). This paper shows that traditional SVA techniques are useless when the sensor operates with a squint angle. The reasons for this behaviour are analyzed, and a new implementation that largely improves the results is presented. The algorithm is applied to simulated SAR images in order to demonstrate the good quality achieved along with efficient computation. [J2209]

"Rain Retrieval Performance of a Dual-Frequency Precipitation Radar Technique With Differential-Attenuation Constraint"

Assessments on the performance of dual-frequency (13.6/35.5 GHz) Precipitation Radar (DPR) rain retrieval techniques are performed by means other than relying on the surface reference technique. A DPR inversion technique (DPR-IT) with an independent estimate of the differential attenuation, i.e., the difference of attenuation differences between two frequencies over a certain range, is introduced as an alternative to surface reference or iterative methods for resolving the path-integrated attenuation (PIA) information. Retrieval performance of the proposed method is tested to some vertical rain profiles synthesized with arbitrarily defined and disdrometer-measured raindrop-size distribution data. Retrievals of two other DPR-IT-type methods, namely the DPR-IT with sets of preselected surface PIAs at two frequencies from wide ranges and the DPR-IT iterative algorithm, are also considered for the analysis. The comparison of the simulated results obtained from these three methods is presented and discussed. [J2210]

"Multistatic Ground-Penetrating Radar Experiments"

A multistatic ground-penetrating radar (GPR) system has been developed and used to measure the response of a number of targets to produce data for the investigation of multistatic inversion algorithms. The system consists of a linear array of resistive-vee antennas, microwave switches, a vector network analyzer, and a 3-D positioner, all under computer control. The array has two transmitters and four receivers which provide eight bistatic spacings from 12 to 96 cm in 12-cm increments. Buried targets are scanned with and without surface clutter, which is a layer of rocks whose spacing is empirically chosen to maximize the clutter effect. The measured responses are calibrated so that the direct coupling in the system is removed, and the signal reference point is located at the antenna drive point. Images are formed using a frequency-domain beamforming algorithm that compensates for the phase response of the antennas. Images of targets in air validate the system calibration and the imaging algorithm. Bistatic and multistatic images for the buried targets are very good, and they show the effectiveness of the system and processing. [J2211]

"Rain Scatter Interference in mm-Wave Broadband Fixed Wireless Access Networks Caused by a 2-D Dynamic Rain Environment"

The classical Mie scattering theory together with the bistatic radar equation has been applied in this paper to quantify interference levels in broadband fixed wireless access (BFWA) for two different network topologies: mesh and cellular. The complete scattering analysis takes into account the realistic variations of rainfall along the propagation paths and inside the common volume. The interfering element is a rain cell model that follows closely the experimental characteristic dimension, decay and movement obtained in recent research by the authors. The signal-to-interference power ratios (S/I) for two different frequencies, 28 and 42 GHz, and several scattering angles have been calculated. They show that, when two beams cross each other, rain-induced interference must be taken into account for an efficient planning of radio communication systems operating at these millimeter-wave frequencies as well as for an adequate design and implementation of fade mitigation techniques. [J2212]

"Z-complementary Binary Sequences"

In this letter, Z-complementary sequences are introduced. These sequences include the conventional complementary sequences as special cases. It is shown that, different from the normal complementary pair of binary sequences which exist only for very limited lengths, i.e., 2a10b26cfor a,b,cges0, a Z-complementary pair of binary sequences exists for many more lengths. In addition, for a Z-complementary set with zero correlation zone Z, P binary sequences, each having length N, the maximum number of distinct Z-complementary mates is smaller than or equal to P[N/Z]. [J2213]

"Precise Grating Profile Evaluation for DFB Lasers Using an Optical Metrology"

A precise grating profile evaluation method for distributed-feedback (DFB) laser diodes was achieved using a simple optical metrology. Spectroscopic scatterometry, an optical-wavelength light-diffraction technique, is emerging as a fast, accurate, and nondestructive means of monitoring profiles. A photoresist grating pattern on an InP substrate and an etched InP grating with periods of 0.2 and 0.24 mum were successfully evaluated by using unpolarized simple optical metrology. A precise grating profile evaluation technique with an accuracy of nanometers enabled us to obtain an accurate coupling coefficient (kappaL) for DFB laser diodes. DFB laser diodes with well-controlled kappaL are very promising for practical use in cost-effective optical networks. [J2214]

"An Airborne Radar Power Supply With Contactless Transfer of Energy-Part I: Rotating Transformer"

Reliability and precision are key requirements for electronic systems in aerospace applications. Transferring electrical energy from a stationary to a moving device involves wearable parts such as slip rings and brushes. This paper examines the possibility of using a rotating transformer for contactless transfer of energy from the base to the revolving platform of an airborne radar system. The first part of the series focuses on the magnetic interface, investigating its electrical properties and their association with the core and windings geometry. The reader will gain an understanding of the merits and limitations of this technology and will be able to assess its suitability for other applications. The effects of the increased leakage and reduced magnetizing inductances of the transformer are investigated, and two winding layouts are proposed and characterized by measurements and finite-element analysis. Some equations are presented along with practical guidelines on designing a rotating transformer with a 0.25-2-mm air gap. The transformer voltage gain and efficiency plots are introduced as performance-assessment tools. The impact of the air-gap stray flux on the winding conduction losses is shown, and some electromagnetic-compatibility considerations are presented. Finally, a mechanical layout for a 1-kW

rotating transformer is proposed. [J2215]

"Correspondence"

{no data available} [J2216]

"Improved nonlinear frequency scaling algorithm for squint FMCW SAR"

An improved nonlinear frequency scaling algorithm is proposed to process squint frequency modulated continuous wave synthetic aperture radar data. The algorithm uses a decimation technique to decrease the bandwidth of the signal introduced by the frequency scaling operation, effectively removing the range frequency aliasing. Simulated results show the validity of the algorithm. [J2217]

"An Airborne Radar Power Supply With Contactless Transfer of Energy-Part II: Converter Design"

A magnetic link is established between the stationary and revolving frames of a radar system by means of a rotating transformer. Based on the magnetics analysis of Part I of the series, a design methodology is proposed for integrating a rotating transformer into a power electronic converter using the efficiency and voltage gain plots. It is shown that a phase-shifted full-bridge topology can effectively utilize the parasitic components of the transformer. The increased magnetizing current assists the resonant transition, and this, in turn, compensates for the increased conduction losses that a rotating transformer yields. The proposed design method secures the soft-switching operation of the converter over the entire load range and allows efficient operation and reduced electromagnetic emissions. The methodology is evaluated experimentally, and the resulting prototype demonstrates an average efficiency of 92.6% in the 0.2-1-kW output power range. The proposed topology extends the power capacity of the rotating transformer without compromising its size, cost, or performance. A comparison between the slip rings and rotating transformer solutions highlights the merits and weaknesses of each technology. [J2218]

"A System for the Measurement of the Amazon"

The System for the Vigilance of the Amazon (SIVAM) is a $1.4 billion dollar project of Brazil aimed at the development and deployment of a high-technology system-of-systems to perform monitoring, protection, and control of the land, air, and water resources of the Brazilian Amazon region. The primary challenge of the SIVAM project is to perform remote sensing and communications over a vast and undeveloped land area. The SIVAM network meets this challenge through an extensive network of Air Traffic Control/Surveillance Radars, Environmental Sensors, Communications Systems, Airborne Sensor Systems, and Coordination Centers. Now fully operational, the SIVAM system is the world's largest fully integrated remote monitoring system of the environment and provides critical information on a timely basis to the Brazilian government, law enforcement agencies, and to commercial, educational, and research groups. [J2219]

"Potential GPRS 900/180-MHz and WCDMA 1900-MHz Interference to Medical Devices"

This study compared the potential for interference to medical devices from radio frequency (RF) fields radiated by GSM 900/1800-MHz, general packet radio service (GPRS) 900/1800-MHz, and wideband code division multiple access (WCDMA) 1900-MHz handsets. The study used a balanced half-wave dipole antenna, which was energized with a signal at the standard power level for each technology, and then brought towards the medical device while noting the distance at which interference became apparent. Additional testing was performed with signals that comply with the requirements of the international immunity standard to RF fields, IEC 61000-4-3. The testing provides a sense of the overall interference impact that GPRS and WCDMA (frequency division duplex) may have, relative to current mobile technologies, and to the internationally recognized standard for radiated RF immunity. Ten medical devices were tested: two pulse oximeters, a blood pressure monitor, a patient monitor, a humidifier, three models of cardiac defibrillator, and two models of infusion pump. Our conclusion from this and a related study on consumer devices is that WCDMA handsets are unlikely to be a significant interference threat to medical electronics at typical separation distances. [J2220]

"Classifying Multifrequency Fully Polarimetric Imagery With Multiple Sources of Statistical Evidence and Contextual Information"

This paper presents the use of a new distribution for fully polarimetric image classification. Several classification strategies are compared in order to assess the importance of a careful statistical modeling of the data and the complementary nature of the information provided by different frequencies. Spatial context, which is relevant in order to obtain good results with noisy data, is described by means of the multiclass Potts model, and an iterated conditional modes classification algorithm that employs pseudolikelihood is proposed. The data are

described using multivariate Gaussian laws and fully multilook polarimetric distributions arising from the multiplicative model. L-band, C-band, and both bands are used to assess the influence of dimensionality on the classification. Contextual and pointwise maximum-likelihood classifications are compared using real data. Results show that both context and number of frequencies contribute for better classification products, and that, a careful statistical description of the data leads to improved results. [J2221]

"Distinguished Tutorials Program [JSociety News & Information]"

{no data available} [J2222]

"Ranging and Three-Dimensional Imaging Using Time-Correlated Single-Photon Counting and Point-by-Point Acquisition"

Time-correlated single-photon counting techniques have been applied to time-of-flight ranging and imaging. This article describes recent progress in photon-counting systems performing surface mapping using point-by-point acquisition of noncooperative targets at short ranges of the order of 1-50 m, as well as measurements on distributed targets at longer ranges of the order of a 100 m to a few kilometers. We describe the measurement approach, the signal analysis methodology and algorithm selection. [J2223]

"An Earlier Kind of Computer [JHistory]"

When we hear the word computer today, we automatically think of a digital, general purpose, programmable device. From laptops to paralleled supercomputers, they all share these characteristics. However, before there was digital, there was analog. Before there was general purpose, there was special purpose. Before there was programmable, there was hard wired. Before there was UNIVAC, or even ENIAC, there was the Mark 1. This paper gives a brief discussion about Mark 1 which was a product of 40 years of development of mechanical analog computers for gun fire control on Navy ships. [J2224]

"Direction of Arrival Estimation Based on Support Vector Regression: Experimental Validation and Comparison With MUSIC"

In this letter, the problem of estimating the directions of arrival (DOAs) of coherent electromagnetic waves impinging upon a uniform linear array (ULA) is considered. In particular, an efficient DOA estimation approach based on the support vector regression is assessed using experimental measurements. Moreover, the obtained results are compared with those yielded by the multiple signal classification (MUSIC) algorithm. [J2225]

"Polarimetric Analysis of Bistatic SAR Images From Polar Decomposition: A Quaternion Approach"

This paper focuses on polar decomposition, which is based on the quaternion formalism, in single-look and multilook synthetic aperture radar polarimetry. Polar decomposition is used to decompose a bistatic or monostatic polarimetric scattering matrix into a product of a Hermitian matrix (boost) and a unitary matrix (rotation). After an overview of polar decomposition principle and quaternion properties, coherent (single-look complex) and incoherent (multilook) polar decompositions are discussed. In single-look polar decomposition, we introduce the boost parameter and the rotation parameter with the purpose of classifying scattering mechanisms of different natures. New relationships between these geometrical parameters and the scattering matrix elements are obtained. We also briefly reexamine the standard coherent polarimetric target decomposition algorithms in the light of quaternions. Next, an original use of polar decomposition for incoherent polarimetric imaging is proposed, which leads to the definition of the multilook boost parameter and of the degree of polarization dispersion. Subsequently, a new approach is presented, which consists in decomposing the scattering matrix into boost and rotation components before vectorization, then in averaging to generate boost and rotation coherency matrices separately. This leads to new inferred parameters: the boost and rotation entropies, and the concurrent dominant scattering mechanisms. The link between these new parameters and standard polarimetric invariants from the Cloude and Pottier decomposition is discussed. Eventually, the multilook extension of polar decomposition may allow this to be applied to the classification of remote sensing data. In this framework, a set of five parameters reducing to four in the monostatic case can be considered. [J2226]

"Approach of Adaptive Synchronization for Bistatic SAR Real-Time Imaging"

The use of a novel synchronization link to compensate time, phase, and spatial synchronization errors is proposed, aiming at the development of a practical synchronization technique for bistatic synthetic aperture radar (BiSAR) real-time imaging. With the proposed technique, an amplitude-modulated signal emitting from the transmitter is received by a passive receiver and divided into two channels. One is passed through an envelope detector and then used to trigger the sampling clock, and the second is used to achieve spatial synchronization

and phase synchronization. Finally, the residual time synchronization errors are compensated with a proposed high-precision range realignment method, and the residual phase synchronization errors are compensated with autofocus algorithms. This technique allows a passive receiver, which is teamed with an illuminator at a safe standoff distance, to receive the data reflected from potentially hostile areas of interest. Thus, this configuration, making real-time imaging possible, has a particular value in military applications. Simulation results show that successful adaptive synchronization for BiSAR real-time imaging is possible by using this dedicated synchronization link. [J2227]

"Deinterleaving of radar signals and PRF identification algorithms"

Electronic warfare (EW) receivers are passive receivers which receive emissions from other platforms, and do certain analysis on these emissions. Some EW receivers receive radar pulses, measure the parameter of each pulse received and group the pulses that belongs to the same emitter together to determine the radar parameters for each emitter. These parameters are then compared with values stored for known radar types, to identify the emitter type. Two parts are focused, emitters deinterleaving and PRF-type identification. The deinterleaving is done through parameters clustering. Two parameters are selected for clustering direction of arrival and radio frequency. A self-organising neural network called Fuzzy ART is proposed for clustering. This algorithm has a very good clustering quality and can run in real-time applications.The PRF-type identification is done through time-of-arrival (TOA) analysis. Three previously presented algorithms are combined in new scheme to do the TOA analysis (or PRF-type identification). These algorithms are difference TOA histogram, TOA folding histogram and sequence search algorithm. The complete proposed system has been tested using three different tests. These tests are simple PRI test, jittered PRI test and staggered PRI test. The proposed system identifies up to 90 simple emitters, 20 jittered emitters and 20 staggered emitters. In all tests, the data were simulated and generated using software. [J2228]

"Statistical prediction of monopulse angle measurement"

The statistical prediction of monopulse angle measurement where the amplitude fluctuation law of the signal source is unknown and multiple observations are available is presented. The mean and the variance of the monopulse ratio have been derived for the general case where the signal source is embedded in spatially coloured Gaussian noise and the receiver sum-channel is possibly completed by a detection step. This result completes the statistical prediction of a Swerling target and provides a powerful method to compute the mean and variance of the monopulse ratio conditioned by the detection test, whatever the amplitude fluctuation law of the signal source. [J2229]

"Highly integrated automotive radar sensor"

The design and measured results of the developed radar sensor for automotive applications are presented. The radar sensor is highly integrated with the transceiver module, antenna and baseband circuits. The proposed antenna is composed of a novel microstrip-line-fed horn antenna and a quasi-optic lens antenna. [J2230]

"Design and evaluation of a low-cost multistatic netted radar system"

This paper reports on the design and initial evaluation of a low-cost multistatic radar system that exploits digital components. The system is based on a commercial-off-the-shelf and open architecture approach, using a direct digital synthesiser, a field programmable gate array and a digital signal processor as core components. Instrument function testing, calibration and the results of the initial field tests are reported. Some of the first multistatic experimental results are reported and demonstrate a number of aspects of the performance of such a configuration. The advantages and limitations of a low-cost digital radar design are discussed and further system development possibilities outlined. This system will enable the collection of a wide range of novel multistatic data and has the potential to demonstrate a number of new radar applications. [J2231]

"Analytic performance prediction of feature-aided global nearest neighbour algorithm in dense target scenarios"

An analytic performance prediction method for the feature-aided global nearest neighbour tracking algorithm in multi-target tracking (MTT) scenarios is proposed. The approach serves as an alternative to the costly Monte Carlo simulation method. In MTT, evaluation of interference among multiple targets remains a crucial issue on tracking performance study. This issue is investigated in dense target scenarios with feature information and unrestrictive motion. Analytic expressions are developed for tracking performance in terms of the probability of correct association and estimation accuracy. Feature information of targets is incorporated in the formulation which provides us an insight on how the tracking performance is impacted by features. In the derivations, a series of simplification assumptions are made and the results are not intended to be used directly in practical

tracking applications. The major contribution of the paper is to provide a theoretical exploration and a methodology for analytic performance prediction of MTT. [J2232]

"Use of Enhanced-Resolution QuikSCAT/SeaWinds Data for Operational Ice Services and Climate Research: Sea Ice Edge, Type, Concentration, and Drift"

Enhanced-resolution QuikSCAT/SeaWinds (QSer) data recently entered the daily ice chart operation of the national ice services. Algorithms have been developed to extract four important sea ice parameters from this data over the whole Arctic: sea ice edge, type, concentration, and drift. This paper will summarize the different algorithms with a more detailed presentation of the sea ice concentration (IC) algorithm that has not been previously published. The sea ice edge can be detected to IC as low as 10%. Sea ice types can be roughly separated by a single threshold of 12 dB in the horizontal polarization. The IC algorithm gives reasonable qualitative results, separating into three classes: high, medium, and low ICs. It resolves even some characteristic ice features in the marginal ice zone and dynamic areas like the Fram Strait. However, it is very empirical and quantitatively not reliable. Sea ice drift can be determined with an accuracy of about 2.6 cm/s for a 48-h drift. Operating since 1999, QS is an important global data set for climate research, and two crucial applications how these sea ice products can be used for climate research are presented: the seasonal evolution of the sea ice cover and the export of sea ice volume through Fram Strait. [J2233]

"Investigating Attenuation, Scattering Phase Center, and Total Height Using Simulated Interferometric SAR Images of Forested Areas"

The objective of this paper is to examine the link between the attenuation coefficients and the interferometric phase center heights, for several frequencies from P- to L-band, and to study the extent to which it depends on the canopy architecture and description. This paper relies on the use of a coherent and full polarimetric scattering model, which simulates the fields backscattered by a forested area. In the first part, we study the behavior with a frequency of the interferometric phase center heights, and in the second part, we focus on the attenuation coefficients. Then, we compare the behaviors of these two quantities, and we propose to empirically derive a relation between these two quantities and the mean forest height. Finally, we investigate if a change in the initial forest or radar configuration has an impact on the determination of this relation. [J2234]

"Impact of Uncertainty in the Drop Size Distribution on Oceanic Rainfall Retrievals From Passive Microwave Observations"

The variability of the drop size distribution (DSD) is one of the factors that must be considered in understanding the uncertainties in the retrieval of oceanic precipitation from passive microwave observations. Here, we have used observations from the Precipitation Radar on the Tropical Rainfall Measuring Mission spacecraft to infer the relationship between the DSD and the rain rate and the variability in this relationship. The impact on passive microwave rain rate retrievals varies with frequency and rain rate. The total uncertainty for a given pixel can be slightly larger than 10% at the low end (ca. 10 GHz) of frequencies commonly used for this purpose and smaller at higher frequencies (up to 37 GHz). Since the error is not totally random, averaging many pixels, as in a monthly rainfall total, should roughly halve this uncertainty. The uncertainty may be lower at rain rates less than about 30 mm/h, but the lack of sensitivity of the surface reference technique to low rain rates makes it impossible to tell from the present data set. [J2235]

"SEABED Algorithm and Comments on “Modeling and Migration of 2-D Georadar Data: A Stationary Phase Approach”"

An imaging algorithm with a transform between the real and data spaces was proposed by Greenhalgh and Marescot for georadar data in 2006. This technique utilizes a reversible transform between the real space (X, Z = F(X)) and the data space (x, z = f(x)). The inverse transform is equivalent to the imaging method that is proposed by Li et al. (2005) if an antenna interval is short. This method was applied to preprocessing for breast cancer detection in 2005. These transforms were originally proposed by Sakamoto and Sato (2004) for an imaging with ultrawideband radar systems. By utilizing these transforms, a high-speed imaging algorithm, which is called as SEABED algorithm, was developed, which was extended to compensate for the phase rotation at caustic points, which was also described by Greenhalgh and Marescot. In addition, the SEABED algorithm was extended to apply to noisy data, 3D systems, experimental data, and bistatic radars. Note that the transform is fundamentally sensitive to noise because it includes derivative operations. A new algorithm was developed by extending the SEABED algorithm to avoid the derivative operations, which is stable and has a high resolution even for noisy data. The reversible transform in is now simultaneously and independently studied by some research groups because it is the sole solution for the imaging with wave fields. In addition, the transform has a variety of applications because it can be applied to electromagnetic waves, sonic and ultrasonic waves, seismic

waves, and other waves. [J2236]

"An Ocean Surface Wind Vector Model Function for a Spaceborne Microwave Radiometer"

Surface wind vector measurements over the oceans are vital for scientists and forecasters to understand the Earth's global weather and climate. In the last two decades, operational measurements of global ocean wind speeds were obtained from passive microwave radiometers (Special Sensor Microwave/ Imagers); and over this period, full ocean surface wind vector data were obtained from several National Aeronautics and Space Administration and European Space Agency scatterometry missions. However, since SeaSat-A in 1978, there have not been other combined active and passive wind measurements on the same satellite until the launch of Japan Aerospace Exploration Agency's Advanced Earth Observing Satellite-II in 2002. This mission provided a unique data set of coincident measurements between the SeaWinds scatterometer and the Advanced Microwave Scanning Radiometer (AMSR). The AMSR instrument measured linearly polarized brightness temperatures (TB) over the ocean. Although these measurements contained wind direction information, the overlying atmospheric influence obscured this signal and made wind direction retrievals not feasible. However, for radiometer channels between 10 and 37 GHz, a certain linear combination of vertical and horizontal brightness temperatures causes the atmospheric dependence to cancel and surface parameters such as wind speed and direction and sea surface temperature to dominate the resulting signal. In this paper, an empirical relationship between AMSR TB's (specifically A .TBV- TBH) and surface wind vectors (inferred from SeaWinds' retrievals) is established for three microwave frequencies: 10, 18, and 37 GHz. This newly developed wind vector model function for microwave radiometers can serve as a basis for wind vector retrievals either separately or in combination with active scatterometer measurements. [J2237]

"Singularity-Spreading Phase Unwrapping"

How to process phase singular points (SPs), or residues, is a difficult problem in a 2-D phase-unwrapping process to generate digital elevation maps (DEMs). Although the minimum-cost network-flow method is an effective and widely used technique, some problems still remain. That is, the method often generates spikes in high SP-density areas and long clifflike artifacts for isolated SPs. It also takes a long time to unwrap phase data that contain many SPs. In this paper, we propose a new unwrapping method, namely, singularity-spreading phase unwrapping (SSPU), which solves these problems. In this method, we spread the singularity at SPs around to make the closely located positive and negative SPs combine gently with each other or make the isolated SPs fade away. Experiments demonstrate that the spreading process compensates the distortion in phase values in the vicinities of SPs appropriately for landscape reconstruction. The SSPU generates high-quality DEMs with smaller calculation costs than the conventional method. Besides the simple SSPU, we also present weighted SSPU where we utilize amplitude information to improve the performance further. In addition, we discuss the relationship between landscape characteristics and SSPU performance. [J2238]

"Onboard Sensor-Based Collision Risk Assessment to Improve Pedestrians' Safety"

Many systems have been designed for pedestrian detection and tracking. However, pedestrians may or may not be in dangerous situations. Signaling every detected pedestrian generates too many false alarms, which could lead the driver not to pay attention to the warnings. The contribution of this paper is to develop a novel approach to assessing the risk of collision with a pedestrian based on the scenario and the behavior of the pedestrian. The risk assessment is based on extensive offline Monte Carlo simulations relying on a simple, yet representative, stochastic model of the pedestrian. The approach has been applied for the design of the Risk Assessment Unit of the PROTECTOR project dealing with pedestrian detection and classification funded by the European Commission. [J2239]

"Design and Analysis of a Mobility Gateway for GPRS-WLAN Integration"

This paper presents the design and analysis of general packet radio service (GPRS)-wireless local area network (WLAN) mobility gateway (GWMG) for the integration of GPRS and WLANs. The interworking between GPRS and WLANs is achieved by the GWMG that resides on the border of GPRS and WLAN systems. The design goal is to minimize the modifications in GPRS and WLANs as both systems are already widely available. By deploying the GWMG, users can seamlessly roam among the two systems. Unlike other related work, the proposed GWMG could be used when either the GPRS or WLAN is a user's home network. Both mathematical analysis and simulation are developed to analyze the performance. The proposed GWMG has also been implemented in a testbed comprising a commercial GPRS system. The results show that the GWMG could achieve a design goal that will effectively integrate GPRS and WLANs. [J2240]

"On Localization Performance in Imaging Sensor Nets"

We propose a massively scalable ldquoimagingrdquo architecture for sensor networks, in which sensor nodes act as ldquopixelsrdquo that electronically reflect (and possibly modulate data on top of) a beacon transmitted by a collector node. The collector employs sophisticated radar and image processing techniques to localize the responding sensor nodes, and (if data modulation is present) multiuser data demodulation techniques to extract the data sent by multiple sensors. The sensors do not need to know their own locations, do not need to communicate with each other, and can be randomly deployed. In this initial exposition, we develop basic insight into the localization capabilities of this approach, ignoring sensor data modulation. This reduces to an idealized one-bit, on-off keyed, communication model in which the the sensors are either ldquoactiverdquo or ldquoinactive,rdquo with the active sensors responding to the collector's beacon without superimposing data modulation. We consider a moving collector, with the sensor reflections creating a synthetic aperture radar (SAR)-like geometry. However, the collector must employ significant modifications to SAR signal processing for estimation of the location of the active sensors: noncoherent techniques similar to those in noncoherent radar tomography to account for the lack of carrier synchronization between sensor and collector nodes, and decision feedback mechanisms for estimation of the locations of multiple closely spaced active sensors. Measures for localization performance are defined, and the effect of system parameters such as bandwidth, beamwidth and signal-to-noise-ratio (SNR) on performance is investigated. [J2241]

"Error Exponents for Neyman-Pearson Detection of Markov Chains in Noise"

A numerical method for computing the error exponent for Neyman-Pearson detection of two-state Markov chains in noise is presented, for both time-invariant and fading channels. We give numerical studies showing the behavior of the error exponent as the transition parameters of the Markov chain and the signal-to-noise ratio (SNR) are varied. Comparisons between the high-SNR asymptotics in Gaussian noise for the time-invariant and fading situations will also be made. [J2242]

"A Rapid and Automatic MRF-Based Clustering Method for SAR Images"

This letter presents a precise and rapid clustering method for synthetic aperture radar (SAR) images by embedding a Markov random field (MRF) model in the clustering space and using graph cuts (GCs) to search the optimal clusters for the data. The proposed method is optimal in the sense of maximum a posteriori (MAP). It automatically works in a two-loop way: an outer loop and an inner loop. The outer loop determines the cluster number using a pseudolikelihood information criterion based on MRF modeling, and the inner loop is designed in a ldquohardrdquo membership expectation-maximization (EM) style: in the E step, with fixed parameters, the optimal data clusters are rapidly searched under the criterion of MAP by the GC; and in the M step, the parameters are estimated using current data clusters as ldquohardrdquo membership obtained in the E step. The two steps are iterated until the inner loop converges. Experiments on both simulated and real SAR images test the performance of the algorithm. [J2243]

"Signal Representation and the Nonlinear Property of Phase Images"

This letter proposes a representation of pixel value in a phase image as a complex number, which implies that the phase image is a nonlinear field. Consequently, conventional linear filtering will not properly work. Local statistics filters (LSFs) are chosen as a special case of the signal-processing algorithm to show the significance of signal representation to filtering performance. First, relationships among various LSFs, namely, ordinary LSF, speckle LSF, and phasor LSF, are discussed. We found that they are related to each other, whose general form is a complex-valued LSF (CV-LSF). It is also realized that directional windowing for the CV-LSF is actually not required, which indicates that the complex-valued formulation (representation and algorithm) is the most suitable one for phase image filtering. We demonstrate that the linear filtering to a simulated complex-valued image and an actual interferometric synthetic aperture radar image will start to fail when the window size is subsequently enlarged due to the nonlinear nature of the phase image. [J2244]

"Theoretical Limits for Estimation of Periodic Movements in Pulse-Based UWB Systems"

In this paper, Cramer-Rao lower bounds (CRLBs) for estimation of signal parameters related to periodically moving objects in pulse-based ultra-wideband (UWB) systems are presented. The results also apply to estimation of vital parameters, such as respiration rate, using UWB signals. In addition to obtaining the CRLBs, suboptimal estimation algorithms are also presented. First, a single-path channel with additive white Gaussian noise is considered, and closed-form CRLB expressions are obtained for sinusoidal object movements. Also, a two-step suboptimal algorithm is proposed, which is based on time delay estimation via matched filtering followed by least-squares estimation, and its asymptotic optimality property is shown in the limit of certain system parameters. Then, a multipath environment is considered, and exact and approximate CRLB expressions are derived. Moreover, suboptimal schemes for parameter estimation are studied. Simulation studies are

performed for the estimation of respiration rates in order to evaluate the lower bounds and performance of the suboptimal algorithms for realistic system parameters. [J2245]

"Introduction to the Issue on Performance Limits of Ultra-Wideband Systems"

The fifteen papers in this special issue focus on signal processing capabilities in ultra wideband (UWB) systems, system performance studies, and fundamental limitations of UWB systems. [J2246]

"Geocoding of Synthetic Aperture Radar Images Using Digital Vector Maps"

In this letter, a possible approach to automate synthetic aperture radar (SAR) geocoding (or to automatically refine the existing one) is presented. The procedure is based on edge detection, where ground control lines obtained from digital vector maps are located in the SAR images. In geocoding, affine, projective, and rigorous SAR sensor transformation models can be used. According to the experiments, the procedure seems to be accurate and reliable as long as the initial values of the geocoding transformation model are accurate enough. The procedure copes well with displacements of about ten pixels on SAR images, but good results have been obtained in cases of even larger displacements. According to the well-defined checkpoints, the resulting geocoding accuracies for test images were around a few pixels. When the rigorous SAR sensor model was used, the accuracies were less than two pixels in most cases. [J2247]

"Inferring Vegetation Water Content From C- and L-Band SAR Images"

This paper addresses the capability of synthetic aperture radar and optical images in combination with theoretical models to detect the vegetation water content (VWC) at field level. In this paper, a retrieval algorithm for the estimation of VWC from AirSAR acquired on vegetated fields during the SMEX'02 experiment is addressed. The aforementioned campaign has been chosen because, along with sensor observations, extensive ground truth measurements were acquired. The retrieval procedure, which is based on a Bayesian approach, has been initially developed for soil moisture extraction. It consists of two modules: one is pertinent to bare soils and the other one has been modified for vegetated fields. The last one uses the synergy with optical images to correct for the contribution of VWC. The VWC, a variable in the inversion procedure, as well as soil moisture can be estimated. The results indicate a good correlation with both ground measurements and VWC calculated from Landsat images through the use of normalized difference water index (NDWI). Furthermore, in the inversion procedure, the introduction of the dependence on roughness improves the estimates. This indicates that, even for dense vegetation, the contribution from bare soil greatly influences the radar signal. Three main levels of VWC are discriminated in the inversion procedure: values below 1 kg/m2, values between 1 and 3 kg/m2, and values greater than 3 kg/m2. [J2248]

"Modeling Interferogram Stacks"

Synthetic aperture radar interferometry is limited by temporal and geometrical decorrelation. Permanent scatterers (PSs) are helpful to overcome these problems, but their density in agricultural and out-of-town areas is not always sufficient. The forthcoming availability of satellite platforms with thinner orbital tubes and shorter revisit times will enhance the use of interferogram stacks, which are usable for distributed and progressively decorrelating targets, like those found in agricultural areas. To estimate the possibilities of the interferogram stack technique, a Markovian model for the temporal decorrelation is considered. ERS-1 data measured in C-band over Rome with a three-day repeat cycle are used to identify the parameters for this model, namely, the decorrelation time (estimated as 40 days) and the short-term coherence (estimated as 0.6). In the hypothesis of small deviations from a model of the motion, the optimal weights to be used to combine a sequence of interferograms taken at intervals that are shorter than the decorrelation time are calculated in the cases of progressive and sinusoidal ground motion. The dispersion of the optimal estimate of the motion is then determined. This model is extended to frequencies other than C-band. These evaluations are compared with the known results obtained for PSs. As an example, the case of a time interval between the takes of T = 12 days is considered. With N consecutive images, interferogram stack results are equivalent to PSs if the pixel count in the window used to smooth the interferograms grows with N2. [J2249]

"Adaptive Robust DOA Estimation for a 60-GHz Antenna-Array System"

Direction-of-arrival (DOA) estimation in a phased-array system is considered for a non-Gaussian noise environment. In this paper, a robust M-estimation scheme based on Huber's loss function with an adaptive threshold is proposed. The method is evaluated using experimental data from the University of California, Los Angeles, 60-GHz antenna-array system. It is shown that the proposed method enables a decreased sensitivity of the DOA estimates with respect to noise components having heavy-tailed distributions. [J2250]

"Linear Fusion of Image Sets for Display"

Many remote-sensing applications produce large sets of images, such as hyperspectral images or time-indexed image sequences. We explore methods to display such image sets by linearly projecting them onto basis functions designed for the red, green, and blue (RGB) primaries of a standard tristimulus display, for the human visual system, and for the signal-to-noise ratio of the dataset, creating a single color image. Projecting the data onto three basis functions reduces the information but allows each datapoint to be rendered by a single color. Principal components analysis is perhaps the most commonly used linear projection method, but it is data adaptive and, thus, yields inconsistent visualizations that may be difficult to interpret. Instead, we focus on designing fixed basis functions based on optimizing criteria in the perceptual colorspace CIELab and the standardized device colorspace sRGB. This approach yields visualizations with rich meaning that users can readily extract. Example visualizations are shown for passive radar video and Airborne Visible/Infrared Imaging Spectrometer hyperspectral imagery. Additionally, we show how probabilistic classification information can be layered on top of the visualization to create a customized nonlinear representation of an image set. [J2251]

"Along-Track Focusing of Airborne Radar Sounding Data From West Antarctica for Improving Basal Reflection Analysis and Layer Detection"

This paper presents focused synthetic aperture radar (SAR) processing of airborne radar sounding data acquired with the High-Capability Radar Sounder system at 60 MHz. The motivation is to improve basal reflection analysis for water detection and to improve layer detection and tracking. The processing and reflection analyses are applied to data from Kamb Ice Stream, West Antarctica. The SAR processor correlates the radar data with reference echoes from subsurface point targets. The references are 1-D responses limited by the pulse nadir footprint or 2-D responses that include echo tails. Unfocused SAR and incoherent integration are included for comparison. Echoes are accurately preserved from along-track slopes up to about 0.5deg for unfocused SAR, 3deg for 1-D correlations, and 10deg for 2-D correlations. The noise/clutter levels increase from unfocused SAR to 1-D and 2-D correlations, but additional gain compensates at the basal interface. The basal echo signal-to-noise ratio improvement is typically about 5 dB, and up to 10 dB for 2-D correlations in rough regions. The increased noise degrades the clarity of internal layers in the 2-D correlations, but detection of layers with slopes greater than 3deg is improved. Reflection coefficients are computed for basal water detection, and the results are compared for the different processing methods. There is a significant increase in the detected water from unfocused SAR to 1-D correlations, indicating that substantial basal water exists on moderately sloped interfaces. Very little additional water is detected from the 2-D correlations. The results from incoherent integration are close to the focused SAR results, but the noise/clutter levels are much greater. [J2252]

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{no data available} [J2253]

"Improving Mobile Core Network Security with Honeynets"

Despite improved security, core network vulnerabilities continue to threaten third-generation (3G) mobile systems. This article offers a security assessment conducted in the packet-switched domain of a mobile operator's infrastructure. A honeynet architecture could help address 3G security. [J2254]

"Stochastic Differential Equation Theory Applied to Wireless Channels"

Modeling wireless channels is essential to wireless communication systems. An autoregressive (AR) process of order one for wireless channel has long been assumed, but without a rigorous mathematical/physical basis. In this paper, we derive a first-order stochastic AR model for a flat stationary wireless channel, which comes from stochastic differential equation (SDE) theory concerning the nature of multipath fading channels. The resulting AR model describes more of the origin of multipath fading channels than previous AR models, and it can efficiently model and generate Rayleigh-distributed stationary fading channels. The Markovian property of the AR model is inherited through the SDE approach. [J2255]

"Hydraulic Splines: A Hybrid Approach to Modeling River Channel Geometries"

The hydraulic spline algorithm generates irregular 2D channel grids from highly accurate cross-sectional survey data at any desired resolution, facilitating its integration with high-density light detection and ranging (lidar) data. [J2256]

"CFAR Outlier Detection With Forward Methods"

Separation or classification of signal-present samples from noise-only samples is studied. The false-alarm probability implies how many noise-only samples are wrongly classified as outliers, and typically it should be smaller than some upper limit. The noise distribution parameters are not known a priori and have to be estimated. Multiple outliers have a strong influence to that estimation and may lead to uncontrollable false-alarm probability. The false-alarm probability control can be improved by robust estimators and/or by forward-detection methods. In this article, the false-alarm probability of the forward methods is analyzed. The forward consecutive mean excision (FCME) algorithm is enhanced to allow better false-alarm control. It is proposed that the forward method using the cell-averaging (CA) constant false-alarm rate (CFAR) technique can be applied for locating the outliers. The results show that its false-alarm probability stays close to the required value even in the presence of multiple outliers. [J2257]

"Warren D. White Award-for Excellence in Radar Engineering"

{no data available} [J2258]

"Low-Complexity MDL Method for Accurate Source Enumeration"

A low-complexity method for source enumeration is proposed in this letter. Given the training data of a desired signal, an array data matrix is partitioned into orthogonal signal and noise components. The noise components are then used to calculate the total description length required to encode the array data. The model with the minimum description length (MDL) is chosen as the best model. Unlike the traditional MDL methods, the proposed method linearly partitions the array data into the cleaner signal and noise components and thereby is more accurate and computationally efficient. Its performance is demonstrated via numerical results. [J2259]

"SAR Image Autofocus By Sharpness Optimization: A Theoretical Study"

Synthetic aperture radar (SAR) autofocus techniques that optimize sharpness metrics can produce excellent restorations in comparison with conventional autofocus approaches. To help formalize the understanding of metric-based SAR autofocus methods, and to gain more insight into their performance, we present a theoretical analysis of these techniques using simple image models. Specifically, we consider the intensity-squared metric, and a dominant point-targets image model, and derive expressions for the resulting objective function. We examine the conditions under which the perfectly focused image models correspond to stationary points of the objective function. A key contribution is that we demonstrate formally, for the specific case of intensity-squared minimization autofocus, the mechanism by which metric-based methods utilize the multichannel defocusing model of SAR autofocus to enforce the stationary point property for multiple image columns. Furthermore, our analysis shows that the objective function has a special separble property through which it can be well approximated locally by a sum of 1-D functions of each phase error component. This allows fast performance through solving a sequence of 1-D optimization problems for each phase component simultaneously. Simulation results using the proposed models and actual SAR imagery confirm that the analysis extends well to realistic situations. [J2260]

"Robust Wideband Beamforming by the Hybrid Steepest Descent Method"

This paper uses the hybrid steepest descent method (HSDM) to design robust smart antennas. Several design criteria as well as robustness are mathematically described by a finite collection of closed convex sets in a real Euclidean space. Desirable beamformers are defined as points of the generalized convex feasible set which is well defined even in the case of inconsistent design criteria. A quadratic cost function is formed by the correlations of the incoming data, and the HSDM constructs a point sequence that (strongly) converges to the (unique) minimizer of the cost function over the generalized convex feasible set. Numerical examples validate the proposed design. [J2261]

"Bootstrap Methods in Signal Processing [JFrom the Guest Editors]"

The bootstrap does with a computer what the experimenter would do in practice if it were possible: they would repeat the experiment. The seven articles in this special section on bootstrap methods in signal processing are summarized here. [J2262]

"SAR Remote Sensing Analysis of the Sea Surface by Polynomial Filtering [JApplications Corner]"

Synthetic aperture radar (SAR) allows the observation of the sea surface over large areas regardless of weather conditions. In what follows we discuss a digital signal processing (DSP) formalism that makes use of polynomial filters such as Volterra models to extract the geophysical information from SAR images and to model several nonlinear transfer functions. Polynomial filters allow the extension of algorithms derived for the linear case to the

nonlinear case. First, we will briefly discuss the types and sources of nonlinearities in SAR mapping of the ocean surface. Next, we will summarize the main characteristics of the Volterra filters and apply them to the understanding of hydrodynamic nonlinearities and instrumental nonlinearities. Then, we will combine their Volterra models to model the complete mapping process. Although we have only focused on the particular example of Volterra filters here, nonlinear autoregressive moving average (NARMA) models can also been applied to extract geophysical information from a nonlinear marine feature signature. [J2263]

"Signal Processing for Humanitarian Mine Action [JIn the Spotlight]"

{no data available} [J2264]

"Full-Waveform Inversion of Crosshole Radar Data Based on 2-D Finite-Difference Time-Domain Solutions of Maxwell's Equations"

Crosshole radar techniques are important tools for a wide range of geoscientific and engineering investigations. Unfortunately, the resolution of crosshole radar images may be limited by inadequacies of the ray tomographic methods that are commonly used in inverting the data. Since ray methods are based on high-frequency approximations and only account for a small fraction of the information contained in the radar traces, they are restricted to resolving relatively large-scale features. As a consequence, the true potential of crosshole radar techniques has yet to be realized. To address this issue, we introduce a full-waveform inversion scheme that is based on a finite-difference time-domain solution of Maxwell's equations. We benchmark our new scheme on synthetic crosshole data generated from suites of increasingly complex models. The full-waveform tomographic images accurately reconstruct the following: (1) the locations, sizes, and electrical properties of isolated subwavelength objects embedded in homogeneous media; (2) the locations and sizes of adjacent subwavelength objects embedded in homogeneous media; (3) abrupt media boundaries and average and stochastic electrical property variations of heterogeneous layered models; and (4) the locations, sizes, and electrical conductivities of water-filled tunnels and closely spaced subwavelength pipes embedded in heterogeneous layered models. The new scheme is shown to be remarkably robust to the presence of uncorrelated noise in the radar data. Several limitations of the full-waveform tomographic inversion are also identified. For typical crosshole acquisition geometries and parameters, small resistive bodies and small closely spaced dielectric objects may be difficult to resolve. Furthermore, electrical property contrasts may be underestimated. Nevertheless, the full-waveform inversions usually provide substantially better results than those supplied by traditional ray methods. [J2265]

"Global Analysis of Envisat RA-2 Burst Mode Echo Sequences"

The Envisat RA-2 burst echoes are being gathered throughout the mission; however, these data are only now being made generally available by the European space agency. Considerable work has been necessary to turn these engineering-level data into a useable altimeter product. This paper documents the processing steps undertaken to generate usable data and presents the first extensive analysis of this unique dataset, using over 75 000 burst sequences with a global distribution. The results show that the burst echo data from Envisat are of extremely low noise, which is particularly evident over non-ocean surfaces, and contain a wealth of detailed information from both land and ocean surfaces. Examples illustrate the complexity of surface response from targets such as inland water and rough terrain. These unique data clearly have the potential to inform future instrument design as well as to improve the understanding of existing altimeter datasets. [J2266]

"Image-Driven Data Mining for Image Content Segmentation, Classification, and Attribution"

Image-driven data mining methods are described for image content segmentation, classification, and attribution, where each pixel location of an image-under-analysis is the center point of a pixel-block query that returns an estimated class label. Feature attribute estimates may also be mined when sufficient attribute strata exist in the data warehouse. Novel methods are presented for pixel-block mining, pattern similarity scoring, class label assignments, and attribute mining. These methods are based on a direct sum tree structure called a sigma-tree that is utilized with near-neighbor similarity scoring. The sigma-tree structure provides a solution to the challenge of high computation/memory costs of pixel-block similarity searching. The sigma-trees are integrated into warehouse subsystems that provide referential capability into feature attribute data, resulting in a foundation for data mining called Source Optimized, Labeled, DIgital Expanded Representations (SOLDIER). The variable depth "bit-plane" data representations produced by sigma-tree path selections provide an approach to image content segmentation, and provide a structure for formulation of Bayesian classification with data-adaptive Parzen classifiers with variably sized windows. Preliminary methods and results for postprocessing of mined feature-thematic layers for higher level scene understanding are also presented. Sample results are shown with synthetic aperture radar images and with high-resolution pan-sharpened satellite images of the Payagala, Sri Lanka area before the site was devastated by the 2004 Asian Tsunami. [J2267]

"Ultrawideband Radar Measurements of Thickness of Snow Over Sea Ice"

An accurate knowledge of snow thickness and its variability over sea ice is crucial in determining the overall polar heat and freshwater budget, which influences the global climate. Recently, algorithms have been developed to extract snow thicknesses from satellite passive microwave data. However, validation of these data over the large footprint of the passive microwave sensor has been a challenge. The only method used thus far has been with meter sticks during ship cruises. To address this problem, we developed an ultrawideband frequency-modulated continuous-wave radar to measure the snow thickness over sea ice. We synthesized a very linear chirp signal by using a phase-locked loop with a digitally generated chirp signal as a reference to obtain a fine-range resolution. The radar operates over the frequency range from 2-8 GHz. We made snow-thickness measurements over the Antarctic sea ice by operating the radar from a sled in September and October 2003. We performed radar measurements over 11 stations with varying snow thicknesses between 4 and 85 cm. We observed an excellent agreement between radar estimates of snow thickness with physical measurements, achieving a correlation coefficient of 0.95 and a vertical resolution of about 3 cm. Comparison of simulated radar waveforms using a simple transmission line model with the measurements confirms our expectations that echoes from snow-covered sea ice are dominated by reflections from air-snow and snow-ice interfaces. [J2268]

"Atmospheric Components Determination From Ground-Level Measurements During the Spectra Barax Campaigns (SPARC) Field Campaigns"

The surface processes and ecosystem changes through response analysis (SPECTRA) Barrax campaigns were validation campaigns developed in the framework of the SPECTRA mission in order to verify that the geophysical data products provided by satellite imagery are consistent with the measurements made by independent means. Two campaigns took place in Barrax, Spain, during the summers of 2003 and 2004. This paper presents the results of the characterization of the atmospheric composition from solar radiation, radiosoundings, and lidar measurements. Several potentially interesting situations involving atmospheric layers with different types of aerosols and water content are discussed. The presence of a residual layer capping the mixing layer during some days of the 2003 campaign and the arrival of a dust-rich air mass from the Sahara on the last two days of the 2004 campaign provide some relevant aerosol vertical profiles to test atmospheric correction algorithms. The study of the effects of these atmospheric situations on radiative transfer calculations is required in the development and validation of advanced atmospheric correction codes for the new generation of Earth observation systems. [J2269]

"The Influence of Antenna Pattern on Faraday Rotation in Remote Sensing at L-Band"

The influence of the pattern of the receive antenna on measured Faraday rotation is examined in the context of passive remote sensing of soil moisture and ocean salinity at L-band. Faraday rotation is an important consideration for radiometers on future missions in space, such as SMOS and Aquarius. Using the radiometer on Aquarius as an example, it is shown that, while I = Tv + Th is independent of Faraday rotation to first order, it has rotation dependence when realistic antenna patterns are included in the analysis. In addition, it is shown that using the third Stokes parameter to measure the rotation angle can yield a result that is biased by as much as 1deg by purely geometrical issues that are associated with the finite width of the main beam. [J2270]

"Paddy Fields as Electrically Dense Media: Theoretical Modeling and Measurement Comparisons"

Early models for paddy fields consist of a single-layered medium in which coherent effects within clusters of leaves are considered but multiple volume scattering is not. In this paper, the paddy canopy is modeled as a multilayered dense discrete random medium consisting of cylindrical and needle-shaped scatterers. Consideration is given to the coherent and near-field effects of the closely spaced scatterers through the Dense Medium Phase and Amplitude Correction Theory and Fresnel corrections, respectively, in the phase matrix. Then, this dense medium phase matrix is applied in the radiative transfer equations and solved up to the second order to consider double-volume scattering. Ground truth measurements of paddy fields were acquired at Sungai Burung, Selangor, Malaysia, for an entire season from the early vegetative stage of the plants to their reproductive stage. Measured parameters are used in the theoretical model to calculate the backscattering coefficients of paddy fields. Theoretical analysis of the simulation results shows in particular that second-order effects are important for cross-polarized backscatter data and that coherent effects need to be considered at lower frequencies. However, the use of needles to represent paddy leaves tends to underestimate the HH-polarized backscattering coefficients especially at the latter stages of plant growth, i.e., when the leaves are broader. The results are also used for comparisons with the backscattering coefficients obtained from RADARSAT images as well as that of earlier models to test the validity of the dense medium model with promising results. [J2271]

"Wind Farm Clutter Mitigation in Air Surveillance Radar"

Windmills provide a renewable energy resource that could become major components of the power infrastructure in the United States, Europe, and Asia within the next decade. However, collections of windmills, known as wind farms, cause interference in radars that are critical to air defense and air traffic systems. Therefore, to maintain and, perhaps, improve air surveillance, methods that mitigate the inevitable performance degradation seen in radar systems must be proven and implemented to deal with wind farms as they become more prevalent. Herein, the authors discuss recommended techniques for wind farm mitigation, which are based on a UK Royal Air Force-sponsored demonstration on a Watchman radar, conducted at Clatter, South Wales. Specifically, false alarm and false track reductions will be quantified. [J2272]

"Radar Scattering and Target Imaging Obtained Using Ramp-Response Techniques"

The response from targets illuminated by a transient plane wave the time dependence of which takes the form of a ramp function has been used to generate signatures for conductive and penetrable targets. Modified geometrical profile functions of various targets are used to generate their ramp response, which in turn is used to evaluate their scattered fields as a function of frequency. In early time, the ramp response is proportional to the physical cross-sectional area of the target (as a function of time or distance as the wave propagates over the target). Thus, the ramp response can be generated from the target's geometry. This is then Fourier transformed to obtain the spectrum of the ramp response. To obtain the spectrum of the impulse response, this result is simply multiplied by (jomega)2, where omega is the angular frequency. These simple steps can be readily performed by anyone with an electrical engineering background to obtain the backscattered fields to a reasonable approximation. These same fundamentals can also be used to approximate a target's image from the measured ramp response. This has been done for axial incidence of rotationally symmetric targets. It can be extended to non-rotationally symmetric targets using an iterative process. [J2273]

"Instructions for AP-S and URSI Authors"

{no data available} [J2274]

"A Partial Rotation Formulation of the Circular Near-Field-to-Far-Field Transformation (CNFFFT)"

For many years now, General Dynamics has described the development, characterization, and performance of an image- based circular near-field-to-far-field transformation (CNFFFT) for predicting far-field radar cross sections (RCS) from near- field measurements collected on a circular path around the target. In this paper, we consider the CNFFFT algorithm as an azimuthal-filtering process, and develop a formulation capable of transforming data that is not measured over a full 360deg. Such a formulation has applications in measurement scenarios where collection of a complete rotation is not practical. As part of the development, we provide guidelines for the near-field data support required to achieve a desired accuracy in the sub-360deg CNFFFT result. Numerical simulations are provided to demonstrate that the results of this partial-rotation formulation are consistent with the full-circle CNFFFT results presented in past papers. [J2275]

"Correlation Properties of Signals Backscattered From Fractal Profiles"

A successful mathematical description of natural landscapes relies upon a class of random processes known as fractional Brownian motions (fBms), which may exhibit correlation with long-range dependence (LRD). In remote sensing applications, the sensor observes a certain real scene Band records data Ifor successive signal processing tasks. Assuming that B is modeled as an fBm, does the recorded signal Ipreserve the LRD character of B? More in general, can we relate the Hurst coefficient (an index of LRD) of the real scene to that of the recorded data? We address the problem in a simplified setup in which the data are related to (the slope of) the original scene through a zero-memory mapping. A mathematical framework is presented in which the above questions can be answered in the asymptotic regime of infinite data size. The effect of the finite sample size is also investigated. The mathematical model is also validated by real data, which are collected by a synthetic aperture radar that is mounted onboard of ERS-1/2 satellites. [J2276]

"Influence of high-resolution processing on background noise distribution in ship-borne radar"

When a high-resolution algorithm is applied in a ship-borne radar, its non-linearity and distributional characteristics before high-resolution processing determine the distributional characteristics of background clutter after high resolution and detector design afterwards. Because background noise before high-resolution has physical significance, the statistical model of first-order Bragg lines and second-order components of sea clutter is put forward. Then, by using higher order cumulative quantity's statistical verification of actual measured data, it is concluded that the background noise before high resolution conforms to normal distribution in a ship-borne

radar. The non-linearity of the high-resolution algorithm means that the background noise after high-resolution processing conforms to non-normal distribution. Non-normal-distributed clutter mainly includes Weibull, lognormal, and K-clutter. Rayleigh clutter can be seen as a special case of Weibull clutter. These clutter types have different statistical characteristics and can be discriminated by recognition of clutter characteristics. The numerical domain's distribution after high-resolution processing is determined by an improved, minimum entropy, clutter characteristics recognition method based on the AIC rule, namely, a two-parameter domain-scanning method. This identification method has a higher recognition rate. It is verified that the background noise after high-resolution by pre-whitened-constrained-MUSIC conforms to lognormal distribution. [J2277]

"Adaptive Doppler-Kalman filter for radar systems"

Time-dependent Fourier transform plays an important role in radar signal analysis. The Doppler frequency carries information about the relative velocity of a moving target regarding the radar antenna. However, because the target movement may be very complex, with temporary high-intensity manoeuvres, the Doppler frequency must be estimated by using a window function. In order to minimise the estimation error, the window function width must be dependent on the target manoeuvre as well as on the signal-to-noise ratio. Here, a system consisting of a Doppler filter and a second-order Kalman filter, connected in an adaptive structure, has been proposed as an efficient solution to this problem. The proposed approach enables the window width adaptation, based on the estimates of target acceleration and signal-to-noise ratio, generated by an adaptive Kalman filter. Simulation results demonstrate the advantage of this structure compared to the fixed-width, window-based algorithms, giving acceptable results even for very bad signal-to-noise conditions. [J2278]

"Approximation to Zolotarev polynomial ideal difference beams for linear arrays"

A simple technique is reported, able to generate ideal array antenna difference beam patterns necessary for high angular accuracy determination from linear array radar systems. The technique relies on an approximation to the Zolotarev polynomial. [J2279]

"Physical optics-based electromagnetic bias theory with surface height-slope cross-correlation and hydrodynamic modulation"

An electromagnetic (EM) bias model for microwave frequencies is derived using the physical optics scattering approximation with a sea surface model that includes the effects of hydrodynamic modulation and non-Gaussian long-wave statistics. Correlation of long-wave slopes with displacement and hydrodynamic modulation of short-wave amplitudes are the two major contributors to the EM bias. The fact that the bias is caused by physical processes with different dependencies on frequency and sea state parameters accounts for some of the difficulties encountered with previous bias modeling efforts. The frequency dependence of the bias is weak because the trends of the hydrodynamic and height-slope skewness contributions with respect to frequency are in opposition. The model provides theoretical support for previous empirical observations of weak correlation of relative bias with wind speed and strong correlation with root-mean-square long-wave slope. While the presence of wind-generated small-wave roughness is crucial to the portion of the bias caused by hydrodynamic modulation, the magnitude of the bias thus induced is largely independent of local wind speed. The bias model is validated by comparison to measured data from two tower radar experiments, the Gulf of Mexico experiment (1991-1992) and the Brigham Young University off-nadir experiment (2003). Both quantitative and qualitative agreements between model and measurements are observed. [J2280]

"Calibration of spaceborne laser Altimeters-an algorithm and the site selection problem"

Meeting the accuracy demand of products derived from spaceborne laser altimetry requires post-launch calibration/validation procedures. Over general surfaces, such as the ones land or ice offer, calibration methods that suite undulating topography should be applied. Whereas the estimation of calibration parameters usually refers to the derivation of an error model, the problem here extends beyond that. Not knowing in advance the offsets between the recorded and actual footprint locations implies that the offsets and the calibration parameters should be estimated jointly. In addition, concerns arise regarding the reliability and quality of the estimates, namely avoiding convergence to a false solution and avoiding estimates that are highly correlated and with a low level of accuracy. The correlation and the accuracy can indeed be estimated in retrospect, but the preference is to learn in advance what factors affect them and under what circumstances they can be optimized. This paper analyzes the calibration problem along the lines of correctness and reliable estimation and shows that the error recovery model provides ample information that can lead to a solution that is both efficient and an integral part of a calibration model. Analysis of the model shows that over natural topography relatively short sites are sufficient for achieving a reliable calibration. The paper then shows that by applying optimization criteria on the estimation, rules for predicting the quality of the solution can be derived as well as general measures for evaluating sites

considered for calibration. [J2281]

"A two-dimensional satellite rainfall error model"

A two-dimensional satellite rainfall error model (SREM2D) is developed for simulating ensembles of satellite rain fields on the basis of "reference" rain fields derived from higher accuracy sensor estimates. With this model we aim at characterizing the multidimensional stochastic error structure of satellite rainfall estimates as a function of scale. The pertinent error dimensions we seek to address are: 1) the joint probability density function for characterizing the spatial structure of the successful delineation of rainy and nonrainy areas; 2) the temporal dynamics of rain estimation bias; and 3) the spatial variability of rain rate estimation error. Ground radar rain fields in the Southern plains of the United States are used as reference to evaluate SREM2D error parameters at 0.25-deg and hourly spatiotemporal resolution for an infrared (IR) rain retrieval algorithm (IR-3B41RT) developed at NASA. Comparison of SREM2D simulated satellite rainfall with actual IR-3B41RT data showed that the error modeling technique can preserve the estimation error characteristics across scales with marginal deviations. The model performance is compared against two simpler, but widely used, approaches of error modeling that do not account for uncertainty in rainy/nonrainy area delineation. It is shown that both of these approaches fare poorly with regards to preserving the error structure across scales. They underestimated the sensor retrieval error standard deviation by more than 100% upon aggregation, which, for SREM2D, was found to be below 30%. SREM2D is modular in design-it can be applied for any satellite rainfall algorithm to consistently characterize its error structure. [J2282]

"Development of a new millimeter-wave integrated-circuit sensor for surface and subsurface sensing"

A new millimeter-wave sensor employing the stepped-frequency radar technique has been developed using microwave and millimeter-wave integrated circuits and demonstrated for surface and subsurface sensing. The sensor is based on the coherent super-heterodyne scheme and operated from 29.72-37.7GHz. It has been used to profile the surface of a sample with range accuracy within plusmn0.1 cm. The sensor was also used to monitor continuously varying liquid levels in a tank and was able to detect the displacement of liquid level with less than plusmn0.1 cm error. The sensor successfully detected and located anti-personnel mines buried under sand with less than 1.8 and 0.2 cm of errors in horizontal and vertical directions, respectively [J2283]

"Derivation and comparison of SAR and frequency-wavenumber migration within a common inverse scalar wave problem formulation"

Two common Fourier imaging algorithms used in ground penetrating radar (GPR), synthetic aperture radar (SAR), and frequency-wavenumber (F-K) migration, are reviewed and compared from a theoretical perspective. The two algorithms, while arising from seemingly different physical models: a point-scatterer model for SAR and the exploding source model for F-K migration, result in similar imaging equations. Both algorithms are derived from an integral equation formulation of the inverse scalar wave problem, which allows a clear understanding of the approximations being made in each algorithm and allows a direct comparison. This derivation brings out the similarities of the two techniques which are hidden by the traditional formulations based on physical scattering models. The comparison shows that the approximations required to derive each technique from the integral equation formulation of the inverse problem are nearly identical, and hence the two imaging algorithms and physical models are making similar assumptions about the solution to the inverse problem, thus clarifying why the imaging equations are so similar. Sample images of landmine-like targets buried in sand are obtained from experimental GPR data using both algorithms. [J2284]

"Two-dimensional and three-dimensional NUFFT migration method for landmine detection using ground-penetrating Radar"

Ground-penetrating radar (GPR) has been widely used for landmine detection due to its high signal-to-noise ratio (SNR) and superior ability to image nonmetallic landmines. Processing GPR data to obtain better target images and to assist further object detection has been an active research area. Phase-shift migration is a widely used method; however, its wavenumber space is nonuniformly sampled because of the nonlinear relationship between the uniform frequency samples and the wavenumbers. Conventional methods use linear interpolation to obtain uniform wavenumber samples and compute the fast Fourier transform (FFT). This paper develops two- and three-dimensional migration methods that process GPR data to obtain images close to the actual target geometries using a nonuniform fast Fourier transform (NUFFT) algorithm. The proposed method is first compared to the conventional migration approaches on simulated data and then applied to landmine field data sets. Results suggest that the NUFFT migration method is useful in focusing images, estimating landmine structure, and retaining relatively high signal-to-noise ratio in the migrated data. The processed data sets are

then fed to the normalized energy and least-mean-square-based anomaly detectors. Receiver operating characteristic curves of data sets processed by different migration methods are compared. The NUFFT migration shows potential improvements on both classifiers with a reduced false alarm rate at most probabilities of detection. [J2285]

"A unified framework for the Sussman, Moyal, and Janssen formulas"

This paper derives three fundamental identities in the radar and sonar literature, namely, Sussman' identity for ambiguity functions, Moyal's formula which establishes the value of the inner product between two scattering functions, and Janseen's formula which establishes identities for mixed inner products between waveforms and Gabor wavelets. Starting from the fundamental convolution identity, we derive Sussman's identity. Following from an initial value theorem of Fourier analysis, we obtained Moyal's formula. Following from Poisson's sum formula and an initial value theorem, we also obtained Janssen's equality. The relationship between these three identities is as follows: Janssen's formula is a sampled-data version of Moyal's formula, and both follow from Sussman's identity. In turn, Sussman's identity is a consequence of the fundamental convolution identity. [J2286]

"Lidar detection of underwater objects using a neuro-SVM-based architecture"

This paper presents a neural network architecture using a support vector machine (SVM) as an inference engine (IE) for classification of light detection and ranging (Lidar) data. Lidar data gives a sequence of laser backscatter intensities obtained from laser shots generated from an airborne object at various altitudes above the earth surface. Lidar data is pre-filtered to remove high frequency noise. As the Lidar shots are taken from above the earth surface, it has some air backscatter information, which is of no importance for detecting underwater objects. Because of these, the air backscatter information is eliminated from the data and a segment of this data is subsequently selected to extract features for classification. This is then encoded using linear predictive coding (LPC) and polynomial approximation. The coefficients thus generated are used as inputs to the two branches of a parallel neural architecture. The decisions obtained from the two branches are vector multiplied and the result is fed to an SVM-based IE that presents the final inference. Two parallel neural architectures using multilayer perception (MLP) and hybrid radial basis function (HRBF) are considered in this paper. The proposed structure fits the Lidar data classification task well due to the inherent classification efficiency of neural networks and accurate decision-making capability of SVM. A Bayesian classifier and a quadratic classifier were considered for the Lidar data classification task but they failed to offer high prediction accuracy. Furthermore, a single-layered artificial neural network (ANN) classifier was also considered and it failed to offer good accuracy. The parallel ANN architecture proposed in this paper offers high prediction accuracy (98.9%) and is found to be the most suitable architecture for the proposed task of Lidar data classification [J2287]

"Monitoring and surveillance potentialities obtained by splitting the antenna of the COSMO-SkyMed SAR into multiple sub-apertures"

The authors discuss the potentialities obtained by splitting the antenna of the COSMO-SkyMed synthetic aperture radar (SAR), developed by Alenia Spazio under contract to the Italian Space Agency and Italian Ministry of Defence, into multiple sub-apertures. The modified sensor has the capability to detect slowly moving ground targets that compete with the clutter Doppler spectrum. Special attention is devoted to a preliminary analysis of the signal processing techniques to be used. Moreover their capabilities for surveillance purposes are characterised based on theoretical and simulated results. Moreover the modified sensor is shown to allow sea current/wave monitoring by along-track SAR interferometry, relocation of moving targets in high resolution SAR images, and fully polarimetric imaging. Some practical implementation issues related to the possible modification are also briefly discussed. [J2288]

"Demonstration of advanced reconnaissance techniques with the airborne SAR/GMTI sensor PAMIR"

PAMIR (Phased Array Multifunctional Imaging Radar) is an experimental airborne radar system that has been designed and built by the Research Institute for High Frequency Physics and Radar Techniques (FHR) of Forschungsgesellschaft fьr Angewandte Naturwissenschaften (FGAN). The goal is to meet the growing demands for future reconnaissance systems with respect to flexibility and multi-mode operation by the use of an electronically steerable phased array antenna. The X-band system with a bandwidth of 1.8 GHz serves as a platform for different tasks. One of the main objectives is to demonstrate synthetic aperture radar (SAR) imaging at a very high resolution and for a long range. The fine resolution will also be applied for inverse SAR (ISAR) imaging of ground moving targets. Moreover, five parallel receiving channels allow array processing techniques like ground moving target indication (GMTI) via space-time adaptive processing, electronic counter-counter-measures and interferometric SAR with a very high 3D-resolution. A multi-channel scan-MTI mode with a range

resolution adapted to the target size allows for a wide area GMTI operation that can be complemented by target tracking. Together with the predecessor system AER-II, operating at a frequency band contained in that of PAMIR, the possibility of experimental investigation of bistatic SAR is given. SAR images of large urban areas and ISAR images of moving objects, both with finest resolution down to the sub-decimetre scale, are presented. Results of GMTI in a wide area scanning mode and broadband bistatic experiments including true bistatic SAR processing are shown as well. [J2289]

"A particle filter for tracking two closely spaced objects using monopulse radar channel signals"

For the case of a single resolved target, monopulse-based radar sub-beam angle and sub-bin range measurements carry errors that are approximately Gaussian with known covariances, and hence, a tracker that uses them can be Kalman based. However, the errors accruing from extracting measurements for multiple unresolved targets are not Gaussian. We therefore submit that to track such targets, it is worth the effort to apply a nonlinear (non-Kalman) filter. Specifically, in this letter, we propose a particle filter that operates directly on the monopulse sum/difference data for two unresolved targets. Significant performance improvements are seen versus a scheme in which signal processing (measurement extraction from the monopulse data) and tracking (target state estimation from the extracted measurements) are separated. [J2290]

"Coming to grips with Univac"

When it made successful use of magnetic tape, the Univac I pioneered the way for federal and commercial applications with extensive files. But pioneering posed many challenges because technology barely supported the production and introduction of electronic computers. This article is a recollection of efforts the US Air Force made to accommodate and use the first Univac moved out of the factory. [J2291]

"A photonic technique for microwave frequency measurement"

A novel photonic technique for microwave frequency measurement utilizing dispersion in a multichannel chirped fiber Bragg grating is presented. The technique is based on the amplitude comparison of power fading functions generated by double sideband modulated optical carriers propagating through a dispersive medium [J2292]

"Extinction pulses synthesis for radar target discrimination using /spl beta/-splines, new E-pulse conditions"

The extinction pulse method has been proven to be a suitable method for radar target discrimination using the natural resonance annihilation concept. The standard procedure for extinction pulse (E-pulse) construction is based on an expansion on subsectional polynomials. In this paper it is proposed a new formalism for E-pulse construction using beta-splines. This formalism allows the E-pulse polynomial basis expansion to be treated in a unified theoretical framework and leads to a simplification of the original problem due to the linear nature of all the involved parameters. This new formulation has been also used to impose new conditions over the spectral contents of the E-pulses. These E-pulses constructed using the new conditions annihilate better the natural modes in the late-time radar target response, and provide a better discrimination rates than the classical scheme [J2293]

"UWB standards correspondence"

{no data available} [J2294]

"SAR amplitude probability density function estimation based on a generalized Gaussian model"

In the context of remotely sensed data analysis, an important problem is the development of accurate models for the statistics of the pixel intensities. Focusing on synthetic aperture radar (SAR) data, this modeling process turns out to be a crucial task, for instance, for classification or for denoising purposes. In this paper, an innovative parametric estimation methodology for SAR amplitude data is proposed that adopts a generalized Gaussian (GG) model for the complex SAR backscattered signal. A closed-form expression for the corresponding amplitude probability density function (PDF) is derived and a specific parameter estimation algorithm is developed in order to deal with the proposed model. Specifically, the recently proposed "method-of-log-cumulants" (MoLC) is applied, which stems from the adoption of the Mellin transform (instead of the usual Fourier transform) in the computation of characteristic functions and from the corresponding generalization of the concepts of moment and cumulant. For the developed GG-based amplitude model, the resulting MoLC estimates turn out to be numerically feasible and are also analytically proved to be consistent. The proposed parametric approach was validated by using several real ERS-1, XSAR, E-SAR, and NASA/JPL airborne SAR images, and the experimental results prove that the method models the amplitude PDF better than several previously

proposed parametric models for backscattering phenomena. [J2295]

"The peak sidelobe level of families of binary sequences"

A numerical investigation is presented for the peak sidelobe level (PSL) of Legendre sequences, maximal length shift register sequences (m-sequences), and Rudin-Shapiro sequences. The PSL gives an alternative to the merit factor for measuring the collective smallness of the aperiodic autocorrelations of a binary sequence. The growth of the PSL of these infinite families of binary sequences is tested against the desired growth rate o(√nlnn) for sequence length n. The claim that the PSL of m-sequences grows like O(√n), which appears frequently in the radar literature, is concluded to be unproven and not currently supported by data. Notable similarities are uncovered between the PSL and merit factor behavior under cyclic rotations of the sequences. [J2296]

"Using probability distribution functions for satellite validation"

Probability distribution functions (PDFs) can be used to assist in the validation of trace gas retrievals made by satellites. A major advantage of this approach is that large statistical samples are used that do not require correlative measurements to be co-located in space and time. Examples are shown from the launch of UARS through to the present. This approach is also useful to evaluate the consistency among Aura instruments as well as their agreement with other datasets. A key feature of this work is putting the observations of Aura in their long-term historical context via statistical comparisons with previous datasets collected over more than a decade. To validate the Aura data, we use data from a variety of platforms including solar occultation (Canadian ACE) and limb sounder satellite instruments, ozonesondes (WOUDC), lidar (NDSC), and aircraft instruments (AVE, PAVE, and MOZAIC). The width of the trace gas PDFs can be used to accurately estimate the atmospheric spatial variability (or representativeness uncertainty) of trace gases as a function of time and location. This statistical analysis is also being used as preparation for full Kalman filter chemical assimilations. The analysis is presented online at http://www.PDFCentral.info. [J2297]

"Special issue on subsurface sensing using ground penetrating radar (GPR)"

{no data available} [J2298]

"A baseband Doppler simulator for radar system development"

Elementary electronics building blocks can be configured as a low-cost baseband Doppler simulator for developing the post-detector processing parts such as MTIs and MTDS of millimeter wave pulsed radars employing amplitude and phase channels. The challenge of narrow pulses in conjunction to low Doppler frequencies is handled here by CMOS switches and normal function generator ICs. Test noise is generated with an off-the-shelf radio RF/IF circuit. Wideband video amplifiers are not required. Typical performance figures include pulse widths from 50 ns, target ranges from 0 to ambiguity maximum, target velocities from 0.5 m/s to 500 m/s and PRFs up to 100 kflz. Virtual target RCS can be adjusted as needed in a straightforward way. [J2299]

"Educational activities await your participation!"

{no data available} [J2300]

"Ultra-high performance, low-power, data parallel radar implementations"

Radar involves similar operations applied to large amounts of data. It is thus well suited to data parallel (SEMD) hardware. In the past, large data-parallel machines have been applied to radar with limited success. This has been due to such reasons as programming issues, cost, and the hardware being too big for most embedded applications. Most SBVED machines went away a decade ago. There is now a new generation of SIMD COTS technology with powerful processing elements (PEs) and floating-point hardware. WorldScape is applying these chips to radar processing, and has demonstrated significantly more performance with much lower power dissipation (GFLOPS/Watt). These implementations provide attractive alternatives to traditional FPGA and DSP solutions. Lockheed-Martin has provided benchmark validation testing and support for these implementations. The current implementation is based on a 64 PE, 25 GFLOP CS-301 chip supplied by ClearSpeed Technology PLC. WorldScape has demonstrated FFT, Pulse Compression, a form of QR factorization, and other applications on this generation of hardware using a mix of C-level programming and optimized assembly. The next generation chip is compatible, but also has several improvements that will significantly enhance I/O performance as well as raw GFLOP throughput. An updated demonstration and discussion of a scalable processing platform for embedded radar processing which significantly improves I/O performance and provides a roadmap to

government-qualified hardware for technology insertion. Architectures, data parallel coding approaches, additional functionality of the scalable processing platform, and relevance to embedded defense radar applications will be discussed. [J2301]

"Gauss–Markov Model for Wavelet-Based SAR Image Despeckling"

This letter presents synthetic aperture radar (SAR) image despeckling using dyadic wavelet transform. Maximum a posteriori (MAP) estimation is used to despeckle a SAR image in the wavelet domain. A wavelet transformed speckle-free image is approximated with a Gauss–Markov random field, and a Gaussian model is chosen to approximate speckle in the wavelet domain. A speckle-free wavelet coefficient is estimated with Bayesian inference using image and noise model parameters, which produce the highest evidence. The experimental results showed that the despeckling algorithm removes speckle noise in the homogeneous areas better than the state-of-the-art methods, which operate in the wavelet and image domain. The proposed method is very simple and computationally not demanding. [J2302]

"Special issue on subsurface sensing using ground penetrating radar (GPR)"

{no data available} [J2303]

"Multiobjective optimization of safety related systems: an application to short-term conflict alert"

Many safety related and critical systems warn of potentially dangerous events; for example, the short term conflict alert (STCA) system warns of airspace infractions between aircraft. Although installed with current technology, such critical systems may become out of date due to changes in the circumstances in which they function, operational procedures, and the regulatory environment. Current practice is to "tune," by hand, the many parameters governing the system in order to optimize the operating point in terms of the true positive and false positive rates, which are frequently associated with highly imbalanced costs. We cast the tuning of critical systems as a multiobjective optimization problem. We show how a region of the optimal receiver operating characteristic (ROC) curve may be obtained, permitting the system operators to select the operating point. We apply this methodology to the STCA system, using a multiobjective (1+1) evolution strategy, showing that we can improve upon the current hand-tuned operating point, as well as providing the salient ROC curve describing the true positive versus false positive tradeoff. We also provide results for three-objective optimization of the alert response time in addition to the true and false positive rates. Additionally, we illustrate the use of bootstrapping for representing evaluation uncertainty on estimated Pareto fronts, where the evaluation of a system is based upon a finite set of representative data. [J2304]

"Assessment of the operational applicability of RADARSAT-1 data for surface soil moisture estimation"

The present paper focuses on the ability of currently available RADARSAT-1 data to estimate surface soil moisture over an agricultural catchment using the theoretical integral equation model (IEM). Five RADARSAT-1 scenes acquired over Navarre (north of Spain) between February 27, 2003 and April 2, 2003 have been processed. Soil moisture was measured at different fields within the catchment. Roughness measurements were collected in order to obtain representative roughness parameters for the different tillage classes. The influence of the cereal crop that covered most of the fields was taken into account using the semiempirical water cloud model. The IEM was run in forward and inverse mode using vegetation corrected RADARSAT-1 data and surface roughness observations. Results showed a great dispersion between IEM simulations and observations at the field scale, leading to inaccurate estimations. As the surface correlation length is the most difficult parameter to measure, different approaches for its estimation have been tested. This analysis revealed that the spatial variability in the surface roughness parameters seems to be the reason for the dispersion observed rather than a deficient measurement of the correlation length. At the catchment scale, IEM simulations were in good agreement with observations. The error values obtained in the inverse simulations were in the range of in situ soil moisture measuring methods (0.04 cm3·cm-3). Taking into account the small size of the catchment studied, these results are encouraging from a hydrological point of view. [J2305]

"A dual-polarization rain profiling algorithm"

A new attenuation correction algorithm based on profiles of reflectivity, differential reflectivity, and differential propagation phase shift is presented. A solution for specific attenuation retrieval in rain medium is proposed, which solves the integral equations for reflectivity and differential reflectivity with cumulative differential propagation phase shift constraint. The conventional rain profiling algorithms that connect reflectivity and specific attenuation can retrieve specific attenuation values along the radar path assuming a constant intercept parameter of the normalized drop size distribution. However, in convective storms, the drop size distribution

parameters can have significant variation along the path. This paper presents a dual-polarization rain profiling algorithm for horizontal looking radars incorporating reflectivity as well as differential reflectivity profiles. The dual-polarization rain profiling algorithm has been evaluated with X-band radar observations simulated from drop size distribution derived from high-resolution S-band measurements collected by the Colorado Statue University CHILL radar. The analysis shows that the retrieved specific attenuation, differential attenuation, reflectivity, and differential reflectivity from the dual-polarization rain profiling algorithm provide significant improvement over the current algorithms. [J2306]

"Estimation of radio refractivity from Radar clutter using Bayesian Monte Carlo analysis"

This paper describes a Markov chain Monte Carlo (MCMC) sampling approach for the estimation of not only the radio refractivity profiles from radar clutter but also the uncertainties in these estimates. This is done by treating the refractivity from clutter (RFC) problem in a Bayesian framework. It uses unbiased MCMC sampling techniques, such as Metropolis and Gibbs sampling algorithms, to gather more accurate information about the uncertainties. Application of these sampling techniques using an electromagnetic split-step fast Fourier transform parabolic equation propagation model within a Bayesian inversion framework can provide accurate posterior probability distributions of the estimated refractivity parameters. Then these distributions can be used to estimate the uncertainties in the parameters of interest. Two different MCMC samplers (Metropolis and Gibbs) are analyzed and the results compared not only with the exhaustive search results but also with the genetic algorithm results and helicopter refractivity profile measurements. Although it is slower than global optimizers, the probability densities obtained by this method are closer to the true distributions. [J2307]

"Robust inversion technique for retrieving soil moisture from multi-polarised backscatter of bare surface"

A robust inversion technique using a genetic algorithm (GA) for retrieving soil moisture content from the multi-polarised radar data of bare soil surfaces is presented. This inversion technique employs a semi-empirical polarimetric backscattering model as a cost function for the GA. Good agreement is found between the values estimated by this inversion technique and those measured in situ. [J2308]

"Pseudonoise sequences based on algebraic feedback shift registers"

Over the past half century, various statistical properties of pseudorandom sequences have played important roles in a variety of applications. Among these properties are Golomb's randomness conditions: (R1) balance, (R2) run property, and (R3) ideal autocorrelations, as well as the closely related properties (R4) shift and add, and (R5) de Bruin (uniform distribution of subblocks). The purpose of this paper is to describe the relationships among these conditions, and to introduce a new method for generating sequences with all these properties, using algebraic feedback shift registers. [J2309]

"Geometric symmetry in the quadratic fisher discriminant operating on image pixels"

This correspondence examines the design of Quadratic Fisher Discriminants (QFDs) that operate directly on image pixels, when image ensembles are taken to comprise all rotated and reflected versions of distinct sample images. A procedure based on group theory is devised to identify and discard QFD coefficients made redundant by symmetry, for arbitrary sampling lattices. This procedure introduces the concept of a degeneracy matrix. Tensor representations are established for the square lattice point group (8-fold symmetry) and hexagonal lattice point group (12-fold symmetry). The analysis is largely applicable to the symmetrization of any quadratic filter, and generalizes to higher order polynomial (Volterra) filters. Experiments on square lattice sampled synthetic aperture radar (SAR) imagery verify that symmetrization of QFDs can improve their generalization and discrimination ability [J2310]

"GA design of a thin-wire bow-tie antenna for GPR applications"

A microgenetic algorithm has been applied to design a new ultrawideband thin-wire bow-tie antenna for ground-penetrating radar applications. The broadband performance of the antenna is achieved by resistive loading and by optimizing the number of wires and the angular distances between those wires. The radiation characteristics of the optimized antenna are discussed, and its performance is compared to that of a resistively loaded Wu-King dipole. [J2311]

"Polarimetric and interferometric characterization of coherent scatterers in urban areas"

In this paper the concept of point-like coherent scatterers (CSs) in urban areas is introduced. The detection of CSs in single and quad-polarized images is addressed and applied on polarimetric and interferometric high-

resolution airborne SAR data at L-band. For the detection of CSs two different approaches are proposed and their individual performance is analyzed. The properties of the detected CSs and their polarimetric and interferometric characteristics are assessed. The role of polarimetry on the detection of the CSs is evaluated and the potential of extracting the orientation and dielectric properties of individual CSs is finally addressed. [J2312]

"Orientation angle preserving a posteriori polarimetric SAR calibration"

Fully polarimetric synthetic aperture radar (SAR) data analysis has found wide application for terrain classification, land-use, soil moisture, and ground cover classification. Critical to all analyses and applications is accurate calibration of the relative amplitudes of and phases between the various polarimetric channels. Here we propose an a posteriori method imposing only the weakest of constraints, scattering reciprocity, on the polarimetric data. Calibration parameters are self-consistently estimated from full 4Ч4 polarimetric covariance matrices. Whilst the complete set of calibration parameters is underdetermined, we give several reasonable heuristic methods to provide a complete calibration. Stronger constraints reduce the number of independent parameters and provide an overdetermined set of equations but at a cost-the loss of polarimetric fidelity when the underlying assumptions are violated. Without recourse to in situ calibration targets, the extent of the polarimetric distortion that results from polarimetric calibration remains unknown. We apply our new method to simulated data, anechoic chamber data and polarimetric SAR imagery. We also present comparisons with alternate calibration methods and different approximate solutions of the new technique. [J2313]

"Analysis of sea spikes in radar sea clutter data"

In this paper three sets of high-resolution, coherent, and polarimetric radar sea clutter data are analyzed and compared with radar sea clutter models. The nature of the data allows a thorough analysis of the power, polarization and velocity of the sea clutter. It is shown that these quantities, especially the velocity, are good measures of many physical properties of the ocean surface. Furthermore, it is shown that these physical properties match well with the sea clutter models. Sea clutter is found to consist of two components, a diffuse background, characterized by low values of backscattered power, HH/VV polarization ratio and Doppler velocity, and a number of spiking events, which possess higher power, polarization ratio and velocity. The background is reasonably well modeled by tilt-modulated Bragg scattering, whereas the spikes may be associated with the scattering on steepened and/or breaking waves. Moreover, it is shown that the influence of microbreakers has to be taken into account to explain the relatively high polarization ratio. A breaking wave origin for the spikes is supported in two ways. First, by a detailed analysis of the temporal behavior of individual spike backscatter properties, and second, by a statistical analysis of the entire population of spikes. [J2314]

"Monitoring flood condition in marshes using EM models and Envisat ASAR observations"

This paper discusses the contribution of multipolarization radar data in monitoring flooding events in wetland areas of the Delta of the Paranar' River, in Argentina. The discussion is based on the comparison between radiative transfer model simulations and ENVISAT Advanced Synthetic Aperture Radar observations of two types of marshes: junco and cortadera. When these marshes are flooded, the radar response changes significantly. The differences in radar response between the flooded and nonflooded condition can be related to changes in the amount of emerged biomass. Based on this, we propose a vegetation-dependent flooding prediction scheme for two marsh structures: nearly vertical cylinders (junco-like) and randomly oriented discs (cortadera-like). [J2315]

"Use of radar and optical remotely sensed data for soil moisture retrieval over vegetated areas"

This work assesses the possibility of obtaining soil moisture maps of vegetated fields using information derived from radar and optical images. The sensor and field data were acquired during the SMEX'02 experiment. The retrieval was obtained by using a Bayesian approach, where the key point is the evaluation of probability density functions (pdfs) based on the knowledge of soil parameter measurements and of the corresponding remotely sensing data. The purpose is to determine a useful parameterization of vegetation backscattering effects through suitable pdfs to be later used in the inversion algorithm. The correlation coefficients between measured and extracted soil moisture values are R=0.68 for C-band and R=0.60 for L-band. The pdf parameters have been found to be correlated to the vegetation water content estimated from a Landsat image with correlation coefficients of R=0.65 and 0.91 for C- and L-bands, respectively. In consideration of these correlations, a second run of the Bayesian procedure has been performed where the pdf parameters are variable with vegetation water content. This second procedure allows the improvement of inversion results for the L-band. The results derived from the Bayesian approach have also been compared with a classical inversion method that is based on a linear relationship between soil moisture and the backscattering coefficients for horizontal and vertical polarizations. [J2316]

"Sea ice monitoring by L-band SAR: an assessment based on literature and comparisons of JERS-1 and ERS-1 imagery"

Spaceborne single-polarization C-band synthetic aperture radar (SAR) imagery is widely used to gather information about the state of the sea ice cover in the polar regions. C-band is regarded as a reasonable choice for all-season monitoring capabilities. For specific mapping tasks, however, other frequency bands can be more suitable. In the first part of this paper, the summary of a literature study dealing with the utilization of L-band SAR imagery for sea ice monitoring is presented. Investigations reveal that if deformation features such as ice ridges, rubble fields, and brash ice are to be mapped, L-band radar is superior in a number of cases. The second part of this paper addresses the comparison of JERS-1 and ERS-1 SAR images that were acquired over sea ice east of Svalbard and along the east coast of Greenland. The effects of the different frequencies, polarizations, and incidence angles of the two SAR systems are discussed. It is demonstrated that the images of both sensors complement one another in the analysis of ice conditions, resulting in a more detailed view of the sea ice cover state. [J2317]

"Retrieving snowpack properties and accumulation estimates from a combination of SAR and scatterometer measurements"

This study combines two satellite radar techniques, low-resolution C-/Ku-band scatterometer and high-resolution C-band synthetic aperture radar (SAR) for glaciological studies, in particular mass-balance estimations. Three parameters expressing the mean backscattering and its dependency on azimuth and incidence angle are used to describe and classify the Antarctic ice sheets backscattering behavior. Simple linear regression analyses are carried out between ground truth accumulation data and the SAR backscattering coefficient along continuous profile lines. From this we parameterize the accumulation rate separately for certain snow pack regimes. We find that SAR data can be used to map mass-balance changes, however only within limited areas. Applying this method therefore generally requires accurate ground truth for regional calibration together with additional information regarding mean air temperature or elevation. This investigation focuses on the area of Dronning Maud Land, Antarctica. We present the first high-resolution accumulation map based on SAR data for the surrounding area of the EPICA deep ice core drilling site Kohnen, which is compared to reliable ground truth records as well as to a surface-mass-balance map interpolated from these at low resolution. [J2318]

"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 (11.7GHz at -10dB 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 to 12 GHz. Novel principle of human being detection is considered and verified experimentally. [J2319]

"GMTI along-track interferometry experiment"

Synthetic aperture radar (SAR) along track interferometry (ATI) has been used extensively to measure ocean surface currents. Given its ability to measure small velocities (10 cm/s) of relatively radar-dark water surfaces, there is great potential that this technique can be adapted for ground moving target indication (GMTI) applications, particularly as a method for detecting very slow targets with small radar cross-sections. In this paper we describe preliminary results from an ATI GMTI experiment. The SAR data described herein were collected by the dual-frequency NASA/JPL airborne radar in its standard dual-baseline ATI mode. The radar system imaged a variety of control targets including a pickup truck, sport utility vehicles, passenger cars, a bicycle, and pedestrians over multiple flight passes. The control targets had horizontal velocities of less than 5 m/s. The cross-sections of the targets were not purposely enhanced, although the targets' reflectivities may have been affected by the existence of the GPS equipment used to record the targets' positions. Single-look and multiple-look interferograms processed to the full azimuth resolution were analyzed. In the data processed to date, all of the targets were observed by visual inspection in at least one of the four combinations of dual-frequency, dual-baseline interferometric data. This extremely promising result demonstrates the potential of ATI for GMTI applications. [J2320]

"Modeling and phantom studies of ultrasonic wall shear rate measurements using coded pulse excitation"

Wall shear rate (WSR) is the derivative of blood velocity with respect to vessel radius at the endothelial cell (EC) surface. The product of WSR and blood viscosity is the wall shear stress (WSS) that has been identified as an

important factor for atherosclerosis development. High echo signal-to-noise ratio (eSNR) and high spatial resolution are crucial for minimizing the errors in WSR estimates. By transmitting coded pulses with time-bandwidth product greater than one, high eSNR from weak blood scatter can be achieved without increasing instantaneous power or sacrificing spatial resolution. This paper summarizes a series of measurements in a straight tube (5-mm diameter), constant velocity flow phantom using a 10 MHz transducer (60% bandwidth, f/1.5) imaged with a 72° Doppler angle, 125 MHz sampling frequency and 1 kHz pulse repetition frequency. Measurements were made using a frequency-modulated (FM) code, phase-modulated (PM) codes, and uncoded broadband and narrow band pulse transmissions. Both simulation and experimental results show that coded-pulse excitation increases accuracy and precision in WSR estimation for laminar flow over a broad range of peak velocity values when compared to standard pulsing techniques in noise-limited conditions (eSNR [J2321]

"Correspondence"

{no data available} [J2322]

"March 2006 Disfinguished Lecturers Program"

{no data available} [J2323]

"2006 IEEE Radar Conference"

{no data available} [J2324]

"Improved CFAR performance in the littoral"

Littoral operation of radars poses severe signal processing difficulties due to the highly stressing, inhomogeneous clutter. This report describes an initial investigation into the feasibility of utilising site-specific radar modelling to provide a localised estimate of the clutter statistics which can then be used to predict the required threshold to maintain a given false alarm rate. The technique has been applied to littoral clutter recordings obtained from the experimental S-band phased array radar, MESAR2. Results are presented for the technique in comparison with a conventional, non-adaptive, cell averaging CFAR. This paper concludes that significant performance enhancements are possible through the use of this new technique. [J2325]

"Radar Systems Analysis and Design Using MA TLAB-Second Edition [JBook Review]"

{no data available} [J2326]

"Signal model and linearization for nonlinear chirps in FMCW Radar SAW-ID tag request"

In this paper, we present a frequency-modulated continuous-wave radar interrogation concept, based on direct digital synthesis (DDS), that operates without the commonly necessary high-frequency DDS reference oscillator. As the generated frequency sweeps are nonlinear, standard Fourier transform methods for baseband signal evaluation cannot be applied directly. We show the corresponding signal model, derive a linearization concept on the basis of resampling, and demonstrate the linearization algorithm on simulated data, as well as on real wireless interrogations of surface acoustic-wave sensors. [J2327]

"Binary optical true-time delay based on the white cell: design and demonstration"

An optical true-time delay device that uses a binary counting system in a modified White cell is demonstrated. The switching engine uses four spherical mirrors and a three-state digital micromirror array. The delay part, as designed, provides 6 bits of delay ranging from 78 ps to 5 ns, using a combination of dielectric blocks for short delays and lens trains for longer ones. Long lens trains are folded for compactness. The authors describe the design and demonstrate two of the 6 bits of delays experimentally. Delays were accurate to within the measurement resolution of 1.25 ps. The insertion loss varied from 3.1-5.2 dB, depending on delay. It was found that the micromirrors do not contribute significantly to the loss. [J2328]

"Unified framework for two robust beamforming methods"

Robust beamforming plays a key role in adaptive beamforming. Double constraint robust Capon beamforming (DCRCB) and subspace-DCRCB (S-DCRCB) are investigated. It is shown that both robust beamforming approaches could be unified to a single one by using the power of R (POR) method. One more powerful robust beamforming, called m-DCRCB, is achieved, which simultaneously has the advantages of the two other robust beamforming approaches. Simulation results indicate that the m-DCRCB approach converges to the S-DCRCB

one. [J2329]

"Tissue sensing adaptive Radar for breast cancer detection-investigations of an improved skin-sensing method"

Active microwave breast imaging is being researched as a supplement to current breast imaging modalities. Ultra-wideband radar approaches involve analyzing reflections from the breast to identify the presence of tumors. Skin sensing, which involves estimating the location and thickness of the skin, is a key step in this process, as the reflections from the skin dominate the signal. Current methods employing a rudimentary peak detection process estimate the location of the breast with acceptable accuracy. However, estimates of skin thickness in the range of 1.0-2.0 mm have unacceptable error. A method using deconvolution to obtain the impulse response of a scattering object is investigated to improve the performance of the skin-sensing algorithm. The new method employs a calibration step using a perfect electric conductor. Application to simulated data shows success in reducing the error percentage in both breast skin location and thickness estimates by more than half. [J2330]

"Exploiting temperature dependency in the detection of NQR signals"

Nuclear quadrupole resonance (NQR) offers an unequivocal method of detecting and identifying land mines. Unfortunately, the practical use of NQR is restricted by the low signal-to-noise ratio (SNR), and the means to improve the SNR are vital to enable a rapid, reliable, and convenient system. In this paper, an approximate maximum-likelihood detector (AML) is developed, exploiting the temperature dependency of the NQR frequencies as a way to enhance the SNR. Numerical evaluation using both simulated and real NQR data indicate a significant gain in probability of accurate detection as compared with the current state-of-the-art approach. [J2331]

"Fast algorithms for single frequency estimation"

In this paper, some new estimators of the frequency of a single complex sinusoid are presented. The rotate-add-decimate (RAD) method of Crozier is first refined to more closely approach the Cramer-Rao Bound (CRB). An additional modification yields an unbiased estimator (ERAD) that essentially achieves the CRB above a signal-to-noise ratio (SNR) threshold comparable to that of RAD. In addition, this estimator is proven to achieve the CRB for high SNR. The ERAD method requires approximately 2N complex multiply-adds and log2N arctangents. A modified ERAD (MERAD) is proposed that matches the SNR threshold and computational complexity of the RAD method (approximately 3N complex multiply-adds and log2N arctangents) but achieves the CRB for high SNR. [J2332]

"Evolutionary design of 2-dimensional recursive filters via the computer language GENETICA"

In this paper, we present a new design method for a class of two-dimensional (2-D) recursive digital filters using an evolutionary computational system. The design of the 2-D filter is reduced to a constrained minimization problem the solution of which is achieved by the convergence of an appropriate evolutionary algorithm. In our approach, the genotypes of potential solutions have a uniform probability within the region of the search space specified by the constraints and zero probability outside this region. This approach is particularly effective as the evolutionary search considers only those potential solutions that respect the constraints. We use the computer language GENETICA, which provides the expressive power necessary to get an accurate problem formulation and supports an adjustable evolutionary computational system. Results of this procedure are illustrated by a numerical example, and compared with those of some previous designs. [J2333]

"Feature fusion to improve road network extraction in high-resolution SAR images"

This letter aims at the extraction of roads and road networks from high-resolution synthetic aperture radar data. Classical methods based on line detection do not use all the information available; indeed, in high-resolution data, roads are large enough to be considered as regions and can be characterized also by their statistics. This property can be used in a classification scheme. Therefore, this letter presents a road extraction method which is based on the fusion of classification (statistical information) and line detection (structural information). This fusion is done at the feature level, which helps to improve both the level of likelihood and the number of the extracted roads. The proposed approach is tested with two classification methods and one line extractor. Results on two different datasets are discussed. [J2334]

"On Bayesian scatterometer wind inversion"

In a quest for a generic unbiased scatterometer wind inversion method, the different inversion procedures currently in use are revisited in this paper. A careful examination of both the errors in the wind and in the

measurement domain, combined with the nonlinear shape of the geophysical model function (GMF), leads to a generic and novel Bayesian wind retrieval approach in the measurement domain. In this approach the shape of the GMF solution manifold in measurement space is more important than the specified noise. This shape is related to the system wind direction sensitivity, and when this sensitivity is uniform, realistic and precise wind direction distributions are retrieved, even when measurements lie far from the GMF manifold. A simplified measurement space transformation that produces such uniform sensitivity for the European Remote Sensing Satellite (ERS) scatterometer is presented and shown to have reduced wind direction bias compared to the more traditional (measurement-noise normalized) inversion for ERS. Moreover, the simplified wind inversion reveals a similar performance to the current operational ERS wind inversion, but is potentially more generally applicable. The simplified method is then applied to SeaWinds but is ineffective. In this case the instrument geometry results in a low sensitivity to wind direction at a few specific directions. As a consequence, certain wind direction solutions remain favored in the SeaWinds inversion. [J2335]

"Ground-plane-backed hemispherical Luneberg-lens reflector"

A spherical Luneberg-lens reflector provides excellent passive wideband and wide-angular radar-signature augmentation, and has been widely used. Much of its signature-enhancement performance over half of its angular coverage can potentially be achieved by using a corresponding low-profile, hemispherical Luneberg-lens reflector, mounted on a reflective ground plane. This paper presents a quantitative study of a practical design of an off-the-shelf hemispherical Luneberg-lens reflector to gain insight and to fully explore its performance limits. Extensive wideband and wide-angle measurements were carried out for this lens configuration, and a comprehensive numerical analysis was also conducted, using the finite-element method combined with a boundary integral equation to complement the test data. The effect, in practice, of a finite-sized ground plane, and the resulting vertically polarized traveling-wave interference to the direct lens reflector's return, were demonstrated. Key design issues are discussed, and potential solutions are suggested [J2336]

"Polarimetric Ka-band backscattering measurements at grazing-angle extremes"

Polarimetric millimeter-wave backscattering data has been measured in true operational environments for perpendicular illumination and for grazing angles below one degree. Manmade objects, such as vehicles and light poles, were found to give a 5-10 dB lower response for vertical polarization, and the cross-polarized returns were about 10-20 dB below the reference level obtained with horizontal polarization. Forest and soil backscattering showed similar characteristics of -7 to -9 dB (vertical) and -14 to -17 dB (cross-polar). An anomaly was observed for horizontally transmitted/vertically received data, where gravel soil showed only about 2 dB attenuation compared to the co-polar reference level. The dynamic variations of mobile target signals at different polarizations indicated that millimeter-wave cross-polarized returns call for high transmitter power if true polarimetric target classification is attempted. Close-to-ground radars seem to benefit from multipath and thus from using horizontal polarization if only maximum range is defined. Variations in the cross-polarized echo amplitudes of moving manmade objects were found to be within 3-5 dB of their typical mean values [J2337]

"A generalized framework for hybrid simulation of multi-component structures using iterative field refinement"

When applying computational simulation techniques to scattering or radiation problems, it is often possible to decompose a complicated geometry into simpler elemental structures (i.e., a helicopter rotor system into its individual blades). By then simulating each component separately, a given problem can be decomposed into smaller and more manageable components, as long as account is taken of the coupling between each component. To implement such coupling, this paper describes a generalized iterative field refinement (IFR) framework, and demonstrates how it can be used as a basis for many hybrid approaches. Within this framework, IFR can also be used to accelerate simulation of geometries made up of rotated, translated, reflected, or replicated versions of a given structure. Several examples are given to show that an approach built around IFR reduces total computation time while allowing the combination of different analysis methods in treating each of the separate components comprising the structure [J2338]

"North-American Radio Science Meeting"

{no data available} [J2339]

"Synthetic aperture radar imaging using a unique approach to frequency-modulated continuous-wave radar design"

Synthetic-aperture-radar (SAR) imaging is an expensive endeavor. It can be difficult for universities, small

business, or individuals to experiment with SAR imaging and algorithm development on a low budget. For this reason, a uniquely inexpensive solution to frequency-modulated continuous-wave (FMCW) radar was developed and then utilized as an ultra-low-cost SAR imaging system. This unique approach to FMCW radar used a pair of low-cost Gunn-oscillator-based microwave transceiver modules, known as "Gunnplexers." These transceiver modules had stability and noise problems, causing them to be unsuitable for use in precise FMCW radar applications when just one module was used. In order to overcome this problem, a unique radar solution was developed that used a combination of two transceiver modules to create a precise and inexpensive FMCW radar system, capable of producing SAR imagery on a budget [J2340]

"AMTA Corner"

{no data available} [J2341]

"Full professorship "microwaves and electronics""

{no data available} [J2342]

"Special issue on subsurface sensing using ground penetrating radar (GPR)"

{no data available} [J2343]

"Performance analysis of a novel matched filter detector with reduced out-of-band response for narrowband signals"

Reduced spectral response in adjacent spectral bins is very desirable for detectors since it provides the capability to detect narrowband signals in the presence of unknown interference and colored noise. Recently, a new method of detecting narrowband signals which uses a close approximation to the matched filter is proposed by Raja Kumar. The impulse response of this filter turns out to be longer than that of the matched filter. In order to support this extra length of filter response, it is proposed that the signal be extrapolated by prediction before the filtering operation. In this paper, the characteristics of this detector are mathematically analyzed and the performance of the detector in the presence of additive white Gaussian noise (AWGN) is studied. The detection method uses predicted signals that are obtained typically from short time data. Hence, in this paper, a method of analyzing the statistics of predicted signals from short time data is presented, and it is applied for the performance analysis of the present detector. The accuracy of the present detection analysis is demonstrated through theoretical and simulation studies. Also the analysis and performance study is extended to fluctuating targets, and it is shown that the proposed method yields near-optimum performance for Swerling's Case-1 and Case-3 targets while giving the excellent advantage of low out-of-bin response [J2344]

"Convergence results for the particle PHD filter"

Bayesian single-target tracking techniques can be extended to a multiple-target environment by viewing the multiple-target state as a random finite set, but evaluating the multiple-target posterior distribution is currently computationally intractable for real-time applications. A practical alternative to the optimal Bayes multitarget filter is the probability hypothesis density (PHD) filter, which propagates the first-order moment of the multitarget posterior instead of the posterior distribution itself. It has been shown that the PHD is the best-fit approximation of the multitarget posterior in an information-theoretic sense. The method avoids the need for explicit data association, as the target states are viewed as a single global target state, and the identities of the targets are not part of the tracking framework. Sequential Monte Carlo approximations of the PHD using particle filter techniques have been implemented, showing the potential of this technique for real-time tracking applications. This paper presents mathematical proofs of convergence for the particle filtering algorithm and gives bounds for the mean-square error [J2345]

"Interferometric SAR coherence magnitude estimation using second kind statistics"

Coherence magnitude is a fundamental parameter for the analysis of applications using interferometric synthetic aperture radar (InSAR). The coherence magnitude estimators are biased and need bias removal. The sample coherence magnitude estimation, computed on a window basis, depends on the number of independent samples and theoretical coherence. It has been shown that the sample coherence magnitude estimator is the maximum-likelihood one. It is a biased estimator, especially for low coherence values. In this paper, we present a novel coherence magnitude estimator obtained from the method of moments using "second kind statistics". Classical methods (with regular statistics) for coherence computation are based on a 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 to compute the second kind statistics defined with the Mellin

transform (log-moment). Thus, it is shown that the estimated coherence given by the first log-moment is less biased. Moreover, it is shown that the coherence magnitude estimation from complex coherence maps (interferometric data) using second kind statistics is the optimal estimation procedure of interferometric coherence. It gives the smallest bias near zero comparing with existing estimators. The developed estimation approaches have been applied to obtain coherence measurements from tandem European Remote Sensing 1 and 2 satellite interferometric data, collected over varying terrain with a variety of ground cover types (agriculture field, forest, lake, urban area, sea) in Tunisia, France, and Nepal [J2346]

"An analysis of gradient-induced distortion in ATI-SAR imagery of surface currents"

This paper summarizes an analysis of gradient-induced distortions in the surface current estimates generated by along-track interferometric SAR (ATI-SAR) systems. In the presence of spatial current gradients, an effect akin to velocity bunching can cause distortion in the measured current profiles. This distortion is caused by variation in the azimuthal displacement induced by the current itself. Up to a point, these distortions can be removed by a straightforward, spatial remapping of the interferogram pixels based upon their phase values. However, there is a critical current gradient beyond which the true surface current field is not recoverable. This mechanism is compounded in dual-beam ATI-SAR systems designed to estimate the surface current vector using only a single aircraft pass. In such systems, interferograms from two squinted beams, one squinted forward of broadside and the other squinted aft by the same amount, are combined to measure the full surface current vector. However, when the current vector does not bisect the angle between the two beams, the along-track component of the current induces unequal azimuthal displacements in the fore- and aft-squinted interferograms. As a result, the two interferograms will not be spatially registered, in that corresponding pixels in the fore- and aft-interferograms will be related to currents at spatially distinct points on the water surface. Additional vector distortions will, therefore, occur in and around the gradient region. These effects are explored through an approximate, linear analysis as well as through an ATI-SAR model that accounts for nonlinearity and finite spatial resolution, using the current gradients present in rivers as an example [J2347]

"Short-wave ocean wave slope models for use in remote sensing data analysis"

Recent developments in the directionality of sea waves are reviewed and adapted into a working model for radiometric remote sensing. There is a weight of evidence, both theoretical and observational, that a bimodality exists in the directional wave spectrum for sea surface gravity waves at wavenumbers greater than the value at the peak of the spectrum. We develop a model for the directional splitting which is consistent with observations but which extrapolates in a credible manner to the omnidirectionality observed at wavelengths around 0.3 m. At shorter wavelengths the directional spectrum becomes unimodal and has an approximately constant shape across the gravity-capillary wave regime. A working model is suggested for the directionality of the wave spectrum to improve the analysis of radiometric sea surface data. The model will also be useful for other analyses including active radar techniques which use Bragg scatter [J2348]

"SAR image segmentation by stochastic complexity minimization with a nonparametric noise model"

We analyze the generalization of a parametric segmentation technique adapted to Gamma-distributed synthetic aperture radar (SAR) images to nonparametric noise models. This approach is based on a polygonal grid which can have an arbitrary topology and whose number of regions and regularity of its boundaries are obtained by minimizing the stochastic complexity of a quantified version on Q levels of the image. It thus leads to a criterion without parameters to be tuned by the user and adapted to different noise models. We analyze the influence of the quantization scheme and of the optimization procedure on the quality of the partitioning. We then compare the performance of the proposed approach to the parametric one on synthetic images. Finally, we show results obtained on real images and compared with a standard segmentation algorithm of SAR images [J2349]

"Eli Brookner to receive the IEEE Dennis J. Picard Medal"

{no data available} [J2350]

"A new approach for synthesizing the range profile of moving targets via stepped-frequency waveforms"

In radar target imaging, motion induces a range-Doppler coupling effect, which results in distortion in synthesizing a range profile for a moving target. To eliminate or suppress the distortion of the synthetic range profile, conventional technology such as motion compensation requires velocity estimation. Unfortunately, for a high-speed moving target, 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 a motion target range profile via stepped-frequency waveform. The new technology does not need the estimation of the velocity. Hence, its computational cost can be minimized. It is also easier to use. The simulation result confirms the effect of the new technology [J2351]

"SAR image coregistration based on isolated point scatterers"

This work considers a technique for fast and accurate coregistration of multipass synthetic aperture radar images based on isolated point scatterers analysis. Several tests, carried out on real data acquired by the European Remote Sensing and Envisat satellites, are presented to demonstrate the registration accuracy improvements with respect to standard cross-correlation techniques, carried out on extended image patches. Particularly relevant is the robustness of this technique also in presence of a large baseline span and in case of high temporal separation [J2352]

"Improving the image quality of spaceborne multiple-aperture SAR under minimization of sidelobe clutter and noise"

As we know, a multiple-aperture radar carried by a group of formation-flying satellites can be used to improve the coverage and azimuth resolution of spaceborne synthetic aperture radar (SAR) simultaneously. However, in the case of the reconstruction of azimuth signal from a periodic nonuniform sampling sequence, the sidelobe clutter and noise may be amplified by tens of decibels in some cases, which makes the final SAR image blurry. In this letter, we present the analytical result of the amplification factor of sidelobe clutter and noise for the evaluation of the reconstruction performance. According to the result, we propose a method to reduce the sidelobe clutter and noise, which considerably improves the quality of SAR image. Computer simulation results confirm the effectiveness of the method [J2353]

"Performance prediction of a phase synchronization link for bistatic SAR"

Oscillator phase noise can dictate the performance of bistatic and multistatic synthetic aperture radar imaging. In this letter, the use of a dedicated synchronization link to quantify and compensate oscillator phase noise is investigated. Different synchronization schemes are presented, and their performance is analyzed. The error contribution of the synchronization link itself, which may suffer from receiver noise, aliasing, interpolation, and filter mismatch, is included in the analysis. The synchronization link performance is given in a frequency-domain closed integral form [J2354]

"The First Fully Integrated Quad-Band GSM/GPRS Receiver in a 90-nm Digital CMOS Process"

We present the receiver in the first single-chip GSM/GPRS transceiver that incorporates full integration of quad-band receiver, transmitter, memory, power management, dedicated ARM processor and RF built-in self test in a 90-nm digital CMOS process. The architecture uses Nyquist rate direct RF sampling in the receiver and an all-digital phase-locked loop (PLL) for generating the local oscillator (LO). The receive chain uses discrete-time analog signal processing to down-convert, down-sample, filter and analog-to-digital convert the received signal. A feedback loop is provided at the mixer output and can be used to cancel DC-offsets as well to study linearization of the receive chain. The receiver meets a sensitivity of -110 dBm at 60mA in a 1.4-V digital CMOS process in the presence of more than one million digital gates [J2355]

"Performance of correlation-based frequency estimation methods in the presence of multiplicative noise"

This paper provides a comprehensive performance evaluation of a correlation-based frequency estimator under different fading channel conditions. The efficiency of the estimator in terms of the Cramer-Rao lower bound (CRB) is investigated for different fading conditions, i.e., slow fading, fast fading, Rayleigh fading, and Ricean fading. The asymptotic CRB, which provides an insight to the frequency estimation in fading channels, has been evaluated via a frequency-domain approach. The optimal correlation lag value suitable for frequency estimation under different fading conditions is determined, and closed-form expressions for the variance of the estimates are provided. For proper implementation of the estimator, the Doppler spread of the signal is also estimated. It is shown that using the Doppler spread information, frequency estimation accuracy at low signal-to-noise ratios can be improved using multiple lags of correlations [J2356]

"Spectral signature calculations and target tracking for remote sensing"

Enhanced tornado detection and tracking can prevent loss of life and property damage. The research weather surveillance radar (WSR)-88D locally operated by the National Severe Storms Laboratory (NSSL) in Norman,

OK, has the unique capability of collecting massive volumes of time-series data over many hours, which provides a rich environment for evaluating our new postprocessing algorithms. With the advent of more memory and computing power, new state-of-the-art algorithms can be explored. In this paper, an approach of identifying tornado vortices in Doppler spectra is proposed and investigated through the use of neural networks. Once the coordinate of the tornado has been established, the research question becomes the following: Can we apply target tracking algorithms to a volume of radar data to make estimations about where the tornado is going? In recent years, particle filters have attracted great attention in several research communities. These filters are used in problems where time-varying signals must be processed in real time, and the objective is to estimate various unknowns of the signals and to detect events described by the signals. The standard solutions of such problems in many applications are based on the Kalman or extended Kalman filters. In situations when the models that describe the behavior of the system are highly nonlinear and/or the noise that distorts the signals is non-Gaussian, the Kalman-filter-based algorithms provide solutions that may be far from optimal. Here, the path of the tornado follows a path that may be described by a set of nonlinear equations. To estimate the path, the particle filter will provide the better estimates. In addition to the single WSR-88D sensor designs, data fusion and tracing designs are also given for a four-node remote sensor network in central Oklahoma. By incorporating the data from each of the sensors, improvements in tracking are illustrated. The particle-filtering algorithms are especially effective in a networked system of sensors when they are in a data-fusion setting. [J2357]

"Photonic RF phase shifter and tunable photonic RF notch filter"

A new photonic RF phase shifter structure for phased array antennas is presented. It is based on a single dual-output modulator and two optical switches and optical attenuators. This can realize continuous phase shifting of 0°-360° without altering the signal amplitude. It has the advantages of wide bandwidth, fast response time, and fine tuning resolution. Experimental results demonstrate phase shifts over a 360° phase range, with RF signal power changes of less than 0.2 dB, which is in close agreement with predictions. A tunable photonic RF notch filter, which is based on the new phase shifter, is also presented. Experimental results demonstrate continuous tuning of the photonic notch filter over a wide tuning range, which covers the full free spectral range, which is in good agreement with predictions. [J2358]

"Nonlinear spatial-temporal prediction based on optimal fusion"

The problem of spatial-temporal signal processing and modeling has been of great interest in recent years. A new spatial-temporal prediction method is presented in this paper. An optimal fusion scheme based on fourth-order statistic is first employed to combine the received signals at different spatial domains. The fused signal is then used to construct a spatial-temporal predictor by a support vector machine. It is shown theoretically that the proposed method has an improved performance even in non-Gaussian environments. To demonstrate the practicality of this spatial-temporal predictor, we apply it to model real-life radar sea scattered signals. Experimental results show that the proposed method can provide a more accurate model for sea clutter than the conventional methods. [J2359]

"Frontal imaging of human using three-element Doppler and direction-of-arrival radar"

A two-dimensional Doppler and direction-of-arrival (DDOA) radar concept is proposed for the frontal imaging of humans. The system consists of a three-element receiver array configured to provide simultaneous DOA measurements in the azimuth and elevation planes. An experimental system has been built and tested. Two-dimensional frontal images of a human in free space as well as in a through-wall scenario are generated. [J2360]

"An estimation and verification of vessel radar cross sections for high-frequency surface-wave radar"

The radar cross sections of both small and large ships for high-frequency surface-wave radar (HFSWR) were studied by using the numerical electromagnetics code, and by using measurements from an HFSWR system at Cape Race, Newfoundland, Canada. The results of the study indicated that Teleost, a 2405-ton Canadian Coast Guard ship, and large cargo container vessels (-36000 ton) have comparable RCS values at 3.1 and 4.1 MHz. This was verified by comparing Teleost signals with the reflections of seven cargo-container vessels, identified during an operational evaluation of the HFSWR. The conclusion of the study was that Teleost and the large cargo container vessels had an angle-averaged radar cross section (RCS) of -40 dBm2, while small vessels (-1000 tons) could reasonably be characterized by an angle-averaged RCS of -30 dBm2, in the lower end of the HF band (3-5 MHz). [J2361]

"The interplay between signal processing and networking in sensor networks"

This paper provides a signal processing perspective on large-scale sensor networks. It focuses on two characteristics of sensor networks: application specificity and energy constraint. The former requires that network protocols be designed for the application at hand, which is often signal processing in nature, and measured by application-specific metrics. The latter calls for novel distributed signal processing techniques to provide accurate and timely network state information that can be exploited by network protocols to ensure energy efficiency. The underlying theme is about how a principled integration of signal processing and networking can lead to an efficient and fair use of limited resources. The paper aims to demonstrate that capturing and exploiting dependencies between signal processing and networking offer design choices resulting in improved network performance. [J2362]

"New titles in antennas & propagation from Wiley & the IEEE press"

{no data available} [J2363]

"North-American Radio Science Meeting"

{no data available} [J2364]

"LPI radar: fact or fiction"

LPI radar is a system that consists of a radar and ES system. Its performance depends on both components. An LPI performance factor is derived and applied to several examples. Operational LPI radars are described. A digital LPI radar detector is described and test results presented. A recent book on LPI radar received a number of somewhat critical reviews that were published in Systems magazine. Although these reviews made a number of excellent points, several questioned the existence of LPI radar. The objectives of this article are to provide a sound technical basis for determining LPI properties of radar, examine several radars that have LPI qualities, and then to describe digital LPI radar detector designed and tested against the PILOT Mk2 radar. LPI radar is a system that represents a confluence between radar and electronic support (ES) technology. The objective of LPI radar is clear; that is, to escape detection by the ES receiver. However, the capability of the LPI radar system depends upon the characteristics of both the radar and ES receiver. To understand LPI radar one must first understand the nature of ES receivers. The functions performed by tactical ES receivers are immediate interception, identification, and location of both friendly and hostile emitters. Location requires interception in the emitter's sidelobes. Identification is performed by comparing the intercepted signature against the signatures contained within its threat library (Schelher, 1999). The metric that establishes the quality of interception is called the probability of intercept (POI) and is generally included in its specifications (Schleher, 1999). From the above discussion it is evident that radar might have LPI properties with respect to one type, but not to another type of ES system. This situation can be clarified if the claim of radar being LPI radar is accompanied by a description of the various types of ES systems for which this claim applies. However the LPI radar can never completely escape detection since there is always a minimum range (RES) between the ES system and radar where the interception receiver detection threshold is exceeded. [J2365]

"A look back-Monitoring hurricanes-Mammoth thermal engines"

First Page of the Article [J2366]

"Statistical signal analysis for the inverse source problem of electromagnetics"

A statistical signal analysis for the inverse source problem of electromagnetics is given. This correspondence considers the problem of estimating either the near field or the radiating current distribution from a measurement of the far field. The solution is derived via a linear operator formalism, and the ill-posedness of the reconstruction is quantified by using the Cramer-Rao lower bound, which is explicitly given in terms of the multipole expansion of the electromagnetic field. A numerical study is included to illustrate the theoretical results. [J2367]

"A hardware signal processing platform for sensor systems"

A field programmable gate array-based computing platform for high-speed sensors such as short-range radars is presented. The circuit performs necessary A/D conversions, raw data stream compression and target detection, and constructs a message structure suitable for external displays. In the prototype, USB is the connecting path to a laptop computer. An elementary pulse radar is utilized as an application example. An application interest would be in collision avoidance systems. Observed data transfer rates with real radar input signals were 36 Mbytes/s when typical target detection algorithms were applied. [J2368]

"Baseband and audio mixed-signal front-end IC for GSM/EDGE applications"

A complete mixed-signal front-end CMOS chip is presented, supporting GSM/EDGE as well as enhanced audio applications. The chosen solution for the transmit section is based on Laurent's approximation of the nonlinear GMSK modulator. This enables burst shaping in the I/Q domain thereby solving the problem of power ramping. Also, up to GPRS class 12 is supported. The receive section on the other hand consists of a low power dual mode continuous-time ΣΔ ADC for I and Q, supporting ZIF and LIF modes of operation and achieving typically 12.5 bit of resolution under production conditions. An on-chip PLL, which supplies all blocks with various clock frequencies, additionally supports clock jitter suppression. The audio section comprises a codec supporting standard formats such as IIS and PCM. It features mono/stereo signaling from various sources in 16bit quality as well as high-drive buffers for 4 Ω single-ended loads (capacitively coupled). The whole chip is powered from a 1.5/2.65 V supply voltage and consumes 22 mW in paging mode. [J2369]

"TerraSAR-X active radar ground calibrator system"

In April 2006, the TerraSAR-X satellite was launched. This paper describes the development of a novel and highly integrated, digitally-controlled active SAR system calibrator (DARC). It consists of both an active transponder path for absolute radiometric calibration and a calibrated receiver chain for antenna pattern evaluation of the satellite antenna. A total of 16 active transponder and receiver systems and 17 receiver-only systems will be fabricated for a calibration campaign in 2006. [J2370]

"Distance estimation at 60 GHz"

An FM-CW radar front-end was fabricated in an integrated manner at 60 GHz by using the NRD guide. Main emphasis was placed on compactness in size and high-precise operation in performance. The fabricated radar consists of an FM Gunn oscillator, a balanced mixer, and a planar antenna fed by leaky NRD guide with a mechanically beam-scanning performance. All circuit components and the antenna were contained in a compact housing of 170 Ч 140 mm in area and 25 mm in thickness, and thus, a thin type of millimeter-wave radar front-end was successfully developed. Moreover, an error of distance estimation was measured to be less than a distance of 0.7 m. [J2371]

"Intensity-driven adaptive-neighborhood technique for polarimetric and interferometric SAR parameters estimation"

In this paper, a new method to filter coherency matrices of polarimetric or interferometric data is presented. For each pixel, an adaptive neighborhood (AN) is determined by a region growing technique driven exclusively by the intensity image information. All the available intensity images of the polarimetric and interferometric terms are fused in the region growing process to ensure the validity of the stationarity assumption. Afterward, all the pixels within the obtained AN are used to yield the filtered values of the polarimetric and interferometric coherency matrices, which can be derived either by direct complex multilooking or from the locally linear minimum mean-squared error (LLMMSE) estimator. The entropy/alpha/anisotropy decomposition is then applied to the estimated polarimetric coherency matrices, and coherence optimization is performed on the estimated polarimetric and interferometric coherency matrices. Using this decomposition, unsupervised classification for land applications by an iterative algorithm based on a complex Wishart density function is also applied. The method has been tested on airborne high-resolution polarimetric interferometric synthetic aperture radar (POL-InSAR) images (Oberpfaffenhofen area-German Space Agency). For comparison purposes, the two estimation techniques (complex multilooking and LLMMSE) were tested using three different spatial supports: a fix-sized symmetric neighborhood (boxcar filter), directional nonsymmetric windows, and the proposed AN. Subjective and objective performance analysis, including coherence edge detection, receiver operating characteristics plots, and bias reduction tables, recommends the proposed algorithm as an effective POL-InSAR postprocessing technique. [J2372]

"High-resolution change estimation of soil moisture using L-band radiometer and Radar observations made during the SMEX02 experiments"

The soil moisture experiments held during June-July 2002 (SMEX02) at Iowa demonstrated the potential of the L-band radiometer (PALS) in estimation of near surface soil moisture under dense vegetation canopy conditions. The L-band radar was also shown to be sensitive to near surface soil moisture. However, the spatial resolution of a typical satellite L-band radiometer is of the order of tens of kilometers, which is not sufficient to serve the full range of science needs for land surface hydrology and weather modeling applications. Disaggregation schemes for deriving subpixel estimates of soil moisture from radiometer data using higher resolution radar observations may provide the means for making available global soil moisture observations at a much finer scale. This paper presents a simple approach for estimation of change in soil moisture at a higher (radar) spatial

resolution by combining L-band copolarized radar backscattering coefficients and L-band radiometric brightness temperatures. Sensitivity of AIRSAR L-band copolarized channels has been demonstrated by comparison with in situ soil moisture measurements as well as PALS brightness temperatures. The change estimation algorithm has been applied to coincident PALS and AIRSAR datasets acquired during the SMEX02 campaign. Using AIRSAR data aggregated to a 100-m resolution, PALS radiometer estimates of soil moisture change at a 400-m resolution have been disaggregated to 100-m resolution. The effect of surface roughness variability on the change estimation algorithm has been explained using integral equation model (IEM) simulations. A simulation experiment using synthetic data has been performed to analyze the performance of the algorithm over a region undergoing gradual wetting and dry down. [J2373]

"A method for retrieving high-resolution surface soil moisture from hydros L-band radiometer and Radar observations"

NASA's Earth System Science Pathfinder Hydrospheric States (Hydros) mission will provide the first global scale space-borne observations of Earth's soil moisture using both L-band microwave radiometer and radar technologies. In preparation for the Hydros mission, an observation system simulation experiment (OSSE) has been conducted. As a part of this OSSE, the potential for retrieving useful surface soil moisture at spatial resolutions of 9 and 3 km was explored. The approach involved optimally merging relatively accurate 36-km radiometer brightness temperature and relatively noisy 3-km radar backscatter cross section observations using a Bayesian method. Based on the Hydros OSSE data sets with low and high noises added to the simulated observations or model parameters, the Bayesian method performed better than direct inversion of either the brightness temperature or radar backscatter observations alone. The root-mean-square errors of 9-km soil moisture retrievals from the Bayesian merging method were reduced by 0.5 %vol/vol and 1.4 %vol/vol from the errors of direct radar inversions for the entire OSSE domain of all 34 consecutive days for the low and high noise data sets, respectively. Improvement in soil moisture estimates using the Bayesian merging method over the direct inversions of radar or radiometer data were even more significant for soil moisture retrieval at 3-km resolution. However, to address the representativeness of these results at the global and multiyear scales, further performance comparison studies are needed, particularly with actual field data. [J2374]

"Decorrelating remote sensing color bands from bathymetry in optically shallow waters"

We have developed a simple technique to decorrelate remote sensing color band data from depth in optically shallow water. The method linearizes color band data with respect to depth by subtracting an optically deepwater value from the entire waveband under consideration and taking the natural logarithm of the result. Next, this linearized waveband is rotated about the model 2 regression line computed against a bathymetry band. The rotated color band is decorrelated from water depth. We demonstrate the technique for a small area of Kailua Bay, Oahu, HI, using Quickbird multispectral and Scanning Hydrographic Operational Airborne Lidar Survey LIDAR data. Results indicate that color band data are effectively decorrelated from depth, while bottom reflector variability is maintained, thus providing the basis for further analysis of the depth-invariant wavebands. The primary benefit of our technique is that wavebands are rotated independently, preserving relative spectral information. [J2375]

"A two-distribution compounded statistical model for Radar HRRP target recognition"

In the statistical target recognition based on radar high-resolution range profile (HRRP), two challenging tasks are how to deal with the target-aspect, time-shift, and amplitude-scale sensitivity of HRRP and how to accurately describe HRRPs statistical characteristics. In this paper, based on the scattering center model, range cells are classified, in accordance with the number of predominant scatterers in each cell, into three statistical types. After resolving the three sensitivity problems, this paper develops a statistical model comprising two distribution forms, i.e., Gamma distribution and Gaussian mixture distribution, to model echoes of different types of range cells as the corresponding distribution forms. Determination of the type of a range cell is achieved by using the rival penalized competitive learning (RPCL) algorithm, while estimation for the parameters of Gamma distribution and Gaussian mixture distribution by the maximum likelihood (ML) method and the expectation-maximization (EM) algorithm, respectively. Experimental results for measured data show that the proposed statistical model not only has better recognition performance but also is more robust to noises than the two existing statistical models, i.e., Gaussian model and Gamma model. [J2376]

"Correction to "An investigation of bistatic calibration Objects""

Weizu Xiong provides a correction on the paper "An investigation of bistatic calibration objects" by Bradley et al., see ibid., vol.43, no.10, p.2177 (1990). [J2377]

"Reply to correction to "An investigation of bistatic calibration objects""

The authors provide a reply to the correction by Weizu Xiong, see ibid., vol.44. no.6, p.1692 (2006), on their paper "An investigation of bistatic calibration objects", see ibid., vol.43, no.10, p.2177 (1990). [J2378]

"Real-time disparity contrast combination for onboard estimation of the visibility distance"

An atmospheric visibility measurement system capable of quantifying the most common operating range of onboard exteroceptive sensors is a key parameter in the creation of driving assistance systems. This information is then utilized to adapt sensor operations and processing or to alert the driver that his onboard assistance system is momentarily inoperative. Moreover, a system capable of either detecting the presence of fog or estimating visibility distances constitutes in itself a driving assistance. In this paper, the authors present a technique to estimate the mobilized visibility distance through a use of onboard charge-coupled device cameras. The latter represents the distance to the most distant object on the road surface having a contrast above 5%. This definition is very close to the definition of the meteorological visibility distance proposed by the International Commission on Illumination. The method combines the computations of local contrasts above 5% and of a depth map of the vehicle environment using stereovision within 60 ms on a current-day computer. In this paper, both methods are described separately. Then, their combination is detailed. The method is operative night and day in every kind of meteorological condition and is evaluated; thanks to video sequences under sunny weather and foggy weather. [J2379]

"Adaptive pulse compression via MMSE estimation"

Radar pulse compression involves the extraction of an estimate of the range profile illuminated by a radar in the presence of noise. A problem inherent to pulse compression is the masking of small targets by large nearby targets due to the range sidelobes that result from standard matched filtering. This paper presents a new approach based upon a minimum mean-square error (MMSE) formulation in which the pulse compression filter for each individual range cell is adaptively estimated from the received signal in order to mitigate the masking interference resulting from matched filtering in the vicinity of large targets. The proposed method is compared with the standard matched filter and least-squares (LS) estimation and is shown to be superior over a variety of stressing scenarios. [J2380]

"Performance improvement for constellation SAR using signal processing techniques"

A new concept of spaceborne synthetic aperture radar (SAR) implementation has recently been proposed-the constellation of small spaceborne SAR systems. In this implementation, several formation-flying small satellites cooperate to perform multiple space missions. We investigate the possibility to produce high-resolution wide-area SAR images and fine ground moving-target indicator (GMTI) performance with constellation of small spaceborne SAR systems. In particular, we focus on the problems introduced by this particular SAR system, such as Doppler ambiguities, high sparseness of the satellite array, and array element errors. A space-time adaptive processing (STAP) approach combined with conventional SAR imaging algorithms is proposed which can solve these problems to some extent. The main idea of the approach is to use a STAP-based method to properly overcome the aliasing effect caused by the lower pulse-repetition frequency (PRF) and thereby retrieve the unambiguous azimuth wide (full) spectrum signals from the received echoes. Following this operation, conventional SAR data processing tools can be applied to focus the SAR images fully. The proposed approach can simultaneously achieve both high-resolution SAR mapping of wide ground scenes and GMTI with high efficiency. To obtain array element errors, an array auto-calibration technique is proposed to estimate them based on the angular and Doppler ambiguity analysis of the clutter echo. The optimizing of satellite formations is also analyzed, and a platform velocity/PRF criterion for array configurations is presented. An approach is given to make it possible that almost any given sparse array configuration can satisfy the criterion by slightly adjusting the PRF. Simulated results are presented to verify the effectiveness of the proposed approaches. [J2381]

"Hierarchical resource management in adaptive airborne surveillance radars"

In this paper we present hierarchical resource management algorithms for adaptive airborne surveillance radars. By abstracting the physical layer sensor performance into a quality of service measure, the resource management problem is formulated as a constrained Markov decision process. A two-level (two-timescale) resource management algorithm is presented based on Lagrangian relaxation. A numerical example is given with scenarios involving different target densities. [J2382]

"Performance comparison of PRF schedules for medium PRF radar"

Previous work has shown how evolutionary algorithms (EAs) are an effective tool in optimising the selection of

pulse repetition frequency (PRF) values of medium PRF schedules in an airborne fire control radar (FCR) application requiring target data in three PRFs. The optimisation is driven by the requirement to minimise range/Doppler blindness whilst maintaining full decodability. In this paper we detail work in which the optimisation process is applied to design novel short medium PRF schedules requiring target data in just two PRFs. The paper reports on the testing of a variety of near-optimum schedules to compare their blindness, decoding, and ghosting performances. The results show that in many situations, the 2 of N schedules are a practical alternative to conventional 3 of N processing. [J2383]

"Team optimal signaling strategies in air combat"

Modern fighter aircraft are equipped with a data link system for relaying encrypted messages containing information on the states of friendly or hostile aircraft within a team of friendly aircraft. During a many-versus-many air combat, only the most important and essential information must be transmitted in order to achieve the best possible situation awareness of pilots. In this paper, we introduce a prioritization approach for solving the team optimal signaling strategy referring to the best sequence of relayed information with respect to the overall goals of the friendly pilots. The approach is based on a value function that captures the preferences of the pilots and prioritizes the existing information. Uncertainty about the states of the aircraft as well as about incomplete preference statements is incorporated into the prioritization by utilizing interval analysis. We also describe a software that is designed for simulating the evolution of team members' information and trajectories in an air-combat game. The prioritization approach is illustrated by numerical examples [J2384]

"Component-oriented radars with probabilistic timing guarantees"

In recent years, many modern phased-array radars are built with commercial off-the-shelf components, and the functions of many hardware components are also reimplemented by software modules. In such systems, radar tasks could be modeled as distributed real-time tasks which require end-to-end deadline guarantees and have precedence constraints. Different from most previous work on either algorithms with restrictions in resource utilization or heuristics without analytical ways for schedulability guarantees, the objective of this paper is to propose a joint real-time scheduling algorithm for both transmitter/receiver and signal processor workloads with an analytical framework for offline probabilistic analysis and online admission control. The strength of our approach is verified by analysis results and a series of experiments based on a real phased-array radar for air defense frigates [J2385]

"Noncoherent pulse compression"

Pulse compression can be performed in noncoherent radars by using coded on-off keying (OOK). We show how any bipolar pulse-compression code (e.g., Barker) can be modified into unipolar OOK through Manchester coding. The resulted transmitted signal is a burst of dense subpulses, with pulse position modulation. In the receiver, the envelope-detected signal is aperiodically cross-correlated with a mismatched bipolar reference signal, yielding noncoherent integration with a low-sidelobe response. The concept can be used in simple radars where Doppler information is not required, in direct-detection laser radars and in ultrawideband (UWB) radars. Examples are given with bursts of 13 and 70 subpulses. Detection probabilities dependence on SNR is studied and compared with coherent processing. [J2386]

"Four new distinguished microwave lecturers"

{no data available} [J2387]

"Team up with EuMW2006"

{no data available} [J2388]

"Automatic commercial aircraft-collision avoidance in free flight: the three-dimensional problem"

In this paper, optimal resolution of air-traffic (AT) conflicts were considered. Aircraft are assumed to cruise within a free altitude layer and are modeled in three dimensions with variable velocity and proximity bounds. Aircraft cannot get closer to each other than a predefined safety distance. The problem of solving conflicts arising among several aircraft that are assumed to move in a shared airspace were considered. For such systems of multiple aircraft, the total flight time by avoiding all possible conflicts were minimized. This paper proposes a formulation of the conflict avoidance problem as a mixed-integer nonlinear-programming problem. In the author's case, only velocity changes are admissible as maneuvers. Nevertheless, in subsequent work, simultaneous velocity and heading angle changes will be checked too. Simulation results for realistic aircraft conflict scenarios are provided. [J2389]

"Dr. Eli Brookner to receive the IEEE Dennis J. Picard Medal"

{no data available} [J2390]

"Uniform versus nonuniform sampling when tracking in clutter"

Many target tracking subsystems have the ability to schedule their own data rates; essentially they can "order" new information whenever they need it, and the cost is in terms of the sensor resource. But among the unmanaged schemes, uniform sampling, in which a new measurement is requested periodically and regularly, is the most commonly-used sampling scheme; deliberately nonuniform schemes are seldom given serious consideration. In this paper, however, we show that such schemes may have been discarded prematurely: a nonuniform sampling can have its benefits. Specifically, the nonuniform and uniform sampling schemes are compared for two kind of trackers: the probabilistic data association filter (PDAF), which updates its track based on a single scan of information at a time; and N-D assignment (an optimization-based implementation of the multi-hypothesis tracker (MHT)), in which the sliding window involves many scans of observations. We find that given the ground rule of maintenance of the same overall scan rate (i.e., the same sensor effort) uniform sampling is always optimal for the single-scan tracker in the sense of track life. However, nonuniform sampling can outperform uniform sampling if a more sophisticated multi-scan tracker is used, particularly when 1) the target has a high process noise, and/or 2) the false alarm density is high, and/or 3) the probability of detection is high. [J2391]

"Performance evaluation of algorithms for SAW-based temperature measurement"

Whenever harsh environmental conditions such as high temperatures, accelerations, radiation, etc., prohibit usage of standard temperature sensors, surface acoustic wave-based temperature sensors are the first choice for highly reliable wireless temperature measurement. Interrogation of these sensors is often based on frequency modulated or frequency stepped continuous wave-based radars (FMCW/FSCW). We investigate known algorithms regarding their achievable temperature accuracy and their applicability in practice. Furthermore, some general rules of thumb for FMCW/FSCW radar-based range estimation by means of the Cramer-Rao lower bound (CRLB) for frequency and phase estimation are provided. The theoretical results are verified on both simulated and measured data. [J2392]

"PTT packet delay analysis for GPRS/GSM links"

Push-to-talk (PTT) is a new mobile service that enables fast-access and two-way communication between two or more users. This paper develops an approximate evaluation model for PTT delay performance in GPRS/GSM networks based on a quasi-stationary assumption and an M/G/1 processor sharing queueing model. Numerical results are presented in order to illustrate the effect of traffic load and other design parameters on PTT packet delay [J2393]

"Special issue on subsurface sensing using ground penetrating radar (GPR)"

{no data available} [J2394]

"Spatiotriangulation with multisensor HR stereo-images"

The objective of this research study was to evaluate the spatiotriangulation applied to multisensor high-resolution satellite stereo-images, which enabled the simultaneous geometric processing of a large number of stereo-pairs together to reduce the control point requirement. The spatiotriangulation is based on the three-dimensional physical models developed for multisensor images at the Canada Centre for Remote Sensing, Natural Resources Canada and on a least squares block stereo-bundle adjustment process with orbital constraints. The spatiotriangulation was applied to five along-/across-track stereo-images [panchromatic Syste`me Pour l'Observation de la Terre 5 (SPOT-5) High-Resolution-Stereoscopy (HRS) and High-Resolution-Geometry (HRG), Ikonos, and QuickBird] acquired over Quebec, Canada. The first results of stereo/block bundle adjustment showed that the same error residuals than the input data errors (1/2 to 1-2 pixels) were obtained depending of the stereo-images, whether independently or simultaneously processed. The second and most important results were related to simultaneous stereo-bundle adjustments of the largest "master" SPOT-5 stereo-pair (either HRS or HRG) using 12 ground control points (GCPs) and the smallest "slave" stereo-pair(s) using no GCP but only stereo tie-points (TPs). Better results were normally obtained with SPOT-5-HRG (5-m resolution) as the "master" stereo-pair due to less difference in the sensors resolution than with SPOT-5 HRS. The root mean square errors, verified by independent check points (ICPs) belonging only to the "slave" stereo-pairs, were around 2 m in the three axes. However, the combined image pointing and map errors of ICPs (1-2

m) are included in these 2-m error results, and the internal accuracy of the stereo-pairs should thus be better (less than one resolution). The research study demonstrated thus the possibility to use the largest stereo-pair with a reduced number of GCPs to simultaneously adjust single or multiple stereo-pair(s) with only stereo TPs, and with no degradation in the accuracy. [J2395]

"Unsupervised change detection on SAR images using fuzzy hidden Markov chains"

This work deals with unsupervised change detection in temporal sets of synthetic aperture radar (SAR) images. We focus on one of the most widely used change detector in the SAR context, the so-called log-ratio. In order to deal with the classification issue, we propose to use a new fuzzy version of hidden Markov chains (HMCs), and thus to address fuzzy change detection with a statistical approach. The main characteristic of the proposed model is to simultaneously use Dirac and Lebesgue measures at the class chain level. This allows the coexistence of hard pixels (obtained with the classical HMC segmentation) and fuzzy pixels (obtained with the fuzzy measure) in the same image. The quality assessment of the proposed method is achieved with several bidate sets of simulated images, and comparisons with classical HMC are also provided. Experimental results on real European Remote Sensing 2 Precision Image (ERS-2 PRI) images confirm the effectiveness of the proposed approach. [J2396]

"Spectrum considerations for public safety in the United States"

Since the inception of mobile radio, public safety agencies have relied on wireless communication systems to coordinate day-to-day and emergency operations. The decentralized and autonomous nature of the various public safety agencies in the United States has led to the deployment of a variety of systems operating in a fragmented spectrum, ranging from lower VHF to upper UHF. Due to the narrowband technologies used in public safety communications systems, public safety agencies have been limited primarily to voice services and low-speed data transfer on their private networks. In contrast, the commercial cellular sector now offers a large portfolio of services that include voice, messaging, email, Web browsing, picture transfer, video streaming, and other wideband services. In this article, some of the factors driving the expansion of spectrum allocated to public safety agencies arc described. [J2397]

"An organizational coevolutionary algorithm for classification"

Taking inspiration from the interacting process among organizations in human societies, a new classification algorithm, organizational coevolutionary algorithm for classification (OCEC), is proposed with the intrinsic properties of classification in mind. The main difference between OCEC and the available classification approaches based on evolutionary algorithms (EAs) is its use of a bottom-up search mechanism. OCEC causes the evolution of sets of examples, and at the end of the evolutionary process, extracts rules from these sets. These sets of examples form organizations. Because organizations are different from the individuals in traditional EAs, three evolutionary operators and a selection mechanism are devised for realizing the evolutionary operations performed on organizations. This method can avoid generating meaningless rules during the evolutionary process. An evolutionary method is also devised for determining the significance of each attribute, on the basis of which, the fitness function for organizations is defined. In experiments, the effectiveness of OCEC is first evaluated by multiplexer problems. Then, OCEC is compared with several well-known classification algorithms on 12 benchmarks from the UCI repository datasets and multiplexer problems. Moreover, OCEC is applied to a practical case, radar target recognition problems. All results show that OCEC achieves a higher predictive accuracy and a lower computational cost. Finally, the scalability of OCEC is studied on synthetic datasets. The number of training examples increases from 100 000 to 10 million, and the number of attributes increases from 9 to 400. The results show that OCEC obtains a good scalability. [J2398]

"Radar target novel characteristic detection method"

In this paper, a method of radar target detection based on 2-dimensional (2D) fractal dimension is proposed. The proposed approach exploits both range information and azimuth information to estimate fractal dimension. Moreover, the approach can increase the number of the data points. The above two merits result in the fractal dimension estimated by this method is more accurate and robust than the previous method. The detection performance is also better than the previous one, which only makes use of 1-dimensional (1-D) information to estimate fractal dimension. Theoretical analysis and experimental result show that the proposed method performs well in strong clutter background. The proposed method is also validated by real-life radar data, and the better result has been achieved. [J2399]

"Advances in non-linear apodization"

Selected new methods and applications of non-linear apodization for irregularly-shaped and parse coherent

apertures and arrays are presented. The benefits include unproved impulse response performance, i.e., reduced peak sidelobes and integrated sidelobe power, along with improved mainlobe resolution, compared to classic windowing techniques. Nonlinear apodization (NLA) techniques can also serve as powerful engines for effective superresolution and bandwidth extrapolation of coherent data for filling sparse apertures. The sparse aperture filling property of superresolution algorithms for radar data forms the basis for a new concept which is introduced here: synthetic multiple aperture radar technology (SMART). Increased swath and/or reduced antenna size are some of the benefits postulated for SMART applied to synthetic aperture radar (SAR) systems. The benefits of these new methods and applications for nonlinear apodization are then demonstrated for two specific applications: 1) sidelobe control for Y-type synthetic aperture radiometers, such as the European Soil Moisture and Ocean Salinity (SMOS) system (Kerr et al.) and JPL's proposed GeoSTAR (Lambrigsten) concept; and, 2) filling of sparse synthetic aperture radar data by exploiting the bandwidth extrapolation properties of nonlinear apodization based superresolution techniques. The methods that have been developed and demonstrated herein have potential application to a wide range of passive and active microwave remote sensing and radar systems. [J2400]

"Accuracy assessment of SAR data-based snow-covered area estimation method"

Employment of satellite radar-based remote sensing data for snow monitoring during the snow melt season has been widely studied by several investigators. Several methods for the estimation of snow-covered area (SCA) fraction have been developed for different types of regions. One common deficiency with the SCA estimation methods has been the lack of statistical accuracy analyses for them. In order to incorporate SCA estimates for operational use, one vital requisite is a thorough statistical analysis of the SCA estimation accuracy. This shortcoming has been addressed for boreal forest region, as an extensive statistical accuracy analysis has been carried out for the Helsinki University of Technology (TKK)-developed SCA method. The TKK SCA method was developed for boreal forest regions, and it is studied here with 24 European Remote Sensing 2 synthetic aperture radar intensity images, on a boreal-forest-dominated test area located in northern Finland. The performance of the SCA method is investigated by using reference data acquired through hydrological modeling. The accuracy analysis is carried out for several statistical variables, and the statistical interpretation is done with respect to several affecting parameters. The accuracy analysis shows a high correlation coefficient between the SCA estimates and the reference data and root mean square error values of 0.213 for open areas and 0.179 for forested areas. In addition, the TKK method employs two reference images for the SCA estimation, and the usability of multiyear reference image utilization was analyzed and proven feasible in this study. [J2401]

"An abrupt change detection algorithm for buried landmines localization"

Ground-penetrating radars (GPRs) are very promising sensors for landmine detection as they are capable of detecting landmines with low metal contents. GPRs deliver so-called Bscan data which are, roughly, vertical slice images of the ground. However, due to the high dielectric permittivity contrast at the air-ground interface, a strong response is recorded at early time by GPRs. This response is the main component of the so-called clutter noise and it blurs the responses of landmines buried at shallow depths. The landmine detection task is therefore quite difficult. This paper proposes a new method for automated detection and localization of buried objects from Bscan records. A support vector machine algorithm for online abrupt change detection is implemented and proves to be efficient in detecting buried landmines from Bscan data. The proposed procedure performance is evaluated using simulated and real data. [J2402]

"A prediction fusion method for reconstructing spatial temporal dynamics using support vector machines"

In this paper, we propose a new spatial temporal predictor using support vector machine (SVM) and data fusion technique. SVMs are used as temporal predictors at different spatial domains and spatial temporal prediction is achieved by prediction fusion. Our proposed prediction fusion technique improves the prediction accuracy even in a non-Gaussian environment. The performance of the proposed spatial temporal predictor is analyzed. Based on real-life radar data, the proposed spatial temporal approach is shown to provide a more accurate model for sea-clutter data than the conventional methods [J2403]

"Image autocoregistration and InSAR interferogram estimation using joint subspace projection"

In this paper, we propose a new method to estimate synthetic aperture radar interferometry (InSAR) interferometric phase in the presence of large coregistration errors. The method takes advantage of the coherence information of neighboring pixel pairs to automatically coregister the SAR images and employs the projection of the joint signal subspace onto the corresponding joint noise subspace to estimate the terrain interferometric phase. The method can automatically coregister the SAR images and reduce the interferometric

phase noise simultaneously. Theoretical analysis and computer simulation results show that the method can provide accurate estimate of the terrain interferometric phase (interferogram) as the coregistration error reaches one pixel. The effectiveness of the method is also verified with the real data from the Spaceborne Imaging Radar-C/X Band SAR and the European Remote Sensing 1 and 2 satellites. [J2404]

"PolInSAR analysis of X-band data over vegetated and urban areas"

This paper investigates the polarimetric and polarimetric interferometric synthetic aperture radar (PolInSAR) information contained in the high-resolution X-band data acquired by the RAMSES airborne SAR system over an area around Avignon, France containing bare surfaces, vegetation, and urban areas. The interferometric coherences are computed over natural and urban areas for all possible baseline copolar polarizations. In the complex plane, the obtained regions of coherence corresponding to most vegetation areas display small angular extents, meaning that if penetration occurs in the foliage, it is shallower than the system height accuracy. To quantify the PolInSAR information, an analysis of the interferometric height accuracy is first performed, and the results are compared with those associated with a theoretical and an empirical model. Concerning vegetation, a 6-m height difference is measured between the different polarimetric phase centers over a sparse pine forest, probably due to the presence of holes in the canopy. Crop study reveals also that wheat-type fields present oriented media properties at X-band due to their vertical structure. Over urban areas, in most cases, building height can be accurately obtained by using Pauli polarimetric phase center information. [J2405]

"Extension of GPM dual-frequency iterative retrieval method with DSD-profile constraint"

A new Dual-Frequency Precipitation Radar (DPR) will be included on the Global Precipitation Measurement (GPM) core satellite which will succeed the highly successful Tropical Rainfall Measuring Mission satellite launched in 1997. New dual-frequency drop-size distribution (DSD) and rain-rate estimation algorithms are being developed to take advantage of the enhanced capabilities of the DPR. It has been shown previously that a backward-iteration algorithm can be embedded within a single-loop feedback model to retrieve the rain rate. However, the single-loop model is unable to correctly estimate DSD profiles for a significant portion of global median-volume-diameter, Do, and normalized DSD intercept parameter, Nw, combinations in rain because of a multiple-value solution space. For the remaining Do,Nwpairs, another retrieval method is necessary. This paper proposes a dual-loop model, in which the intercept parameter, Nw, of the DSD is constrained in its vertical profile, to guide the algorithm to correct convergence. This allows an additional constraint on the DSD values estimated by the iterative algorithm and helps to retrieve correct DSD values in the regions where the iterative approach alone fails. To demonstrate feasibility of the proposed method, three test cases representative of many DSD and profile combinations are discussed. The first case is a constant vertical profile of the DSD parameters. The second case examines linear variation of the DSD parameters, and the third case examines how measurement error affects the retrieval process. In each case, the proposed constraint on the intercept parameter is implemented, and the results are discussed. Using the constraint, the dual-loop algorithm is able to retrieve reasonable values for the DSDs and rain-rate profiles and extend the convergence region of the algorithm. [J2406]

"Microphysical characterization of microwave Radar reflectivity due to volcanic ash clouds"

Ground-based microwave radar systems can have a valuable role in volcanic ash cloud monitoring as evidenced by available radar imagery. Their use for ash cloud detection and quantitative retrieval has been so far not fully investigated. In order to do this, a forward electromagnetic model is set up and examined taking into account various operating frequencies such as S-, C-, X-, and Ka-bands. A dielectric and microphysical characterization of volcanic vesicular ash is carried out. Particle size-distribution (PSD) functions are derived both from the sequential fragmentation-transport (SFT) theory of pyroclastic deposits, leading to a scaled-Weibull PSD, and from more conventional scaled-Gamma PSD functions. Best fitting of these theoretical PSDs to available measured ash data at ground is performed in order to determine the value of the free PSD parameters. The radar backscattering from spherical-equivalent ash particles is simulated up to Ka-band and the accuracy of the Rayleigh scattering approximation is assessed by using an accurate ensemble particle scattering model. A classification scheme of ash average concentration and particle size is proposed and a sensitivity study of ash radar backscattering to model parameters is accomplished. A comparison with C-band radar signatures is finally illustrated and discussed. [J2407]

"Power electronics and future marine electrical systems"

Tomorrow's marine electrical systems will be profoundly different from today's systems. Power electronics is making major impacts on virtually every marine system including propulsion, power distribution, auxiliaries, sonar, and radar. Newly emerging materials, components, and system concepts (such as wide band-gap materials,

silicon-carbide-based power semiconductor devices, power electronics building blocks (PEBBs), and integrated power systems) are, and will continue, enabling future marine systems as different from today's systems as steam ships were to sailing ships. However, these enabling technologies and concepts are not well known and have been difficult to understand. This paper will introduce these new concepts and technologies, identify potential impacts, and explore new design methods to simplify marine electrical system development. [J2408]

"Cognitive radar: a way of the future"

This article discusses a new idea called cognitive radar. Three ingredients are basic to the constitution of cognitive radar: 1) intelligent signal processing, which builds on learning through interactions of the radar with the surrounding environment; 2) feedback from the receiver to the transmitter, which is a facilitator of intelligence; and 3) preservation of the information content of radar returns, which is realized by the Bayesian approach to target detection through tracking. All three of these ingredients feature in the echo-location system of a bat, which may be viewed as a physical realization (albeit in neurobiological terms) of cognitive radar. Radar is a remote-sensing system that is widely used for surveillance, tracking, and imaging applications, for both civilian and military needs. In this article, we focus on future possibilities of radar with particular emphasis on the issue of cognition. As an illustrative case study along the way, we consider the problem of radar surveillance applied to an ocean environment. [J2409]

"Knowledge-based radar signal and data processing: a tutorial review"

Radar systems are an important component in military operations. In response to increasingly severe threats from military targets with reduced radar cross sections (RCSs), slow-moving and low-flying aircraft hidden in foliage, and in environments with large numbers of targets, knowledge-based (KB) signal and data processing techniques offer the promise of significantly improved performance of all radar systems. Radars under KB control can be deployed to utilize valuable resources such as airspace or runways more effectively and to aid human operators in carrying out their missions. As battlefield scenarios become more complex with increasing numbers of sensors and weapon systems, the challenge will be to use already available information effectively to enhance radar performance, including positioning, waveform selection, and modes of operation. KB processing fills this need and helps meet the challenge. [J2410]

"Knowledge-based systems for adaptive radar [JGuest editorial]"

{no data available} [J2411]

"Knowledge-aided adaptive radar at DARPA: an overview"

For the past several years, the Defense Advanced Research Projects Agency (DARPA) has been pioneering the development of the first ever real-time knowledge-aided (KA) adaptive radar architecture. The impetus for this program is the ever increasingly complex missions and operational environments encountered by modern radars and the inability of traditional adaptation methods to address rapidly varying interference environments. The DARPA KA sensor signal processing and expert reasoning (KASSPER) program has as its goal the demonstration of a high performance embedded computing (HPEC) architecture capable of integrating high-fidelity environmental knowledge (i.e., priors) into the most computationally demanding subsystem of a modern radar: the adaptive space-time beamformer. This is no mean feat as environmental knowledge is a memory quantity that is inherently difficult (if not impossible) to access at the rates required to meet radar front-end throughput requirements. In this article, we will provide an overview of the KASSPER program highlighting both the benefits of KA adaptive radar, key algorithmic concepts, and the breakthrough look-ahead radar scheduling approach that is the keystone to the KASSPER HPEC architecture. [J2412]

"The evolution of RFID security"

As RFID technology progresses, security and privacy threats also evolve. By examining RFID's history, we can learn from past mistakes, rediscover successful solutions, and inspire future research. [J2413]

"Knowledge-based resource management for multifunction radar: a look at scheduling and task prioritization"

In this article, we consider two related aspects of radar resource management, scheduling and task prioritization. Two different methods of scheduling are examined and compared and their differences and similarities highlighted. The comparison suggests that prioritization of tasks plays a dominant role in determining performance. A prioritization scheme based on fuzzy logic is subsequently contrasted and compared with a hard logic approach as a basis for task prioritization. The setting of priorities is shown to be critically dependent on

prior expert knowledge. By assessing the priorities of targets and sectors of surveillance according to a set of rules it is attempted to imitate the human decision-making process such that the resource manager can distribute the radar resources in a more effective way. Results suggest that the fuzzy approach is a valid means of evaluating the relative importance of the radar tasks; the resulting priorities have been adapted by the fuzzy logic prioritization method, according to how the radar system perceived the surrounding environment. [J2414]

"Space-time adaptive processing: a knowledge-based perspective for airborne radar"

This article provides a brief review of radar space-time adaptive processing (STAP) from its inception to state-of-the art developments. The topic is treated from both intuitive and theoretical aspects. A key requirement of STAP is knowledge of the spectral characteristics underlying the interference scenario of interest. Additional issues of importance in STAP include the computational cost of the adaptive algorithm as well as the ability to maintain a constant false alarm rate (CFAR) over widely varying interference statistics. This article addresses these topics, developing the need for a knowledge-based (KB) perspective. The focus here is on signal processing for radar systems using multiple antenna elements that coherently process multiple pulses. An adaptive array of spatially distributed sensors, which processes multiple temporal snapshots, overcomes the directivity and resolution limitations of a single sensor. [J2415]

"A tutorial on microwave photonic filters"

Microwave photonic filters are photonic subsystems designed with the aim of carrying equivalent tasks to those of an ordinary microwave filter within a radio frequency (RF) system or link, bringing supplementary advantages inherent to photonics such as low loss, high bandwidth, immunity to electromagnetic interference (EMI), tunability, and reconfigurability. There is an increasing interest in this subject since, on one hand, emerging broadband wireless access networks and standards spanning from universal mobile telecommunications system (UMTS) to fixed access picocellular networks and including wireless local area network (WLAN), World Interoperability for Microwave Access, Inc. (WIMAX), local multipoint distribution service (LMDS), etc., require an increase in capacity by reducing the coverage area. An enabling technology to obtain this objective is based on radio-over-fiber (RoF) systems where signal processing is carried at a central office to where signals are carried from inexpensive remote antenna units (RAUs). On the other hand, microwave photonic filters can find applications in specialized fields such as radar and photonic beamsteering of phased-arrayed antennas, where dynamical reconfiguration is an added value. This paper provides a tutorial introduction of this subject to the reader not working directly in the field but interested in getting an overall introduction of the subject and also to the researcher wishing to get a comprehensive background before working on the subject. [J2416]

"Performance evaluation of a push mechanism for WLAN and mobile network integration"

In this paper, we propose a universal mobile telecommunications system (UMTS) and a wireless LAN (WLAN) interworking solution called WLAN-based general packet radio service (GPRS) support node (WGSN), which allows a UMTS/WLAN dual mode mobile station (MS) to access heterogeneous wireless services. To reduce the power consumption of an MS, most WGSN applications are not activated at the MS, and MS-terminated services, such as incoming voice over IP (VoIP) calls, are not supported. To address this issue, a push mechanism called session initiation protocol (SIP)-based push center (SPC) was implemented in the WGSN node. For an incoming call to an MS, the SPC utilizes the UMTS short message service to activate the SIP User Agent of the MS. We study the performance of the SPC. An analytic model is proposed to derive the expected number of lost calls during the activation period. The analytic results are validated against the simulation experiments. Our study quantitatively indicates how the SPC performance is affected by the activation time and the timeout period, and we also suggest how to select appropriate values of these two factors to optimize the SPC performance. [J2417]

"High-resolution absolute position Vernier shaft encoder suitable for high-performance PMSM servo drives"

Permanent magnet synchronous motor (PMSM) drives are suitable for high-performance servo applications, as in robotics. This, however, requires an accurate position feedback, which is not possible with the existing absolute position encoders, unless one is prepared to compromise on the size of the encoder. This paper proposes a new encoding scheme based on the simple Vernier principle. The proposed scheme improves the resolution of the encoder within limited disk diameter. An improved encoder based on the same principle is also presented with minor modifications to improve the resolution. Computer simulations and experimental work have shown that a suitable modification of the Vernier concept can result in an encoder that is superior to the existing ones. Details of this work are presented. [J2418]

"A multiband, compact, and full-duplex beam scanning antenna transceiver system operating from 10 to 35 GHz"

This paper presents a compact phased-array antenna transceiver system that can operate over a wide bandwidth from 10 to 35 GHz with the abilities of beam scanning and full-duplex communication. The system consists of ultrawide-band Vivaldi antennas, a multiline PET-based phase shifter, a six-channel microstrip multiplexer, and monolithic microwave integrated circuit (MMIC) amplifiers. The multiplexer routes 10, 19, and 32 GHz signals to the transmit path and 12, 21, and 35 GHz signals to the receive path. The multiplexer shows insertion loss between 2.2 and 3.4 dB for all six channels and together with wide-band MMIC amplifiers plays an important role to build a compact, multifrequency, and full-duplex transceiver system. The system should have many applications in multiband satellite communication systems and radar systems. [J2419]

"Demonstration of a continuously variable true-time delay beamformer using a multichannel chirped fiber grating"

A continuously variable true-time delay beamformer based on a multichannel chirped fiber grating (MCFG) is demonstrated. The beamformer is capable of wide-band squint-free operation and demonstrates beam steering of a four-element array over ±40°. The use of an MCFG provides a significant reduction in the length of the chirped grating required, eliminates spurious signal transmission, and utilizes narrow-band tunable laser sources. In addition, the effect of grating errors on the antenna pattern is examined and the tolerance on performance is presented. [J2420]

"Optical signal processing in Radar systems"

Opto-electronic components and their performances are well suited to be integrated in radar systems. In this paper, two optical architectures illustrate functions that are specific to optical processing of microwave signals, i.e., time-delay-based processing and arbitrary waveform generation of large frequency bandwidth signals. [J2421]

"Guest Editorial"

{no data available} [J2422]

"Range adjustment for ground-based radar, derived with the spaceborne TRMM precipitation radar"

We show how the Tropical Rainfall Measuring Mission (TRMM) Precipitation Radar (TPR) can be used to monitor and adjust ground-based radar (GR) data, as a function of the distance from the radar site. Problems caused by the variability of precipitation and differences in sampling volume of the two instruments are reduced to a level that is achievable with, and acceptable for, the present analysis. Throughout the region under surveillance, TPR has poorer spatial resolution than GR. The sampling volume of the GR changes quite remarkably according to the range from the GR site: it increases with the square of the range. TPR, on the other hand, has similar sampling volumes in all the locations. The analysis is based on the average linear radar reflectivity, in circular rings around the GR site, 2pi, as a function of the range from the GR site. The GR/TPR ratio varies, for the Cyprus radar, on average from 2 dB, at 10 km, to -8 dB at 100 km. The average departure at the average range is considered to be mainly caused by the calibration of the GR. The range dependence of the GR/TPR ratio is significant and similar, in all the investigated cases. This is interpreted to be caused by the increasing sampling volume of the GR with range, combined with nonhomogeneous beam filling, e.g., at longer ranges of GR, the lower part of the volume could be in rain, whereas the upper part of the same pulse could be filled with snow, or even be without an echo. After correcting the GR data by using the derived averaged relationship, a significantly better agreement between the GR and TPR is found in all the overpasses analyzed. The agreement between the results of the two instruments is better for both the percentage of echo areas and the rain amount within each area. It is also better for the agreement of the GR with the gauges. In the absence of TPR data, it will be useful to investigate to what extent long-term, climatological data can be used to substitute TPR data. [J2423]

"Robust DFT with high breakdown point for complex-valued impulse noise environment"

Modification of the robust discrete Fourier transform (DFT) is proposed in order to achieve a high breakdown point for signals corrupted by complex-valued impulse noise with independent real and imaginary parts. Obtained results are compared with existing robust DFT forms. In addition, an adaptive procedure for selection of the modified robust DFT form is developed. [J2424]

"Fast iterative approach to difference scattering from the target above a rough surface"

The difference field radar cross section (d-RCS) has been defined to analyze the scattering from the target above a rough surface, which takes account of scattering from the target and multiinteractions of the target and underlying rough surface. The d-RCS removes the effect of the finite illuminated surface length under the tapered wave incidence. In this paper, the electric field integral equations (EFIEs) of the difference-induced current Jsdon the rough surface and the induced current Joon the target are derived. A small section of rough surface toward the target in the specular direction is taken to speed up computation of the scattering contribution Es0from the moderate rough surface to the target. Then, an iterative approach is developed to solve the EFIEs of the induced currents, directly, and yields the bistatic d-RCS. A finite rough surface length for numerical iteration is taken, corresponding to the dependence on the maximum scattering angle. Using the Monte Carlo method to generate rough surface, the bistatic d-RCS of the target, e.g., a cylinder or a square column, above a Pierson-Morkowitz rough surface is numerically simulated. The induced currents on the target and the d-RCS are discussed, and compared with the case of the target in free-space. [J2425]

"The influence of target acceleration on velocity estimation in dual-channel SAR-GMTI"

This paper investigates the effects of target acceleration on estimating the velocity vector of a ground moving target from single-pass dual-channel synthetic aperture radar data. Although vehicles traveling on roads and highways routinely experience acceleration, the majority of estimation algorithms assume a constant velocity scenario, which may result in erroneous estimates of target velocity. It is shown that under most conditions, acceleration has only minor effects on the estimation of across-track velocity using along-track interferometric phase. However, under the assumption of constant velocity, acceleration may significantly bias the estimate of along-track velocity. The influence of both along-track and across-track accelerations is examined through simulations of an airborne geometry and experimental data from Environment Canada's airborne CV 580 dual-channel synthetic aperture radar system. [J2426]

"Scattering-model-based speckle filtering of polarimetric SAR data"

A new concept in polarimetric synthetic aperture radar (POLSAR) speckle filtering that preserves the dominant scattering mechanism of each pixel is proposed in this paper. The basic principle is to select pixels of the same scattering characteristics to be included in the filtering process. To achieve this, the algorithm first applies the Freeman and Durden decomposition to separate pixels into three dominant scattering categories: surface, double bounce, and volume, and then unsupervised classification is applied. Speckle filtering is performed using the classification map as a mask. A single-look or multilook pixel centered in a 9 Ч 9 window is filtered by including only pixels in the same and two neighboring classes from the same scattering category. This filter is effective in speckle reduction, while perfectly preserving strong point target signatures, and retains edges, linear, and curved features in the POLSAR data. The effect of speckle filtering on scattering characteristics, such as entropy, anisotropy, and alpha angle, will be discussed. [J2427]

"An interferometric coherence optimization method in radar polarimetry for high-resolution imagery"

This paper investigates to what extent a new interferometric coherence optimization in radar polarimetry allows the separation of point scatterers located in the same resolution cell according to their interferometric phases. An interferometric coherence definition called the single-mechanism coherence is introduced, and the corresponding optimization method is briefly discussed. This method was first validated theoretically when no volume decorrelation occurs. Then, it has been applied to simple target measurements acquired in an anechoic chamber, and to an X-band polarimetric and interferometric synthetic aperture radar image containing man-made targets. In both cases, the single-mechanism coherence optimization enables to resolve the interferometric phases of several scattering centers inside the same resolution cell. [J2428]

"Study of the SAR signature of internal waves by nonlinear parametric autoregressive models"

In this paper, we propose a method for estimating the nonlinear differential equation governing the propagation of internal waves (IWs) in a stratified water column of the ocean. This estimation of the kind of nonlinear differential equation and the coefficients of this equation is performed from profiles of the synthetic aperture radar signature at the ocean surface. Theoretically, the equation is based upon the Korteveg-de Vries (KdV) equation or one of its improved versions. The estimation of the differential equation version is based on nonlinear polynomial autoregressive models up to the third order. The estimation of the parameters of these models is performed simply by solving a set of linear equations using higher order statistics. This general approach allows us to identify the best model of propagation, i.e., the kind of nonlinearity as well as the structure of each kernel (linear, quadratic, cubic), without determining an analytic solution to the equation of propagation. Moreover, the physical oceanic parameters (such as the thermocline depth) are deduced from the estimated coefficients of the

KdV equation (assuming an underlying model of the water column). Results on simulated profiles generally lead to an exact model identification (i.e., the one used for simulation with the exact order of nonlinearity and the exact structure of each kernel) and lead to satisfying geophysical parameter estimates. Finally, the geophysical parameters estimated from three sets of ERS-1 profiles are generally coherent with the parameters observed in the IW propagation mechanism but have not been validated by "in situ" measurements. [J2429]

"Generalized pairwise complementary codes with set-wise uniform interference-free windows"

This paper introduces an approach to generate generalized pairwise complementary (GPC) codes, which offer a uniform interference free windows (IFWs) across the entire code set. The GPC codes work in pairs and can fit extremely power efficient quadrature carrier modems. The characteristic features of the GPC codes include: the set size is 2K, the processing gain is 4NK, and the IFW's width is 8N identically for all codes in a set, where K is the times to perform Walsh-Hadamard expansions and N is element code length of seed complementary codes. Therefore, by using different N, the IFW width of a GPC code set can be adjusted with its set size unchanged. Each GPC code set consists of two code groups, with each having K codes, and they have sparsely and uniformly distributed autocorrelation side lobes and cross-correlation levels outside the IFWs. [J2430]

"Finite sample size effect on minimum variance beamformers: optimum diagonal loading factor for large arrays"

Minimum variance beamformers are usually complemented with diagonal loading techniques in order to provide robustness against several impairments such as imprecise knowledge of the steering vector or finite sample size effects. This paper concentrates on this last application of diagonal loading techniques, i.e., it is assumed that the steering vector is perfectly known and that diagonal loading is used to alleviate the finite sample size impairments. The analysis herein is asymptotic in the sense that it is assumed that both the number of antennas and the number of samples are high but have the same order of magnitude. Borrowing some results of random matrix theory, the authors first derive a deterministic expression that describes the asymptotic signal-to-noise-plus-interference ratio (SINR) at the output of the diagonally loaded beamformer. Then, making use of the statistical theory of large observations (also known as general statistical analysis or G-analysis), the authors derive an estimator of the optimum loading factor that is consistent when both the number of antennas and the sample size increase without bound at the same rate. Because of that, the estimator has an excellent performance even in situations where the quotient between the number of observations is low relative to the number of elements of the array. [J2431]

"Main beam cochannel interference suppression by range adaptive processing for HFSWR"

The performance of high-frequency (HF) surface wave radar degrades significantly due to cochannel interferences (CCIs) in the user-congested HF band (3-30 MHz). Most of the conventional techniques generally follow a simple spatial adaptive processing (SAP) only in the presence of spatially structured interference, but sometimes, we cannot rely on SAP to cancel interference received through the main beam. In this letter, the correlation function of CCI applied in range domain is analyzed, and a new range adaptive processing technique is utilized to suppress the CCI. Real and simulated data results are presented that the general and robust algorithm can achieve effective CCI suppression without comprising the target detection. [J2432]

"Transform domain approach for sequence design and its applications"

Many communication and radar systems necessitate the use of sequences with desired autocorrelation (AC) and cross-correlation (CC) properties. This paper presents a systematic method based on the transform domain characterization of the AC and CC constraints to generate new families of sequences that meet the requirements. We demonstrate that some existing families can easily be generated by our approach. Our approach, however, renders new families of sequences with less constraints. The proposed approach is elementary and can easily be extended to synthesize two-dimensional arrays or even higher dimensional waveforms that possess the desired multidimensional correlation properties. A preamble structure based on our new sequence family is suggested and performance of frequency offset and channel estimation algorithms for a multiantenna orthogonal frequency-division multiplexing (OFDM) system that uses such a preamble is given. [J2433]

"Arctic-wide operational sea ice drift from enhanced-resolution QuikScat/SeaWinds scatterometry and its validation"

The near-real-time enhanced-resolution QuikScat/SeaWinds (QS) scatterometry composite data are used for daily automatic 48-h sea ice tracking by maximum cross-correlation over the entire Arctic. A correlation window

of 61 Ч 61 pixels is used for best performance. Both QS polarizations, vertical (VV) and horizontal (HH), are used independently, which permits to filter the final results for erroneous vectors by comparing the two drift vectors, u&oarr;VVand u&oarr;HH, respectively. Additional filtering is performed by setting a minimum correlation coefficient and by considering the spatial consistency of the motion field. The algorithm has been validated with winter 2002/2003 buoy data from the International Arctic Buoy Program showing error standard deviations in the 48-h displacement of 3.1 and 3.2 km in the latitude and longitude direction, respectively. This corresponds to an error standard deviation in ice drift speed of just 2.6 cm/s. Errors are largest in dynamic regions with lower ice concentrations as for example the southern Fram Strait. The enhanced-resolution data improve previous drift results by about 25%, but are still blurred by the necessary 36-h period to produce the composites. [J2434]

"Accounting for the effects of widespread discrete clutter in subsurface EMI remote sensing of metallic objects"

In practice, most signal processing strategies for discrimination of buried objects are clutter limited. This applies even to discrimination of shallow sizable metallic objects, such as unexploded ordnance (UXO), which are to be found predominantly in the top meter of soil. The environment typically features widespread metallic clutter from detonated ordnance or other sources. Such fragments can be numerous and are often shallower than the objects of interest. Currently, the preeminent remote sensing mode for buried UXO is ultrawideband electromagnetic induction (EMI), operating over part or all of the band from some tens of hertz up to perhaps hundreds of kilohertz. Particularly because EMI fields fall off sharply with range, signals from shallow clutter may be relatively strong and can easily obscure essential scatterer signatures. To treat this, a rational theory of EMI scattering from widespread metallic clutter is formulated and tested. For dense, well-distributed clutter, analytical rules are derived for dependence of signal strength on sensor elevation, under various fundamental excitation types. For more erratic, sparse clutter distributions, signal statistics from Monte Carlo simulations show patterns like those from the analytical rules. The dependence of clutter signal magnitude on antenna elevation is determined for both thin surface layers and for volume layers of widespread small items, and for both dense and sparse clutter distributions. These are contrasted with the patterns expected from single, larger, discrete objects of interest, and the contrast is exploited in discrimination exercises for the screening problem. For sparse clutter distributions, results from inversion processing formulations that account for the patterns of clutter statistics are compared to simple least squares treatments. [J2435]

"Resonance analysis of a circular dipole array antenna in cylindrically layered media for directional borehole radar"

In this paper, we discuss the influence of a resonance on estimating direction of arrival (DOA) with a circular dipole array in a borehole (CAB). The resonance is caused by the phase-sequence of currents on the dipole antennas. Making use of method of moments (MoM) analysis, we predict resonant frequencies of the CAB and describe a mechanism for the resonance theoretically, making use of the fact that a plane wave can be broken down into cylindrical harmonics. In order to examine the agreement between the MoM and experimental data, we propose a signal processing method to extract phase-sequence components from the actual received array signal. This method is useful for confirming excitation of the phase-sequence resonance in experimental data, as predicted by the MoM. Using the MoM, we examine the influence of the resonances on DOA estimation, and we conclude that the resonances give some spurious solutions. In order to confirm these results, we conduct experiments at a field test site. We arrange the CAB, which consisted of seven receiving dipole antennas. In this experiment, a plane wave is incident on the CAB from a transmitter in another borehole. We apply the proposed signal method, and the measured results demonstrate the existence of the phase-sequence resonance in a physically real CAB. The spurious solutions found to occur in the DOA estimation at the resonant frequencies are also found experimentally. [J2436]

"Dictionary-based stochastic expectation-maximization for SAR amplitude probability density function estimation"

In remotely sensed data analysis, a crucial problem is represented by the need to develop accurate models for the statistics of the pixel intensities. This paper deals with the problem of probability density function (pdf) estimation in the context of synthetic aperture radar (SAR) amplitude data analysis. Several theoretical and heuristic models for the pdfs of SAR data have been proposed in the literature, which have been proved to be effective for different land-cover typologies, thus making the choice of a single optimal parametric pdf a hard task, especially when dealing with heterogeneous SAR data. In this paper, an innovative estimation algorithm is described, which faces such a problem by adopting a finite mixture model for the amplitude pdf, with mixture components belonging to a given dictionary of SAR-specific pdfs. The proposed method automatically integrates the procedures of selection of the optimal model for each component, of parameter estimation, and of optimization of the number of components by combining the stochastic expectation-maximization iterative

methodology with the recently developed "method-of-log-cumulants" for parametric pdf estimation in the case of nonnegative random variables. Experimental results on several real SAR images are reported, showing that the proposed method accurately models the statistics of SAR amplitude data. [J2437]

"Range resolution improvement of airborne SAR images"

This letter proposes an algorithm to improve the range resolution in airborne synthetic aperture radar (SAR) data by coherently combining an interferometric image pair, i.e., two images acquired with slightly different viewing angles. This algorithm is based on the wavenumber shift principle. In contrast to other methods, developed for application to spaceborne SAR data, the proposed algorithm takes the nonlinear effects due the strong variations in incidence angle in airborne SAR data into account. The proposed method is applied to SAR data of German Aerospace Center (DLR)'s E-SAR sensor. Quantitative verification results are obtained by measuring the resolution of several corner reflectors placed in the area under study, as well as the resolution of speckle of different areas. It is demonstrated that a resolution improvement of almost a factor of two can be achieved by incorporating a second interferometric image, which can be acquired easily with an airborne sensor. [J2438]

"Modified range-Doppler processing for FM-CW synthetic aperture radar"

The combination of compact frequency-modulated continuous-wave (FM-CW) technology and high-resolution synthetic aperture radar (SAR) processing techniques should pave the way for the development of a lightweight, cost-effective, high-resolution, airborne imaging radar. Regarding FM-CW SAR signal processing, the motion during the transmission of a sweep and the reception of the corresponding echo were expected to be one of the major problems. In FM-CW SAR, the so-called stop-and-go approximation is no longer valid due to the relatively long sweeps that FM-CW radars transmit. The main effect of the continuous motion is a Doppler frequency shift throughout the SAR observation time. This Doppler frequency shift can be compensated for by modifying the range migration compensation. [J2439]

"The autocorrelation of waveforms generated from ocean-scattered GPS signals"

A "waveform" is generated by cross-correlating local copies of a global positioning system (GPS) signal with an ocean-reflected GPS signal, over a range of carrier frequencies and code delays. The shape of this waveform can be inverted to obtain estimates of the ocean surface roughness. To assess the accuracy of these retrievals, a stochastic model for the waveform time series measurements was developed in a previous publication. In this letter, this model is validated by comparing the predicted autocorrelation function of the waveform against the autocorrelation computed from experimental waveforms collected from an airborne receiver. A 1-ms coherent integration time was used at first. Then, blocks of these measurements were concatenated to produce equivalent integration times of up to 5 ms to compare the dependence of model predictions on integration time. Correlation time was estimated by fitting a model Gaussian function to the magnitude or the real part of the autocorrelation function. The magnitude and phase of the complex autocorrelation function from the model were also studied to show the location of the first, and better explain cases in which the Gaussian function did not fit well. The autocorrelation is found to be weakly dependent upon the surface roughness, over a range of moderate wind speeds. [J2440]

"Refined estimation of time-varying baseline errors in airborne SAR interferometry"

The processing of airborne synthetic aperture radar (SAR) data requires a precise compensation of the deviations of the platform movement from a straight line. This is usually carried out by recording the trajectory with a high-precision navigation system and correcting them during SAR focusing. However, due to the lack of accuracy in current navigation systems, residual motion errors persist in the images. Such residual motion errors are mainly noticeable in repeat-pass systems, where they are causing time-varying baseline errors, visible as artefacts in the derived phase maps. In this letter, a refined method for the estimation of time-varying baseline errors is presented. An improved multisquint processing approach is used for obtaining robust estimates of higher order baseline errors over the entire scene, even if parts of the scene are heavily decorrelated. In a subsequent step, the proposed method incorporates an external digital elevation model for detection of linear and constant components of the baseline error along azimuth. Calibration targets in the scene are not necessary. [J2441]

"Varying complexity in tree-structured image distribution models"

Probabilistic models of image statistics underlie many approaches in image analysis and processing. An important class of such models have variables whose dependency graph is a tree. If the hidden variables take values on a finite set, most computations with the model can be performed exactly, including the likelihood calculation, training with the EM algorithm, etc. Crouse et al. developed one such model, the hidden Markov tree

(HMT). They took particular care to limit the complexity of their model. We argue that it is beneficial to allow more complex tree-structured models, describe the use of information theoretic penalties to choose the model complexity, and present experimental results to support these proposals. For these experiments, we use what we call the hierarchical image probability (HIP) model. The differences between the HIP and the HMT models include the use of multivariate Gaussians to model the distributions of local vectors of wavelet coefficients and the use of different numbers of hidden states at each resolution. We demonstrate the broad utility of image distributions by applying the HIP model to classification, synthesis, and compression, across a variety of image types, namely, electrooptical, synthetic aperture radar, and mammograms (digitized X-rays). In all cases, we compare with the HMT. [J2442]

"Backscatter change on fire scars in Siberian boreal forests in ENVISAT ASAR wide-swath images"

The objective of this letter was to investigate the performance of the C-band Advanced Synthetic Aperture Radar (ASAR) instrument onboard the European ENVISAT satellite for mapping fire scars in boreal forest ecosystems. The Wide Swath Mode (WSM) of the cloud and haze-penetrating ASAR instrument with a spatial resolution of 150 m would be ideal to support nearly real-time fire monitoring and impact assessment over the vast and sparsely populated circumpolar forest belt. We found that: (1) the ASAR WSM backscatter signal was sensitive to fire disturbance; (2) the backscatter change correlated mainly with snow-melt and rainfall; and (3) the backscatter varied as a function of the incidence angle with a higher backscatter occurring at shallower incidence angles. The results suggest ASAR WSM data could be used to support operational fire impact monitoring in boreal forests of Siberia. Multitemporal datasets are required because environmental conditions strongly influence the backscatter signal. [J2443]

"The maximum phase error of a reflected signal in an active coded transponder"

This letter is devoted to investigate the active coded transponder (ACT), which is designed to add a phase shifter to an active transponder (AT). Since a phase shifting error of a phase shifter is inevitable, there is additional phase error in reflected signal from ACT to synthetic aperture radar (SAR). This letter presents the theoretical study of the phase error of reflected signal. A method is proposed to determine the maximum phase error of the reflected signal. Moreover, images of ACT with different maximum phase errors are simulated. Peak-value and integral methods are used also to evaluate the accuracy of SAR radiometric calibration. [J2444]

"Special Issue on subsurface sensing using Ground Penetrating Radar (GPR)"

{no data available} [J2445]

"Postflood damage evaluation using Landsat TM and ETM+ data integrated with DEM"

In recent decades, radar and optical satellite imagery have been used for evaluating flooding extent. In this paper, a straightforward technique based on the sequential use of the spectral-temporal principal component analysis, logical filtering, and image segmentation integrated with the digital elevation model was developed as a decisional support tool for the allocations of the resource destined for the flooded areas. The mapping technique was first applied to the catastrophic event that occurred in the Piemonte Region (Italy) in November 1994, which was the worst event of the past century for that region, with 44 casualities and over 2000 homeless. Next, it was applied to the Obion/Forked Deer inundation that occurred in Tennessee (U.S.) between November and December 2001, in which heavy damage to the infrastructure was reported. Two Landsat-5 Thematic Mapper (path 194, row 28/29) and two Landsat-7 Enhanced Thematic Mapper Plus (path 23, row 35) images were processed, two of them collected before and two after the events. The method proposed proved to be an effective approach for evaluating flood extent and for assessing the damage produced by the flooding. An overall accuracy of 85.6%, a user accuracy of 87.5%, and a producer accuracy of 97.5% were achieved, and an agreement of 83% between ground measures and remotely sensed data in the estimation of flood water volumes was also achieved on a regional scale. [J2446]

"Signal subspace change detection in averaged multilook SAR imagery"

This paper addresses change detection in averaged multilook synthetic aperture radar (SAR) imagery. Averaged multilook SAR images are preferable to full-aperture SAR reconstructions when the imaging algorithm is approximation-based (e.g., polar format processing) or when motion data are not accurate over a long full aperture. We examine the application of a SAR change-detection method, known as signal subspace processing, which is based on the principles of two-dimensional adaptive filtering, and we use it to recognize the addition of surface landmines to a particular area under surveillance. We describe the change-detection problem as a trinary hypothesis testing problem, and define a change signal and its normalized version to determine whether: 1) there is no change in the imaged scene; 2) a target has entered the imaged scene; or 3) a target has exited

the imaged scene. A statistical analysis of the error signal is provided to show its properties and merits. Results are presented for averaged noncoherent multilook and coherent single-look X-band SAR imagery. [J2447]

"Optical multibeamforming network based on WDM and dispersion fiber in receive mode"

We present and experimentally demonstrate an optical beamformer for the receive mode based on optical summation and dispersive fiber. This architecture allows a high number of simultaneous beams without multiplying the number of active elements. The incoherent optical summation based on wavelength division multiplexing is analyzed in term of RF dynamic range and validated by experiments [J2448]

"A locally adaptive filter of interferometric phase images"

We propose an adaptive filtering approach for interferograms, which is a modification to the Lee adaptive complex filter. Based on local frequency estimates, we compute the normal orientation of local phase fringes. A directionally dependent filtering window is aligned perpendicular to the normal orientation of local phase fringes (i.e., along local phase fringes) by interpolation, making the pixels included in the filtering window have approximately more homogeneous values. Moreover, the computation of the filter parameter does not require local phase unwrapping in the real plane. This filter minimizes the loss of signal and reduces the level of noise. By using two sets of simulated data, its effectiveness can be seen in terms of the fidelity to noise-free phases, fringe preservation, and residue reduction. [J2449]

"Inversion of a lidar waveform model for forest biophysical parameter estimation"

Due to its measurement principle, light detection and ranging (lidar) is particularly suited to estimate the horizontal as well as vertical distribution of forest structure. Quantification and characterization of forest structure is important for the understanding of the forest ecosystem functioning and, moreover, will help to assess carbon sequestration within forests. The relationship between the signal recorded by a lidar system and the canopy structure of a forest can be accurately characterized by physically based radiative transfer models (RTMs). A three-dimensional RTM is capable of representing the complex forest canopy structure as well as the involved physical processes of the lidar pulse interactions with the vegetation. Consequently, the inversion of such an RTM presents a novel concept to retrieve biophysical forest parameters that exploits the full lidar signal and underlying physical processes. A synthetic dataset and data acquired in the Swiss National Park (SNP) successfully demonstrated the feasibility and the potential of RTM inversion to retrieve forest structure from large-footprint lidar waveform data. The SNP lidar data consist of waveforms generated from the aggregation of small-footprint lidar returns. Derived forest biophysical parameters, such as fractional cover, leaf area index, maximum tree height, and the vertical crown extension, were able to describe the horizontal and vertical forest canopy structure. [J2450]

"Feature extraction and connectionist classification of SODAR echograms"

Sonic detection and ranging (SODAR) systems are efficient and economical tool to probe the lower planetary boundary layer on a continuous basis. The lower atmospheric patterns (each depicting a different atmospheric condition) recorded by this system can prove to be extremely useful if classified and interpreted correctly. The manual identification of these SODAR patterns is a laborious task and requires considerable expertise. A connectionist system has already been developed by the authors to automate the process to some extent. In this letter, we enhance its generalization of performance, by incorporating feature extraction using the fast Fourier transform. The results are compared with that in earlier work to demonstrate its effectiveness. [J2451]

"Design and demonstration of an optical true-time-delay device based on an octic-style white cell"

A methodology for designing an octic-style optical true-time-delay (TTD) device based on the White cell (WC) is investigated. The octic cell is a "polynomial" cell, one of the two classes of TTD White cells. This octic cell is designed to produce a maximum of 6399 delays in 17 bounces, with a unit delay of 3 ps. Glass blocks are used for short delays, white lens trains are used for the longer delays. The octic cell is designed to use a microelectromechanical tip/tilt micromirror array to direct light beams into various delay paths. [J2452]

"Distance measurement sensor with PIN-photodiode and bridge circuit"

The presented integrated optical distance measurement sensor works on the time-of-flight principle. The distance information is obtained from the correlation of received light and the transmitted signal. The PIN-bridge circuit concept ensures suppression of background light by equally charging and discharging the capacitor within one period, while integrating the wanted signal. The advantages of the included PIN-photodiode are high bandwidth f3 dB>1.35 GHz together with high responsivity R=0.36 A/W at 660 nm. A single distance

measurement is performed in 2 ms. With averaging, an accuracy of better than 1% is achieved for distances up to 3.7 m. Effective pixel size is 250Ч200 µm2having a fill-factor of 16%. The sensor was manufactured in a 0.6-µm BiCMOS process. [J2453]

"CFAR detection of extended and multiple point-like targets without assignment of secondary data"

We design and assess adaptive schemes to detect extended and multiple point-like targets embedded in correlated Gaussian noise. Proposed algorithms rely on either the generalized likelihood ratio test (GLRT) or ad hoc procedures. Such detectors make it possible to get rid of distinct secondary data and guarantee the constant false alarm rate (CFAR) property with respect to the covariance matrix of the disturbance. A preliminary performance assessment, conducted by resorting to simulated data, also in comparison to the so-called modified GLRT (MGLRT) proposed in, has shown that newly introduced CFAR detectors may represent a viable means to deal with uncertain scenarios. [J2454]

"Prediction of inverse covariance matrix (PICM) sequences for STAP"

In this letter, we study issues associated with applying least-squares estimation to predict the inverse covariance matrix in bistatic airborne radar systems. For the bistatic ground moving target indication radar, the clutter Doppler frequency depends on the range for all array geometries. This range dependency leads to problems in clutter suppression through space-time adaptive processing (STAP) techniques. This paper proposes a new method of obtaining an estimate of the inverse covariance matrix using linear prediction techniques. Simulation results show a significant improvement in processor performance as compared to conventional STAP methods. [J2455]

"Demining sensor modeling and feature-level fusion by Bayesian networks"

A method for obtaining the Bayesian network (BN) representation of a sensor's measurement process is developed so that the problems of sensor fusion and management can be approached from a unified point of view. Uncertainty, reliability, and causal information embedded in the sensor data are used to build the BN model of a sensor. The method is applied to model ground-penetrating radar, electromagnetic induction, and infrared sensors for humanitarian demining. Structural and parameter learning algorithms are employed to encode relationships among mine features, sensor measurements, and environmental conditions in the BN model. Inference is used to estimate target features in the presence of heterogeneous soil and varying environmental conditions. A multisensor fusion technique operating on BN models is developed to exploit the complementarity of the sensor measurements. Through the same approach, a BN classifier is obtained to estimate the target typology. The BN models and classifier also compute so-called confidence levels that quantify the uncertainty associated with the feature estimates and the classification decisions. The effectiveness of the approach is demonstrated by implementing these BN tools for the detection and classification of metal and plastic landmines that are characterized by different shape, size, depth, and metal content. Through BN fusion, the accuracy of the feature estimates is improved by up to 64% with respect to single-sensor measurements, and the number of objects that are both detected and classified is increased by up to 62%. [J2456]

"Detecting and characterising returns in a pulsed ladar system"

A new multi-spectral laser radar (ladar) system based on the time-correlated single photon counting, time-of-flight technique has been designed to detect and characterise distributed targets at ranges of several kilometres. The system uses six separated laser channels in the visible and near infrared part of the electromagnetic spectrum. The authors present a method to detect the numbers, positions, heights and shape parameters of returns from this system, used for range profiling and target classification. The algorithm has two principal stages: non-parametric bump hunting based on an analysis of the smoothed derivatives of the photon count histogram in scale space, and maximum likelihood estimation using Poisson statistics. The approach is demonstrated on simulated and real data from a multi-spectral ladar system, showing that the return parameters can be estimated to a high degree of accuracy. [J2457]

"The use of the fractional Fourier transform with coded excitation in ultrasound imaging"

Medical ultrasound systems are limited by a tradeoff between axial resolution and the maximum imaging depth which may be achieved. The technique of coded excitation has been used extensively in the field of RADAR and SONAR for some time, but has only relatively recently been exploited in the area of medical ultrasound. This technique is attractive because allows the relationship between the pulse length and the maximum achievable spatial resolution to be changed. The work presented here explores the possibility of using the fractional Fourier transform as an effective means for the processing of signals received after the transmission of linear frequency modulated chirps. Results are presented which demonstrate that this technique is able to offer spatial resolutions

similar to those obtained with a single cycle duration signal. [J2458]

"Motion measurement errors and autofocus in bistatic SAR"

This paper discusses the effect of motion measurement errors (MMEs) on measured bistatic synthetic aperture radar (SAR) phase history data that has been motion compensated to the scene origin. We characterize the effect of low-frequency MMEs on bistatic SAR images, and, based on this characterization, we derive limits on the allowable MMEs to be used as system specifications. Finally, we demonstrate that proper orientation of a bistatic SAR image during the image formation process allows application of monostatic SAR autofocus algorithms in postprocessing to mitigate image defocus. [J2459]

"New approach for target locations in the presence of wall ambiguities"

A technique for target location estimation in through-the-wall radar imaging applications is presented. The algorithm corrects for the shifts in target positions due to ambiguities in the wall thickness and dielectric constant. We consider uniform walls and perform imaging using wideband beamforming, with the antennas placed against the wall. Behind-the-wall images are obtained using different structures of transmit and receive arrays. For each array structure, a trajectory of the shifts in the target locations is generated assuming different wall parameters. The target position is estimated as the intersection of the corresponding trajectories. The paper shows that for unknown wall thickness or dielectric constant, the point of intersection is the true target position. In the case when both parameters are unknown, the estimated target location is in close proximity to the target true position. It is demonstrated that the performance of the proposed technique is rather insensitive to the target location behind the wall and to various array structures. [J2460]

"Tracker and signal processing for the benchmark problem with unresolved targets"

Radar signal processing is particularly important in tracking closely spaced targets and targets in the presence of sea-surface-induced multipath. Closely spaced targets can produce unresolved measurements when they occupy the same range cell of the radar. These issues are the salient features of the benchmark problem for tracking unresolved targets combined with radar management, for which this paper presents the only complete solution to date. In this paper a modified version of a recently developed maximum likelihood (ML) angle estimator, which can produce two measurements from a single (unresolved) detection, is presented. A modified generalized likelihood ratio test (GLRT) is also described to detect the presence of two unresolved targets. Sea-surface-induced multipath can produce a severe bias in the elevation angle measurement when the conventional monopulse ratio angle extractor method is used. A modified version of a recently developed ML angle extractor, which produces nearly unbiased elevation angle measurements and significantly improves the track accuracy, is presented. Efficient radar resource allocation algorithms for two closely spaced targets and targets flying close to the sea surface are also presented. Finally, the IMMPDAF (interacting multiple model estimator with probabilistic data association filter modules) is used to track these targets. It is found that a two-model IMMPDAF performs better than the three-model version used in the previous benchmark. Also, the IMMPDAF with a coordinated turn model works better than the one using a Wiener process acceleration model. The signal processing and tracking algorithms presented here, operating in a feedback manner, form a comprehensive solution to the most realistic tracking and radar management problem to date. [J2461]

"Two-valued frequency-coded waveforms with favorable periodic autocorrelation"

There are known phase-coded (two-valued or polyphase) CW radar signals that exhibit perfect periodic autocorrelation function (PACF). A PACF is perfect when all its out-of-phase autocorrelation values are identically equal to zero. This paper investigates periodic, two-valued, frequency-coded signals. While none could be found with perfect PACF, we present examples with nearly perfect PACF. Their relationship to binary phase-coded signals is also considered. These signals should be attractive for CW radars because of their simple implementation, clean spectrum, and the favorable range response of their matched receiver. [J2462]

"Relative entropy and the multivariable multidimensional moment problem"

Entropy-like functionals on operator algebras have been studied since the pioneering work of von Neumann, Umegaki, Lindblad, and Lieb. The best known are the von Neumann entropy |(rho):=-trace(rhologrho) and a generalization of the Kullback- Leibler distance S(rhoparsigma):=trace(rhologrho-rhologsigma), referred to as quantum relative entropy and used to quantify distance between states of a quantum system. The purpose of this paper is to explore | and S as regularizing functionals in seeking solutions to multivariable and multidimensional moment problems. It will be shown that extrema can be effectively constructed via a suitable homotopy. The homotopy approach leads naturally to a further generalization and a description of all the solutions to such moment problems. This is accomplished by a renormalization of a Riemannian metric induced by entropy

functionals. As an application, we discuss the inverse problem of describing power spectra which are consistent with second-order statistics, which has been the main motivation behind the present work [J2463]

"Image feature-based space-time processing for ground moving target detection"

An image feature-based space time processing (IFSTP) algorithm is introduced to effectively detect ground moving targets in clutter and jamming via airborne radar. This new approach exploits the distinct image features of targets and interference signals in the angle-Doppler domain. An image segmentation algorithm, referred to as region growing, extracts targets and interference features in the angle-Doppler domain, and an innovative block-size detection algorithm discriminates between moving targets and interference based on the extracted image features. The proposed IFSTP algorithm is particularly suitable for detecting ground moving targets in highly nonhomogeneous clutter environments, without any requirement for clutter covariance estimation. [J2464]

"Electromagnetic reverberation at VHF on wires in uncased water-filled boreholes"

Guided electromagnetic wave pulses were excited on long, thin conducting wires in water-filled, uncased boreholes by a VHF monostatic borehole radar. Reverberations were recorded at the excitation point. Spectral warping focused the dispersed echoes in space-time. Echo patterns are correlated with geological and geotechnical structures, e.g. bedding plane intersections. [J2465]

"Minimum norm property for the sum of the adaptive weights for a direct data domain least squares algorithm"

In most adaptive algorithms, it is generally assumed that one knows the direction of arrival (DOA) of the signal of interest (SOI) through the steering vector of the array and the goal is to estimate its complex amplitude in the presence of jammer, clutter and noise. In space-time adaptive processing (STAP) the goal is to seek for a target located along a certain look direction and at a particular Doppler frequency through a given steering vector. Therefore, the accuracy of the computed results in either case is based on the reliability of this a priori assumption of the steering vector. It is possible that due to mechanical vibrations, calibration errors or atmospheric refractions of the incident electromagnetic waves, the assumed DOA may not be very accurate or that the assumed value of the Doppler frequency is not appropriate. In either of these cases, the adaptive algorithm treats the SOI as an interferer and nulls it out. This perennial problem of signal cancellation is an open problem for adaptive algorithms. In this paper It is shown that the proper steering vector occurs at the minimum of the sum of the norm of the adaptive weights and can be used as an indicator to refine the estimate of the DOA of the SOI in adaptive algorithms or both the DOA or/and the Doppler frequency in STAP. Examples are presented to illustrate that the secondary processing outlined in this paper, may provide a refined estimate for the true DOA or/and Doppler frequency for the SOI in the presence of interference, clutter and noise [J2466]

"Foreword to the Special Issue on the Retrieval of Bio- and Geophysical Parameters from SAR Data for Land Applications"

{no data available} [J2467]

"Forest height retrieval from commercial X-band SAR products"

This paper assesses the accuracy and reliability of tree height retrieval over coniferous plantations using X-band interferometry. Factors such as crown shape, density, tree height, incidence angle, and slope have been assessed and quantified using a simple polarimetric radar interferometry simulator to determine their impact on height retrieval. Results from model simulation show that the most important factors are: crown shape, plantation density, and tree height. Variation in viewing angle and small slopes ([J2468]

"Capabilities of a forest coherent scattering model applied to radiometry, interferometry, and polarimetry at P- and L-band"

The interpretation of radar data would ideally require extensive and numerous observations. However, the number of observations is limited by the difficulty and the cost of acquiring ground truth and radar data. On the other hand, numerical models can provide a wide range of situations, both in inputs and in outputs. More precisely, they have to provide radiometric, polarimetric, and interferometric simulations and be applicable to various forested areas (high density, high/low moisture, inhomogeneous area, etc.) and radar configurations (low/high frequency, bistatic observation, etc.). This paper is dedicated to the presentation of the capabilities of a descriptive coherent scattering model (COSMO) applied to the electromagnetic study of the backscattering by forested areas. Improvements have been implemented in order to produce in output a radar image, which can be treated with the same polarimetric and interferometric tools as those applied to real synthetic aperture radar

images. Thus, comparisons are possible. COSMO has been widely tested from P- to L- bands, over temperate and tropical forests and applied to radiometry, polarimetry, and interferometry. It appears finally as an efficient simulating tool to carry out parametric studies and to analyze how the total scattered field is built from canonical mechanisms and individual scatterer contributions. [J2469]

"A coherent model of forest scattering and SAR imaging in the VHF and UHF-band"

We present a coherent scattering model to determine the forest response to an illuminating plane wave in the frequency band 20-300 MHz. In this frequency band, at low frequencies, it is well-known that the waves penetrate the canopy and allow the detection of a hidden target. We have developed a model based on a domain integral representation of the electric field. A decoupling hypothesis is stated and validated, allowing to significantly reduce the numerical complexity of the problem inherent to integral representations. The simulated scattered field is used in a standard synthetic aperture radar (SAR) imaging algorithm to build horizontal and vertical SAR images of a set of trunks and a concealed target. [J2470]

"Predicting backscatter-biomass and height-biomass trends using a macroecology model"

This study describes the use of a plant structure model from the field of macroecology to make generalized predictions about backscatter-biomass and height-biomass trends from synthetic aperture radar data over forests. A theoretical relationship between canopy height and biomass density is derived. The predicted values of the height exponent are comparable with those from the remote sensing literature. A radiative transfer model parameterized by the macroecology model is also used to predict trends in P-band backscatter. The results imply that backscatter can saturate even for low-opacity canopies and decreasing basal area results in backscatter saturating at lower biomass levels. The theoretical analysis is supported by reference to a range of published results. [J2471]

"Using a priori information to improve soil moisture retrieval from ENVISAT ASAR AP data in semiarid regions"

This paper presents a retrieval algorithm that estimates spatial and temporal distribution of volumetric soil moisture content, at an approximate depth of 5 cm, using multitemporal ENVISAT Advanced Synthetic Aperture Radar (ASAR) alternating polarization images, acquired at low incidence angles (i.e., from 15° to 31°). The algorithm appropriately assimilates a priori information on soil moisture content and surface roughness in order to constrain the inversion of theoretical direct models, such as the integral equation method model and the geometric optics model. The a priori information on soil moisture content is obtained through simple lumped water balance models, whereas that on soil roughness is derived by means of an empirical approach. To update prior estimates of surface parameters, when no reliable a priori information is available, a technique based solely on the use of multitemporal SAR information is proposed. The developed retrieval algorithm is assessed on the Matera site (Italy) where multitemporal ground and ASAR data were simultaneously acquired in 2003. Simulated and experimental results indicate the possibility of attaining an accuracy of approximately 5% in the retrieved volumetric soil moisture content, provided that sufficiently accurate a priori information on surface parameters (i.e., within 20% of their whole variability range) is available. As an example, multitemporal soil moisture maps at watershed scale, characterized by a spatial resolution of approximately 150 m, are derived and illustrated in the paper. [J2472]

"Derivation of surface soil moisture from ENVISAT ASAR wide swath and image mode data in agricultural areas"

Water and energy fluxes at the interface between the land surface and atmosphere are strongly dependent on surface soil moisture content, which is highly variable in space and time. It has been shown in numerous studies that microwave remote sensing can provide spatially distributed patterns of surface soil moisture. In order to use remote-sensing-derived soil moisture information for practical applications as, for example, flood forecasting and water balance modeling in mesoscale areas, frequent large-area coverage is a prerequisite. New sensor generations such as ENVISAT Advanced Synthetic Aperture Radar (ASAR) or RADARSAT allow for image acquisitions in different imaging modes and geometries. Imaging modes with the capability of large-area coverage, such as the Wide Swath Mode of ENVISAT ASAR, are of special interest for practical applications in this context. This paper presents a semiempirical soil moisture inversion scheme for ENVISAT ASAR data. Different land cover types as well as mixed-image pixels are taken into account in the soil moisture retrieval process. The inversion results are validated against in situ measurements, and a sensitivity analysis of the model is conducted. [J2473]

"Parameterization of tillage-induced single-scale soil roughness from 4-m profiles"

Soil roughness greatly affects the scattering process of microwaves to the soil surface. Previous studies showed that the values of roughness parameters increase asymptotically with increasing profile length. In this paper, 25-m profiles are used to study the influence of profile length on the roughness parameters and on the shape of the autocorrelation function. It is further investigated whether correct soil roughness parameters, as obtained from long surface roughness profiles, can be determined from 4-m-long profiles. Therefore, the extrapolation of an empirical relationship between roughness parameters and profile length is investigated, for three different roughness classes. The technique yields parameter values which are comparable to the 25-m roughness parameters. [J2474]

"Influence of geometrical factors on crop backscattering at C-band"

Several efforts, aimed at developing and refining crop backscattering models, have been done during the last years. Although important advances have been achieved, it is recognized that further work is required, both in the electromagnetic characterization of single scatterers and in the combination of contributions. This work is focused on the description of leaf geometry and of the internal structure of stems. Recently developed routines, able to model the scattering cross sections of curved sheets and hollow cylinders, are adopted for this purpose and run within the multiple-scattering model developed at the University of Rome "Tor Vergata". Input parameters are taken from experimental campaigns. In particular, ground data collected over a maize field at the Central Plain site in 1988, over wheat and maize fields at the Loamy site in 2003, and over wheat fields at the Matera site in 2001 and 2003 are considered. The multitemporal backscattering coefficients at C-band are simulated. The results obtained under different assumptions are compared to each other, and with C-band radar signatures collected over the same fields. The influence of some critical factors, affecting crop backscattering, is discussed. It is demonstrated that a more detailed scatterer characterization may improve the model accuracy, especially in the case of hollow stems. [J2475]

"Indoor C-band polarimetric interferometry observations of a mature wheat canopy"

We present results from experiments carried out in the ground-based synthetic aperture radar (GB-SAR) facility at the University of Sheffield to ascertain the role of polarimetric interferometry in crop height retrieval. To this end, a mature wheat canopy, grown in outdoor conditions, was reassembled inside the GB-SAR chamber and imaged at C-band using a two-dimensional scan. This allowed fully polarimetric tomography and interferometry. Interferometry using the VV, HH, and VH polarization states shows that the HH and VH interferograms retrieve a height close to the top of the soil layer for all angles of incidence considered, whereas the height retrieved from the VV interferogram increases with angle of incidence. The use of a Pauli basis gives poor results, due to the different location of the scattering phase centers in the VV and HH channels. The use of arbitrary polarization states shows that the top of the soil can be very accurately estimated using left-circular polarization, whereas, for angles of incidence close to 45°, a polarization state similar to VV can be used to retrieve the top of the canopy; hence crop height can be recovered as the difference of these two interferometric heights. Polarimetric coherence optimization techniques are also studied. Unconstrained coherence optimization gives very unstable results, due to the small number of available samples. Constrained optimization results in stable retrieved heights, and the retrieved polarization states agree well with the polarization synthesis results. [J2476]

"Indoor wide-band polarimetric measurements on maize plants: a study of the differential extinction coefficient"

A study of the wide-band polarimetric backscatter of maize plants, measured in laboratory conditions, is presented. The backscatter slant-range profiles in both linear (H-V) and Pauli basis manifest a higher extinction coefficient in the vertical channel due to the dominant vertical orientation of the structure of corn plants. The difference between the horizontal and vertical range profiles as the wave penetrates into the volume is employed to retrieve the differential extinction coefficient. In addition, the polarimetric target decomposition, as proposed by Cloude and Pottier, is used to obtain range profiles of alpha, entropy, and anisotropy. All these results reveal important features to be accounted for in the retrieval of the biophysical parameters of agricultural crops by means of polarimetric synthetic aperture radar interferometry. [J2477]

"C-band polarimetric indexes for maize monitoring based on a validated radiative transfer model"

This paper assess the possibilities of the synthetic aperture radar (SAR) sensors currently in orbit for the maize monitoring defining the configurations (polarization and incidence angles at C-band) maximizing the sensitivity to plant growth and reducing the impact of the soil moisture on the signal. Temporal evolution of the signal was simulated in all the possible configurations using the radiative transfer model developed by the University of Rome "Tor Vergata." The input parameters came from an intensive field campaign providing a detailed description of maize crop over the Belgian Loamy site all along the 2003 growing season. The model was

validated for vertical (VV) and horizontal (HH) polarization using ERS, ENVISAT, and RADARSAT observations. The C-band SAR signal in single polarization was found to be sensitive to crop growth till the leaf area index (LAI) reached 4.6 m2/m2, while the soil moisture influenced the signal for sparsely vegetated fields (LAI2/m2). Dual-polarizations indexes were found sensitive to maize growth and less sensitive to soil moisture variations. The VV/VH polarization ratios computed from signal recorded at high incidence angle (35° to 45°) could be considered to assess the crop growth till LAI reached 4.9 m2/m2with low sensitivity to soil moisture. At the beginning of growth, the emergence of maize plants could be detected using the copolarized ratio (VV/HH) computed at low incidence angle. These indexes allow discriminating various crop conditions at a given date between fields of a same region. [J2478]

"Environmental effects on the interferometric repeat-pass coherence of forests"

The variability of C-band one-day tandem coherence measurements of forest is analyzed both statistically and with the aid of a soil-vegetation-atmosphere transfer model coupled to models for dielectric, backscattering coefficient, and coherence. Coherence depends strongly on both moisture and wind conditions. The dependence between coherence and moisture fluctuations in the soil and canopy is simulated using a simplified coherence model neglecting canopy coherence; trends are similar to those observed in measured coherence, but the range of variability observed in the satellite data is underestimated. Improved consistency with the data is achieved by using empirical estimates of canopy coherence derived from mature forest, but still with underestimated variability. The canopy coherence values cannot be predicted from the environmental model, and anomalous observations prevent the formulation of a reliable empirical predictor based on weather data; this could potentially be improved if higher time resolution wind data were made available. The study also suggests that canopy dielectric can vary rapidly in daylight, and that current models for dielectric may be inadequate to capture the effect of this behavior on coherence. [J2479]

"A combined method to model microwave scattering from a forest medium"

A novel method, which employs both a matrix doubling algorithm and the first-order solution of a radiative transfer (RT) equation for modeling microwave backscattering from forest, is presented in the paper. The method is based on the assumption that a forest canopy can be divided into a number of distinct horizontal vegetation layers over a dielectric half-space rough surface. The scattering phase matrix of each layer is calculated by either matrix doubling to account for the multiple-scattering effect or first-order solution of an RT equation, depending on the scattering characteristics of the layer. The first-order solution of the RT equation is used for the trunk layer while the matrix doubling technique is applied to both the crown layer and understory. The advanced integral equation model and reflectivity matrix are used to calculate the noncoherent and coherent surface boundary conditions. Comparisons between model predictions and field measurements on radar backscattering coefficients for a walnut orchard showed a good agreement at both L-band and X-band and for all three polarizations. Comparative analyses of model predictions for backscattering from a forest medium calculated using the combined model, first-order RT model, and the standard matrix doubling model were also presented. Understory effects, that can significantly change the weight of each scattering mechanism, were also evaluated by using the combined method. [J2480]

"The efficiency of crop recognition on ENVISAT ASAR images in two growing seasons"

The aim of the presented project was to assess the efficiency of crop recognition based on microwave Advanced Synthetic Aperture Radar (ASAR) images acquired from ENVISAT-1. Investigations were conducted during two consecutive growing seasons, in 2003 and 2004. The agrometeorological conditions during the selected seasons differed markedly, which induced year-to-year variations regarding the relevant characteristics of crop canopy. Multitemporal series of ASAR alternating polarization images were used for crop differentiation. Classification was performed using a neural network classifier trained separately for each year. Field observations conducted in the western part of Poland supplied datasets for training, validation, and testing of the classifier. Despite some differences noted in the classifier performance on two datasets, the results obtained for 2003 and 2004 showed high mutual consistency. [J2481]

"Joint space-time interpolation for distorted linear and bistatic array geometries"

This paper presents a new joint space-time interpolation technique (STINT) to improve the small sample support performance of space-time adaptive processing (STAP) with distorted linear monostatic arrays and linear bistatic array configurations. Brennan's rule for the space-time clutter covariance matrix rank is extended to monostatic linear arrays with arbitrary intersensor spacing, distorted linear arrays and bistatic geometries. It is shown that both distortion in the array geometry and bistatic operation increase the clutter rank and cause the space-time clutter covariance matrix to become range dependent. This results in lower output signal-to-interference-plus-

noise ratio (SINR) for the same number of adaptive degrees of freedom and reduced available sample support. This motivates the development of the STINT technique aimed at compensating for the clutter rank inflation, while also making the clutter statistics appear more stationary across range. More specifically, a linear transformation is designed that maps the received clutter across space and time to that which would be received by a "virtual" monostatic side-looking ULA. By mapping the data to form a reduced rank clutter covariance matrix, fewer snapshots are needed for a statistically stable matrix inversion as required in STAP, thereby improving the short observation time performance. Simulation results for a typical airborne radar scenario indicate up to 10-dB SINR improvement can be obtained using STINT with limited sample support. [J2482]

"Spatial diversity in radars-models and detection performance"

Inspired by recent advances in multiple-input multiple-output (MIMO) communications, this proposal introduces the statistical MIMO radar concept. To the authors' knowledge, this is the first time that the statistical MIMO is being proposed for radar. The fundamental difference between statistical MIMO and other radar array systems is that the latter seek to maximize the coherent processing gain, while statistical MIMO radar capitalizes on the diversity of target scattering to improve radar performance. Coherent processing is made possible by highly correlated signals at the receiver array, whereas in statistical MIMO radar, the signals received by the array elements are uncorrelated. Radar targets generally consist of many small elemental scatterers that are fused by the radar waveform and the processing at the receiver, to result in echoes with fluctuating amplitude and phase. It is well known that in conventional radar, slow fluctuations of the target radar cross section (RCS) result in target fades that degrade radar performance. By spacing the antenna elements at the transmitter and at the receiver such that the target angular spread is manifested, the MIMO radar can exploit the spatial diversity of target scatterers opening the way to a variety of new techniques that can improve radar performance. This paper focuses on the application of the target spatial diversity to improve detection performance. The optimal detector in the Neyman-Pearson sense is developed and analyzed for the statistical MIMO radar. It is shown that the optimal detector consists of noncoherent processing of the receiver sensors' outputs and that for cases of practical interest, detection performance is superior to that obtained through coherent processing. An optimal detector invariant to the signal and noise levels is also developed and analyzed. In this case as well, statistical MIMO radar provides great improvements over other types of array radars. [J2483]

"Special issue on subsurface sensing using ground penetrating radar (GPR)"

{no data available} [J2484]

"Experimental trials on ionospheric clutter suppression for high-frequency surface wave radar"

The unwanted radar echoes from the ionosphere are collectively called ionospheric clutter. This has proved to be the greatest impediment to achieving consistently good performance in long-range sea state monitoring for high-frequency surface wave radar (HFSWR). Ionospheric clutter can mask sea echoes having similar Doppler shifts. The potential for exploiting some fundamental characteristics of ionospheric clutter in directivity and frequency to suppress it is assessed. A post-Doppler spatial adaptive processing algorithm (PD-SAP) and the dual-frequency operation mode are introduced to suppress directional and non-directional ionospheric clutter, respectively. Experimental results confirm that both of these techniques can achieve effective ionospheric clutter suppression using the field experimental data recorded by the HFSWR OSMAR2003 (Ocean State Monitor and Analysis Radar, manufactured in 2003), located near Zhoushan in Zhejiang, China. [J2485]

"Reduced complexity acquisition of GPS signals for software embedded applications"

Location technologies have many possible applications in wireless communications, surveillance, military equipment, gaming industry, tracking and safety applications to name a few. Wireless operators expect annual revenues to be tens of billions from potential location-based services. The paper focuses on the positioning in cellular wireless networks using Assisted Global Positioning System (A-GPS) technology. State-of-the-art A-GPS receivers are implemented using hardware correlators, as the computational complexity is very high. Positioning receivers are operated in many operational modes depending on the environment, provided assistance, internally available data and measurements. Hardware implementations constrain the performance of A-GPS receivers and as a result their operation is not robust indoors and in urban canyons. Highly reconfigurable receivers can accommodate all the possible modes of operation, and receivers implemented in 'software' are the most promising and flexible ones. To implement A-GPS receivers in 'software', one should drastically reduce the complexity of algorithms. The authors suggest a novel fast Fourier transform (FFT)-based correlator which is good for software implementations. As the focus is on A-GPS, the assistance information from aiding sources reduces the operational range of the correlator and this approach combines gains due to FFT processing and aiding. The complexity is further reduced by employing a search in frequency in FFT

domain which is called the shifting replica method. Extensive simulations on several platforms confirm the validity of the proposed method. [J2486]

"Harmonic array design: technique for efficient non-periodic array optimisation in digital sonar beamforming"

A highly constrained iterative technique for the optimisation of non-periodic, (random and sparse) array geometries is presented. This approach involves establishing a set of array configurations which seek to minimise the peak sidelobe level of the array beampattern. The technique, harmonic array design, quickly produces a constrained set of near-optimal array solutions which can then be tried and tested. This is seen as an alternative to intensive computational search algorithms. Results of simulations for ten element linear non-periodic arrays are presented and their performance compared with equivalent periodic arrays. Such non-periodic arrays have the potential to offer improved angular resolution at a lower cost than periodic designs and have applications in all forms of acoustic and electromagnetic imaging. Here, the particular application of digital sonar beamforming is considered. [J2487]

"Adaptive polarisation-space-time domain radar target detection in inhomogeneous clutter environments"

The polarisation-space-time processing technique performs significantly better than the space-time processing technique, as it makes use of the polarisation information as well as the angle and Doppler information of radar returns when the secondary data set is large enough to overcome the detection loss. However, considering the degree of freedom of the polarisation-space-time processor, it is rarely possible to obtain such a large set of secondary data vectors, especially in an airborne radar target detection where clutter is inhomogeneous and/or non-stationary. Here, two adaptive polarisation-space-time localised processors, which are of significant use in limited secondary data environments, are developed by efficiently combining the space-time localised processor and the polarisation processor. The authors first analyse the performance potential of the polarisation-space-time processors with different configurations because selecting a processor configuration is a critical issue that should be solved prior to developing adaptive algorithms. The detection performance of the adaptive processors developed by considering the performance potential is then derived analytically in terms of the probabilities of detection and false alarm, and a performance comparison is made for limited secondary data environments. [J2488]

"Observations of tropical cyclone structure from WindSat"

Passive microwave (PMW) radiometric observations of clouds from multichannel imaging sensors onboard low Earth-orbiting environmental satellites are now a vital operational dataset. The first operational passive microwave sensor was the Special Sensor Microwave/Imager onboard the Defense Meteorological Satellite Program satellites, which has been gathering hydrological data records since 1987, and continued with the Tropical Rainfall Measuring Mission (TRMM) and the Advanced Microwave Scanning Radiometer onboard Aqua. These sensors view the underlying scene with an Earth incidence angle near 53° and with a variable azimuthal angle, depending upon the orbit direction and scan position. The WindSat sensor onboard the Coriolis satellite, launched in January 2003, is a five-channel polarimetric PMW radiometer designed to optimize ocean surface wind vector retrievals. While it does not have 85-GHz channels, an added feature is its unique fore-aft viewing capability across a portion of its fore scan swath. This provides a view of the underlying scene from two separate azimuthal directions, which provides added information on the three-dimensional (3-D) structure of clouds and their evolution. In this paper, we compare WindSat and TRMM Precipiation Radar observations of tropical cyclones (TCs) with Monte Carlo radiative transfer simulations performed on idealized 3-D convective cloud structures. The TC 3-D structure and possible tilt in the convective cloud structure are inferred from the difference between the 37-GHz equivalent blackbody brightness temperatures (TB) from the corresponding fore and aft view observations. The information gained from this analysis is important since asymmetries in the cloud vertical and horizontal structure may be an indication of upper level wind shear, which plays a major role in influencing changes of the TC intensity. [J2489]

"Exploiting nonacoustic sensors for speech encoding"

The intelligibility of speech transmitted through low-rate coders is severely degraded when high levels of acoustic noise are present in the acoustic environment. Recent advances in nonacoustic sensors, including microwave radar, skin vibration, and bone conduction sensors, provide the exciting possibility of both glottal excitation and, more generally, vocal tract measurements that are relatively immune to acoustic disturbances and can supplement the acoustic speech waveform. We are currently investigating methods of combining the output of these sensors for use in low-rate encoding according to their capability in representing specific speech

characteristics in different frequency bands. Nonacoustic sensors have the ability to reveal certain speech attributes lost in the noisy acoustic signal; for example, low-energy consonant voice bars, nasality, and glottalized excitation. By fusing nonacoustic low-frequency and pitch content with acoustic-microphone content, we have achieved significant intelligibility performance gains using the DRT across a variety of environments over the government standard 2400-bps MELPe coder. By fusing quantized high-band 4-to-8-kHz speech, requiring only an additional 116 bps, we obtain further DRT performance gains by exploiting the ear's insensitivity to fine spectral detail in this frequency region. [J2490]

"Impact-time-control guidance law for anti-ship missiles"

In this paper, a new guidance problem with the impact time constraint is investigated, which can be applied to salvo attack of anti-ship missiles. The closed form solution based on the linear formulation is derived, suggesting an additional loop for adjusting the impact time in addition to the traditional optimal guidance loop. This solution is a combination of the well-known PNG law and the feedback of the impact time error, which is the difference between the impact time by PNG and the prescribed impact time. The new guidance law called ITCG (Impact-Time-Control Guidance) can be used to guide multiple missiles to hit a stationary target simultaneously at a desirable impact time. Nonlinear simulation of several engagement situations demonstrates the performance and feasibility of ITCG. In addition, the similarity of the closed form solution and APNG is investigated and the switching rule for practical implementation is discussed. [J2491]

"Evaluation of hurricane ocean vector winds from WindSat"

The ability to accurately measure ocean surface wind vectors from space in all weather conditions is important in many scientific and operational usages. One highly desirable application of satellite-based wind vector retrievals is to provide realistic estimates of tropical cyclone intensity for hurricane monitoring. Historically, the extreme environmental conditions in tropical cyclones (TCs) have been a challenge to traditional space-based wind vector sensing provided by microwave scatterometers. With the advent of passive microwave polarimetry, an alternate tool for estimating surface wind conditions in the TC has become available. This paper evaluates the WindSat polarimetric radiometer's ability to accurately sense winds within TCs. Three anecdotal cases studies are presented from the 2003 Atlantic Hurricane season. Independent surface wind estimates from aircraft flights and other platforms are used to provide surface wind fields for comparison to WindSat retrievals. Results of a subjective comparison of wind flow patterns are presented as well as quantitative statistics for point location comparisons of wind speed and direction. [J2492]

"Improved slope estimation for SAR Doppler ambiguity resolution"

The idea of using the Radon transform to measure the alignment of linear features in synthetic aperture radar (SAR) data has breathed new life into the "look displacement" class of Doppler ambiguity resolution algorithms. In these algorithms, the slope of target energy is estimated to obtain the satellite beam pointing angle accurately enough to resolve the Doppler ambiguity. After explaining the method and adding some minor improvements, it is shown how it can work well on satellite SAR data. Then, an alternate method is developed that combines the ideas of the Radon and look displacement algorithms to obtain a computationally simpler and more accurate algorithm. In addition, the quality checks of the "spatial diversity" approach are used to increase the robustness of the algorithm. Even though the algorithm was conceived for high-contrast scenes, it works remarkably well in low to medium contrast scenes as well. [J2493]

"RFI detection and mitigation for microwave radiometry with an agile digital detector"

A new type of microwave radiometer detector has been developed that is capable of identifying high and low levels of radio-frequency interference (RFI) and of reducing or eliminating its effect on the measured brightness temperatures. High-level, localized RFI can be easily identified by its unnatural appearance in brightness temperature imagery. Low-level or persistent RFI can be much more difficult to identify and filter out. The agile digital detector (ADD) can discriminate between RFI and natural thermal emission signals by directly measuring higher order moments of the signal than the variance that is traditionally measured. After detection, the ADD then uses spectral filtering methods to selectively remove the RFI. ADD performance is experimentally verified in controlled laboratory tests and in the field near a commercial air traffic control radar. High-level RFI is easily identified and removed. Very low level RFI contamination, with power levels as low as the radiometric measurement uncertainty of the radiometer, is also shown to be reliably detected and removed. [J2494]

"An evaluation of the potential of polarimetric radiometry for numerical weather prediction using QuikSCAT"

It has been proposed that wind vector information derived from passive microwave radiometry may provide an

impact on numerical weather forecasts of similar magnitude to that achieved by scatterometers. Polarimetric radiometers have a lower sensitivity to wind direction than scatterometers at low wind speed but comparable sensitivity at high windspeed. In this paper, we describe an experiment which aimed to determine if an observing system only capable of providing wind direction information at wind speeds over 8 ms-1can provide comparable impact to one providing wind vectors at wind speeds over 2 ms-1. The QuikSCAT dataset used in the experiments has a wide swath and is used operationally by several forecast centers. The results confirm that assimilation of wind vectors from QuikSCAT only for wind speeds above 8 ms-1gives similar analysis increments and forecast impacts to assimilating wind vectors at all wind speeds above 2 ms-1. Measurements from the WindSat five frequency polarimetric radiometer are compared with calculations from Met Office global forecast fields, and this also confirms that WindSat measurement and radiative transfer model accuracy appears to be sufficiently good to provide useful information for numerical weather prediction. [J2495]

"Windtalker [Jelectronic travel guide]"

This article discusses the development of a concept for utilizing abundant human intelligence resources in a shared network over the Internet. Windtalker is a concept that will help people solving the problem of understanding the local culture and language in order to make the trip of a traveler comfortable. By utilizing current Internet, PDA, and wireless networks, the windtalker system virtually brings the bilingual volunteer to the traveler in need. Windtalker servers will find for the traveler a person online who can help with the interpretation. The concept is not limited to language service and is also viable for more extensive human interactions. Future development of windtalker will be focused on making the system architecture more open and user friendly. [J2496]

"Design of temperature-insensitive filters using coupled coaxial cavities"

An efficient method to accomplish thermal stabilisation of metallic coaxial cavities in terms of their resonance frequencies is presented. The mechanical structure required is simpler, lighter and cheaper than other solutions used. Several multi-cavity filters have been implemented using this technique. Measurements over a wide thermal range (150°C) show very good stability. [J2497]

"Exploration of a double-tapered disc-loaded circular waveguide for a wideband gyro-TWT"

The analysis of a disc-loaded circular waveguide interaction structure of a gyro-traveling-wave-tube (gyro-TWT) considering standing and propagating mode harmonics in the disc-occupied and disc-free regions, respectively, gave the beam-absent dispersion relation of the waveguide. The axial phase propagation constant predicted by the dispersion relation was substituted into the gyro-TWT gain-equation, the latter obtainable from the beam-present dispersion relation of the device. A method of double-tapering the structure dimensions was proposed that consists in tapering the disc-hole radius to distribute the midband frequency of amplification over a wide range of frequencies, and simultaneously tapering the waveguide-wall radius to compensate for gain reduction at band edges due to disc-hole radius tapering. The method has demonstrated wide device bandwidths at relatively large gain values. [J2498]

"Index IEEE Aerospace & Electronic Systems Magazine (IEEE-AESM)"

{no data available} [J2499]

"Micro-Doppler effect in radar: phenomenon, model, and simulation study"

When, in addition to the constant Doppler frequency shift induced by the bulk motion of a radar target, the target or any structure on the target undergoes micro-motion dynamics, such as mechanical vibrations or rotations, the micro-motion dynamics induce Doppler modulations on the returned signal, referred to as the micro-Doppler effect. We introduce the micro-Doppler phenomenon in radar, develop a model of Doppler modulations, derive formulas of micro-Doppler induced by targets with vibration, rotation, tumbling and coning motions, and verify them by simulation studies, analyze time-varying micro-Doppler features using high-resolution time-frequency transforms, and demonstrate the micro-Doppler effect observed in real radar data. [J2500]

"SAR-ECCM using phase-perturbed LFM chirp signals and DRFM repeat jammer penalization"

First Page of the Article [J2501]

"Monopulse radar based on spatiotemporal correlation of stochastic signals"

The theory and technique of angle-of-arrival (AOA) estimation using random-noise or other stochastic transmit

waveforms is addressed. The additional uncertainties induced by signal itself and the statistical complexity of the received signals result in major challenges. The statistical properties of the random-noise interferometer and monopulse radar system are studied and compared theoretically using an approximation method. Furthermore, a random-noise coherent correlation receiver (CCR) architecture is proposed. The concept of mean monopulse characteristic curve (MMCC) is introduced. Experimental results using an X-band random-noise monopulse radar system validate the theoretical predictions of random-noise monopulse characteristics and suggest potential applications such as surveillance, imaging, and maneuvering target tracking. [J2502]

"Multiple signal detection and estimation using atomic decomposition and EM"

An algorithm to detect and estimate a linear mixture of deterministic signals corrupted by white Gaussian noise is presented. The number of signals is assumed to be unknown, and the noise power can be either known or unknown. The algorithm is based on an information-theoretic criterion in which the probability of false alarm can be adjusted; typical information criteria, such as the Akaike (AIC) and the minimum description length (MDL) criteria, can be regarded as particular cases of it for given probabilities of false alarm. The proposed approach includes the use of the atomic decomposition and the expectation maximization (EM) algorithms to efficiently approximate the signal maximum likelihood estimate. For the first time, upper-bounds for the probabilities of underestimation and overestimation of the number of signals are obtained. In addition, the constant false-alarm rate (CFAR) characteristic is shown, and the statistical efficiency of the signal parameter estimation is discussed and illustrated by simulation. Numerical experiments show the suitability of the algorithm for signal interception by using synthetic and real-life radar signals. [J2503]

"Strategy of GPR Searching for Low Radar Contrast Plastic Pipes in Ground"

The results of computer simulation of pulse signal scattering by a plastic pipe buried in the ground as well as simulation results of Ground Penetrating Radar (GPR) image of ground-filled trenches have been represented in the work. The "skeleton diagram" of a trench image has been developed. The strategy of GPR searching for low radar contrast plastic pipes in ground (in back-filled trenches) has been considered on the basis of indirect criterion which is the existence of a trench containing buried pipes. [J2504]

"Preventing Damage by Hidden Objects in Vegetation"

The paper presents the experimental radar-based sensor to operate in environment with vegetation cover for detection and discrimination there the small-sized invisible dielectric and metallic objects. This sensor constitutes a vehicle-housed emergency system for surveillance of area with vegetation ahead on the path of moving vehicle to prevent its contact with hidden objects. The emergency system functioning in basically implemented by real-time electromagnetic imaging of the scene of interest and its following image processing to enhance the target responses. The developed and tested experimental radar techniques are under consideration. The results of experimental examinations in field are presented and discussed. [J2505]

"In This Issue-Technically"

For a successful enemy maneuver, their most important action is the ability to identify, locate, and track their correct target. High-resolution imaging sensors such as the inverse synthetic aperture radar perform this action in the most effective way and are especially useful against low radar cross-section targets. Once the correct target is acquired and identified, the decision to engage is made and the weapons are selected. Counter-targeting is the attempt to prevent (or degrade) the engage-and-launch-weapons decision by the enemy. This paper describes an all-digital image synthesizer technique capable of generating realistic false-target images for counter-targeting using modern digital radio frequency memory technology. Uses in counter-lock on for coherent seekers in the terminal mode are also discussed. Examples of the output false target image capability are presented. [J2506]

"Distinguished Lecturers Program"

One of the general trends of the MEMS sensors business is the utilization of the technology to satisfy harsh environment requirements (temperature, shock, vibration, environment security). The conjunction of material (standard Silicon, SiC or SOI), with complex micromachining techniques and advanced assembly techniques are the key to provide robust sensors with a miniimum concession on specification. The goal of this paper is to present progress on gun hard (>20,000 g) and wide temperature range MEMS accelerometers (-120Г‚В°C to +180Г‚В°C). Concrete solutions and results (out of more than 500 tested products)) will be presented and discussed in detail. [J2507]

"Warren D. White Award for Excellence in Radar Engineering"

{no data available} [J2508]

"Fred Nathanson Memorial Radar Award"

{no data available} [J2509]

"From the Editor-in-Chief"

{no data available} [J2510]

"Polarization isolation requirements for linear dual-polarization weather Radar in simultaneous transmission mode of operation"

A dual-polarization radar system operating in simultaneous transmission mode of both horizontal and vertical polarization states is a viable implementation if only copolar measurements are needed. The simultaneous transmission of horizontal and vertical polarizations results in an arbitrary elliptical polarization state transmitted, whereas the reception states in horizontal and vertical polarizations are neither copolar nor cross-polar to the transmitted state. Because of this, it is often referred as the hybrid mode. Previous studies have shown that the hybrid mode in the linear horizontal and vertical polarization basis is capable of providing measurements similar to the alternate transmission mode for most measurement conditions. These findings are based on the assumption of perfect sensing systems. This paper presents the results of radar system limitations on hybrid mode measurements that in turn are converted to system requirements. It is shown that the polarization purity requirement is more stringent for the hybrid mode compared to the alternate mode of operation [J2511]

"High-Accuracy Urban DEM Using Permanent Scatterers"

The permanent scatterers (PS) technique is a powerful operational tool that exploits a long series of synthetic aperture radar data for monitoring ground deformations with millimeter accuracy on a high spatial density grid of pointwise targets. The technique has been applied successfully to a number of applications, from subsidence and volcano monitoring to slow-landslide detection. This paper aims to analyze and demonstrate the positioning capability of the PS technique applied to the generation of urban elevation maps. The problem of the univocal identification of the PS position (discarding pixel-dependent sidelobes, both far and near) is addressed, and an easy and efficient solution is proposed. The results obtained in the Milan site allow the appreciation of the very high quality of an urban digital elevation model retrieved with the PS technique. The ground level of the city is identified with submeter accuracy, and elevated targets, where present, reveal building profiles. The estimated city street level (ranging plusmn3m in 16times18 km2) is then compared to those obtained with the same technique using a descending parallel track and an ascending one. Furthermore, the estimated PS elevation with respect to the ground has been connected to temperature-dependent elongations of high structures [J2512]

"Radar Scattering From a Rolling Target Floating on a Time-Evolving Rough Sea Surface"

The variations in the radar cross section (RCS) of two-dimensional floating targets are studied by means of a numerical model. Of particular interest is the rolling of a target on the waves. It is found that the rolling motion has the most significant effect on the RCS for low-grazing angles of incidence. The effect is very pronounced for a high-RCS shiplike target due the corner-reflector effect between the sea surface and the ship hull, and less noticeable for a low-RCS shape. A simplified means of estimating the variation is also presented [J2513]

"Application of Iterative Techniques for Electromagnetic Scattering From Dielectric Random and Reentrant Rough Surfaces"

Stationary [e.g., forward-backward method (FBM)] and nonstationary [e.g., conjugate gradient squared, quasi-minimal residual, and biconjugate gradient stabilized (Bi-CGSTAB)] iterative techniques are applied to the solution of electromagnetic wave scattering from dielectric random rough surfaces with arbitrary complex dielectric constants. The convergence issues as well as the efficiency and accuracy of all the approaches considered in this paper are investigated by comparing obtained scattering (in the form of normalized radar cross section) and surface field values with the numerically exact solution, computed by employing the conventional method of moments. It has been observed that similar to perfectly and imperfectly conducting rough surface cases, the stationary iterative FBM converges faster when applied to geometries yielding best conditioned systems but exhibits convergence difficulties for general geometries due to its inherit limitations. However, nonstationary techniques are, in general, more robust when applied to arbitrarily general dielectric random rough surfaces, which yield more ill-conditioned systems. Therefore, they might prove to be more suitable for general

scattering problems. Besides, as opposed to the perfectly and imperfectly conducting rough surface cases, the Bi-CGSTAB method and FBM show two interesting behaviors for dielectric rough surface profiles: 1) FBM generally converges for reentrant surfaces when the vertical polarization is considered and 2) the Bi-CGSTAB method has a peculiar convergence problem for horizontal polarization. Unlike the other nonstationary iterative techniques used in this paper, where a Jacobi preconditioner is used, convergent results are obtained by using a block-diagonal preconditioner [J2514]

"Parametric Inversion Technique for Location of Cylindrical Structures by Cross-Hole Measurements"

A new parametric inversion technique to locate cylindrical structures has been developed for borehole radar cross-hole measurements. The technique calculates prediction errors, focusing on curve shapes of first-arrival times, and explicitly uses known parameters on a target. Two schemes to compare the measured first-arrival time curves with the calculated ones are proposed. One is by taking the errors between curve gradients of measured and calculated first-arrival times, and the other is by taking the cross correlation between calculated first-arrival times and measured data. The schemes do not need to select the true first-arrival times, which makes this inversion technique robust and easy to use. This technique is validated with synthetic data sets modeling a metallic pipe in homogeneous and heterogeneous medium models. By both models, the inversion technique is able to retrieve the exact location of the pipe, though it employs a rather simple forward model, which can be solved by only geometrical calculations. The technique is applied to measured data sets, and it successfully estimates a pipe location in good agreement with known information. The inversion is also used for an air-filled subsurface cavity with a very simplified forward model, which considers only Snell's law at the cavity-subsurface media interface. It is also able to locate the cavity at a similar location estimated by other conventional techniques [J2515]

"Stability analysis and stabilization of power amplifiers"

The objective of this article is to provide explanations for some of the anomalous phenomena commonly observed in the measurement of PAs. It will also show how modern stability-analysis techniques, based on harmonic balance, can accurately predict the undesired behavior. The article introduces practical simulation tools, applicable on both in-house and commercial harmonic balance simulators. The identification of the mechanisms behind the different instability phenomena will lead to an efficient derivation of accurate techniques for their elimination from the amplifier response. For illustration, the simulation tools will be applied to a Class E/F amplifier, which showed oscillations, hysteresis, and chaos (Jeon et al., 2005). Using these tools, the amplifier will be globally stabilized for all the expected operating values of the bias voltage and input power. This will be achieved with negligible degradation of the amplifier performance in terms of output power and drain efficiency [J2516]

"Design of Ultra-Wideband Monopulse Receiver"

In this paper, we propose a novel amplitude-comparison monopulse receiver architecture for ultra-wideband radars. This monopulse receiver consists of four ridged-horn antennas placed in a square-feed configuration, a comparator circuit that generates the monopulse sum and difference signals, cross-correlation receivers that detect the monopulse signals, and an amplitude-comparison monopulse processor that determines the target's angular position. The derived monopulse sum and difference signals are verified through measurements. The derived sum and difference patterns are compared with measured patterns, and they show good agreements-measured 3-dB beamwidth=6.4deg(derived=6deg), measured unambiguous tracking range=plusmn5deg(derived=plusmn5deg), and measured sum pattern sidelobe level=-6 dB (derived=-8 dB) [J2517]

"Scatterometer Backscatter Uncertainty Due to Wind Variability"

Wind retrieval from scatterometer backscatter measurements is not trivial. A good assessment of the different measurement uncertainties inherent in scatterometer systems is very important for successful wind retrieval and quality control. One source of these uncertainties, i.e., geophysical noise, is dominated by the subcell wind variability. Although the latter is known to dominate the total measurement noise at low winds, no attempt to fully model such effect has yet been performed. In this paper, a simple method to derive a model of geophysical noise for the European Remote Sensing Satellite (ERS) scatterometer is proposed. It is assumed that this noise is mainly due to the spatial distribution of the backscatter footprints and the wind variability within the wind vector cell. In a simulation experiment these parameters were varied, and the values for which the simulation compares best to real data in the three-dimensional measurement space were selected. The resulting geophysical noise model is dependent on wind speed and across subsatellite track location. The empirical method presented here

is straightforward and could be applied to other scatterometer systems [J2518]

"Polarimetric Weather Radar Retrieval of Raindrop Size Distribution by Means of a Regularized Artificial Neural Network"

The raindrop size distribution (RSD) is a critical factor in estimating rain intensity using advanced dual-polarized weather radars. A new neural-network algorithm to estimate the RSD from S-band dual-polarized radar measurements is presented. The corresponding rain rates are then computed assuming a commonly used raindrop diameter speed relationship. Numerical simulations are used to investigate the efficiency and accuracy of this method. A stochastic model based on disdrometer measurements is used to generate realistic range profiles of the RSD parameters, while a T-matrix solution technique is adopted to compute the corresponding polarimetric variables. The error analysis, which is performed in order to evaluate the expected errors of this method, shows an improvement with respect to other methodologies described in the literature. A further sensitivity evaluation shows that the proposed technique performs fairly well even for low specific differential phase-shift values [J2519]

"Measurement of Correlation Functions and Power Spectra in Clouds Using the NRL WARLOC Radar"

The Naval Research Laboratory W-band Advanced Radar for Low Observable Control (WARLOC) is a high-power 94-GHz radar, with 3-10-kW average and 80-kW peak power, now set up on the western shore of the Chesapeake Bay. It has three orders of magnitude more power and sensitivity than other W-band radar systems. This enables cloud reflectivity to be measured with high signal-to-noise ratios and a resolution of about 15 m over a two (or three)-dimensional region, which can be as large as tens of kilometers on a side. This allows imaging of the internal structure of clouds over great distances in very great detail. At the shortest scale lengths, the structure has a speckle pattern indicating that it is governed at least in part by stochastic processes. The WARLOC data allow the reflectivity correlation function and its Fourier transform, which is the power spectrum, to be computed for scale lengths ranging from 30 m to 10 km. For measurements taken of cirrus clouds on several occasions as well as one case of a precipitating cloud, it was found that for small correlation distance r, the correlation function usually decreases as r2/3, or, equivalently, the wavenumber spectrum scales as k-5/3, where k is the wavenumber. This suggests that fluid turbulence in the inertial range is playing a role; however, unlike classical fluid turbulence, the results suggest that the turbulence here is generally quite anisotropic. Furthermore, for longer scale lengths (the outer range according to the Kolmogorov theory), the reflectivity fluctuations usually show a wavelike behavior in the vertical direction but only occasionally in the horizontal direction [J2520]

"Volcanic Ash Cloud Retrieval by Ground-Based Microwave Weather Radar"

The potential of ground-based microwave weather radar systems for volcanic ash cloud detection and quantitative retrieval is evaluated. The relationship between radar reflectivity factor, ash concentration, and fall rate is statistically derived for various eruption regimes and ash sizes by applying a radar-reflectivity microphysical model. To quantitatively evaluate the ash detectability by weather radars, a sensitivity analysis is carried out by simulating synthetic ash clouds and varying ash concentration and size as a function of the range. Radar specifications are taken from typical radar systems at S-, C-, and X-band. A prototype algorithm for volcanic ash radar retrieval (VARR) is discussed. Starting from measured single-polarization reflectivity, the statistical inversion technique to retrieve ash concentration and fall rate is based on two cascade steps, namely: 1) classification of eruption regime and volcanic ash category and 2) estimation of ash concentration and fall rate. Expected accuracy of the VARR algorithm estimates is evaluated using a synthetic data set. An application of the VARR technique is finally shown, taking into consideration the eruption of the Grinodotacutemsvoumltn volcano in Iceland on November 2004. Volume scan data from a Doppler C-band radar, which is located at 260 km from the volcano vent, are processed by means of the VARR algorithm. Examples of the achievable VARR products are presented and discussed [J2521]

"Estimation of Path-Integrated Attenuation and Its Nonuniformity From TRMM/PR Range Profile Data"

Range profile data from the surface echo of the Precipitation Radar (PR) onboard the Tropical Rainfall Measuring Mission (TRMM) satellite enable the assessment of the nonuniformity of rainfall. The surface echo profile can be converted to a horizontal pattern of surface echo strength within the PR's footprint at off-nadir angles. Then, using the no-rain surface echo profile over ocean as a reference, the horizontal pattern of the path-integrated attenuation (PIA) can be estimated under moderate to heavy rainfall. Based on the horizontal pattern of the PIA, the nonuniform beam-filling parameter is estimated. However, this technique is applicable

only to off-nadir angles and over ocean. Comparisons using ground-based radar data obtained simultaneously with TRMM data verify the effectiveness of this technique [J2522]

"The Calibration of the Envisat Radar Altimeter Receiver by a Passive Technique"

The passive calibration of the Radar Altimeter (RA) consists of characterizing the receiver gain by observing natural surfaces with known emission in the so-called noise-listen mode. It is based on the comparison between the simulated values of the brightness temperature impinging on the altimeter antenna, and the digital counts at the output of the altimeter receiver in the absence of echo. The proposed method aims to calibrate measurements of the backscattering coefficient performed by a spaceborne altimeter based on the assumption that the receiver gain is the main source of uncertainty. This paper focuses on the general approach undertaken to characterize the receiver and to simulate the brightness temperature at the top of the atmosphere observed by the Envisat RA-2. The simulations rely on emissivity models for land and sea, as well as on atmospheric radiation models supported by a continuous flow of online data used as model inputs. To assess the accuracy, the model outputs are compared with observations from calibrated radiometers, namely the Special Sensor Microwave/Imager and Tropical Rainfall Measuring Mission Microwave Imager, with particular attention to the low-frequency channels (10 and 19 GHz). The new method has been first tested on European Remote Sensing satellite data and has been subsequently adopted for Envisat RA-2 in the framework of the Envisat Calibration and Validation activities managed by European Space Agency. The evaluation of the receiver gain at both Ku-band and S-band is presented and compared to the preflight values, as well as to transponder calibration done for Ku-band. An error budget for the final estimates is also presented and discussed [J2523]

"On the Azimuthally Anisotropy Effects of Polarization for Altimetric Measurements"

We have investigated the effect of the radar-altimeter antenna polarization on European Remote-sensing Satellite and Envisat observations of the media penetrable by a radar microwave such as ice sheets. This effect is due to the complex interaction between the radar wave, the subsurface backscatter, and the antenna polarization direction. It is modulated by the angle between the antenna polarization and the direction of the anisotropy of the target. Thus, it depends on both the anisotropy direction and the interaction between the radar wave and the reflecting surface. This effect leads to one of the most complex and least understood errors of radar altimetry over ice sheets and can be clearly identified when looking at the crossover differences between ascending and descending satellite tracks. The crossover differences are as large as a few decibels for a backscattering coefficient and a few meters for height, and affect more strongly the Ku-band than the S-band. This causes limitations and difficulties for the processing of altimetric observations, for instance when comparing time series from different satellites whose polarization geometry differs. This will be the case when a new altimeter will fly on a different orbit, as planned for CryoSat. Nevertheless, the ability of both the roughness anisotropy direction and the subsurface modulation to be inverted with satisfactory precision by using simultaneous observations at crossover points between two different satellites is demonstrated here. Thus, it offers a unique way of describing this error accurately to correct for it [J2524]

"Dynamic Monitoring of Bridges Using a High-Speed Coherent Radar"

Remote dynamic monitoring of bridges by a high-speed interferometric radar is proposed. The equipment is a continuous-wave step-frequency radar with very fast frequency hopping that is capable of sampling the structure at a rate high enough for transient analysis of motion through phase comparison of successively acquired images. An experimental test carried out on a highway bridge forced by vehicular traffic is presented [J2525]

"MIKON 2006: 16th International Conference on Microwaves, Radar, and Wireless Communications"

{no data available} [J2526]

"Radar Polarimetry Analysis Applied to Single-Hole Fully Polarimetric Borehole Radar"

A fully polarimetric borehole radar system using four combinations of dipole and slot antennas was developed to acquire fully polarimetric data sets in drilled boreholes. First, to implement radar polarimetry analysis, a processing scheme suitable for analyzing a single-hole reflection data set acquired by the system is presented. This processing consists of antenna-characteristic compensation, migration for image reconstruction, and time-frequency analysis for single-frequency data set construction. Two polarimetric target decomposition methods, namely: 1) Pauli decomposition and 2) eigenvector-based decomposition, are applied to characterize the scattering problem of the subsurface fractures. The Pauli decomposition method provided important radar polarimetry information of fractures, and the eigenvector-based decomposition method made a significant contribution to understanding the scattering mechanisms from different fractures with different properties.

Furthermore, information about fracture classification can be obtained by analysis of the H-alpha distribution provided by eigenvector-based decomposition of local radar image regions. The potential of polarimetric target decomposition techniques to fracture characterization is shown, which, in turn, provides valuable information about water permeabilities of fractures in hydrogeological studies [J2527]

"Filament Preserving Model (FPM) Segmentation Applied to SAR Sea-Ice Imagery"

Modeling spatial context constraints using a Markov random field (MRF) has been widely used in the segmentation of noisy images. Its applicability to synthetic aperture radar (SAR) sea-ice segmentation has also been demonstrated recently. However, most existing MRF models are not capable of preserving filaments, specifically leads and ridges for SAR sea ice, which are valuable for ship navigation applications and necessary for identifying certain ice types. In this paper, a new statistical context model is proposed that, within the same scene, can simultaneously preserve narrow elongated features while producing similar smooth segmentation results comparable to typical MRF-based approaches. Tested on one synthetic image and two SAR sea-ice scenes, this filament preserving model substantially improves classification accuracies when compared to standard Gaussian mixture and MRF-based segmentation algorithms [J2528]

"Arctic Sea Ice Type and Concentration Mapping Using Passive and Active Microwave Sensors"

The mapping of ice type concentrations in the Arctic is important for commercial operations and for climate-related research. Algorithms based on moderate-resolution passive microwave sensors for mapping first-year ice and multiyear ice concentrations suffer from a number of known problems. In this paper, it has been shown that QuikSCAT scatterometer data can add complimentary information to that available from passive microwave, which can assist in separating different ice classes. Specifically, we identify a class of ice that exhibits a passive microwave signature which is characteristic of first-year ice, but has a scatterometer signature which is typical of multiyear ice. We track the evolution and distribution of this new ice class throughout the Arctic during the winter season of 2003-2004 and compare the results against the U.S. National Ice Center (NIC) ice charts. It has been found that the new ice class is predominantly multiyear ice and is especially prevalent in the Fram Strait and the high Arctic regions north of the islands Franz Josef Land and Severnaya Zemlya. A simple algorithm has been proposed that enables a passive microwave-based partial ice concentration algorithm (for example, the NT algorithm based on Special Sensor Microwave/Imager data) to be adapted using QuikSCAT scatterometer data, so that the new ice class is corrected from the first-year ice class to the multiyear ice category. The algorithm performance is measured against the NIC ice charts. We provide a discussion regarding the possible physical causes of the effects that have been observed and described [J2529]

"Adaptive Detection and Interference Rejection of Multiple Point-Like Radar Targets"

We present an adaptive algorithm aimed at detecting multiple point-like radar targets embedded in correlated Gaussian noise. The proposed detector modifies and improves the adaptive beamformer orthogonal rejection test (ABORT) idea to address detection of multiple targets. More precisely, it relies on the so-called two-step generalized likelihood ratio test (GLRT) design procedure implemented without assignment of a distinct set of secondary data. The newly proposed detector can guarantee the constant false alarm rate (CFAR) property and the performance assessment, conducted resorting to simulated data, has shown that it exhibits better rejection capabilities of mismatched signals than previously proposed detectors, at the price of an acceptable performance loss for matched signals [J2530]

"Multimode adaptive signal processing: a new approach to GMTI radar"

We show how a single reflector antenna with a multimode feed horn can be used in a ground moving target indication (GMTI) radar. In particular, we demonstrate the simultaneous detection and estimation of angular location of a ground moving target via adaptive cancellation of ground clutter [J2531]

"On the High-SNR Conditional Maximum-Likelihood Estimator Full Statistical Characterization"

In the field of asymptotic performance characterization of the conditional maximum-likelihood (CML) estimator, asymptotic generally refers to either the number of samples or the signal-to-noise ratio (SNR) value. The first case has been already fully characterized, although the second case has been only partially investigated. Therefore, this correspondence aims to provide a sound proof of a result, i.e., asymptotic (in SNR) Gaussianity and efficiency of the CML estimator in the multiple parameters case, generally regarded as trivial but not so far demonstrated [J2532]

"Higher Order Nested Wigner Distributions: Properties and Applications"

The concept of Wigner distribution (WD) is extended to higher-order nested Wigner distributions. The nested ambiguity function (NAF) is also derived naturally by employing the known interrelation between the WD and the ambiguity function (AF). These distributions are obtained by nesting a function within itself a number of times. The definitions of these new multidimensional distributions are given in analogy to the standard first-order 2-D distributions in both temporal/spatial and spectral forms and follow the definitions of quartic distributions presented in and . Some important properties are derived and discussed, including interrelationships between the various representations, marginals, correlations, and uncertainties, as well as their geometrical characteristics. The second-order nested Wigner distribution (NWD) is used to showcase the power of such distributions in potential application areas, such as signal estimation, signal separation, and radar signal analysis. For such signal processing tasks, it is demonstrated that the NWDs can be successful in situations where the standard 2-D distributions have proved to be inadequate [J2533]

"A High-Resolution Dual-Doppler Technique for Fixed Multiantenna Airborne Radar"

A new technique is presented for the analysis of data collected by pairs of aircraft (AC)-mounted fixed radar beams directed ~30deg apart, leading to two-dimensional wind field syntheses in the horizontal and vertical planes. The technique was applied to the 95-GHz Wyoming Cloud Radar (WCR) configurations aboard the University of Wyoming King Air and the National Center for Atmospheric Research C-130 research AC. The construction of the data grid allows to closely follow the AC flight attitude, and thus the beam scanned surfaces, with a resolution between 30 and 45 m. A weighted least squares method is employed to solve the velocity inverse decomposition problem for every valid grid cell. The effect on the solution of the nonmeasured (cross-plane) wind component is minimized by using an external estimate of the ambient wind. The error sources are discussed, and maximum expected values for the velocity field errors are provided with reference to the radar system, the data collection process, and specific aspects of the target under investigation. These uncertainties (1-2 m/s) are quantified for two case studies that show the potential of the technique in retrieving the kinematic field in transects of cumulus and stratus clouds. The technique produces smooth fine-scale kinematic fields although each velocity point is the result of an independent calculation, and no binding constraint is imposed among neighboring points as is done in other dual-Doppler techniques [J2534]

"Conservative Polarimetric Scatterers and Their Role in Incorrect Extensions of the Cameron Decomposition"

The properties of conservative symmetric polarimetric scatterer scattering matrices are examined. It is shown that the unambiguous rotation angle for "conservative" symmetric polarimetric scatterers is the interval (-pi/4,+pi/4] as compared with (-pi/2,+pi/2] for nonconservative symmetric scatterers. Errors relating to the Cameron decomposition, which are recently introduced into the literature, are discussed. It is demonstrated that these errors arise from a faulty symmetric scatterer scattering matrix distance measure. This, in turn, leads to an improper mapping of the symmetric scatterer unit disk to a hemisphere. The correct mapping of the symmetric scatterer unit disk to the symmetric scatterer unit sphere is described [J2535]

"Robust Voltage Fitting Techniques for Meteor Doppler Speed Determination"

The nonlinear least square fitting techniques that the authors have employed until recently for measuring the Doppler velocities of head-echo meteor returns have proven to be limited in their effectiveness under certain circumstances where significant incoherent scattering from the ionosphere is present. Two alternative methods developed to independently but jointly determine the Doppler speeds are presented. The first method uses the Moore-Penrose matrix inverse to obtain the relevant meteor parameters. The second method is the steepest descent searching technique. These techniques have been applied to simulated meteor returns as well as meteor data set from February 2001. The Doppler velocities obtained using the new algorithms are presented. The implications of the improved Doppler resolution as well as robustness of the new approach are also discussed [J2536]

"Imaging of Single and Double Scatterers in Urban Areas via SAR Tomography"

Microwave scattering is a rather complex mechanism, especially in urban areas. Three-dimensional (3-D) synthetic aperture radar (SAR) tomography is a technique that uses multiple views to map the scattering power at different heights, thus extending the capability of SAR sensors to fully image the scene in the 3-D space. This paper presents a first validation of spaceborne long-term SAR tomography by demonstrating the capability to resolve a simple layover case, i.e., to separate single- and double-scattering mechanisms within imaged pixels. Results obtained with real data acquired by the European Remote Sensing 1 and 2 (ERS-1 and ERS-2) satellites over the urban area of Napoli are presented. As an additional contribution, an innovative algorithm estimating residual topography and surface deformation, called the spatial-differencing technique, is also

discussed in detail at the data calibration stage [J2537]

"An Investigation of Some Geometrical Shapes and Selection of Shielding and Lumped Resistors of Planar Dipole Antennas for GPR Applications Using FDTD"

A ground-penetrating radar (GPR) antenna system is modeled using the three-dimensional finite-difference time-domain technique. This paper investigates some basic geometrical shapes for planar dipoles to find what shape gives the best performance for GPR applications. The antenna is resistor loaded and shielded by a rectangular conducting cavity to suit the application. The effect of adding a wave-absorbing coat to the shield is also studied. Furthermore, a genetic algorithm is used to optimize the cavity height and the resistor values [J2538]

"On the Usage of GRECOSAR, an Orbital Polarimetric SAR Simulator of Complex Targets, to Vessel Classification Studies"

This paper presents a synthetic aperture radar (SAR) simulator that is able to generate polarimetric SAR (POLSAR) and polarimetric inverse SAR data of complex targets. It solves the electromagnetic problem via high-frequency approximations, such as physical optics and the physical theory of diffraction, with notable computational efficiency. In principle, any orbital monostatic sensor working at any band, resolution, and operating mode can be modeled. To make simulations more realistic, the target's bearing and speed are considered, and for the particular case of vessels, even the translational and rotational movements induced by the sea state. All these capabilities make the simulator a powerful tool for supplying large amounts of data with precise scenario information and for testing future sensor configurations. In this paper, the usefulness of the simulator on vessel classification studies is assessed. Several simulated polarimetric images are presented to analyze the potentialities of coherent target decompositions for classifying complex geometries, thus basing an operational algorithm. The limitations highlighted by the results suggest that other approaches, like POLSAR interferometry, should be explored [J2539]

"Voxel-Based 3-D Modeling of Individual Trees for Estimating Leaf Area Density Using High-Resolution Portable Scanning Lidar"

A method for accurate estimation of leaf area density (LAD) and the cumulative leaf area index (LAI) profiles of small trees (Camellia sasanquaand Deutzia crenata) under different conditions was demonstrated, which used precise voxel-based tree models produced by high-resolution portable scanning lidar. In this voxel-based canopy profiling (VCP) method, data for each horizontal layer of the canopy of each tree were collected from symmetrical azimuthal measurement points around the tree using optimally inclined laser beams. The data were then converted into a voxel-based three-dimensional model that reproduced the tree precisely, including within the canopy. This precise voxel model allowed the LAD and LAI of these trees, which have extremely dense and nonrandomly distributed foliage, to be computed by direct counting of the beam-contact frequency in each layer using a point-quadrat method. Corrections for leaf inclination and nonphotosynthetic tissues reduced the estimation error. A beam incident zenith angle near 57.5deg offered a good correction for leaf inclination without knowledge of the actual leaf inclination. Non-photosynthetic tissues were removed by image-processing techniques. The best LAD estimations showed errors of 17% at the minimum horizontal layer thickness and of 0.7% at the maximum thickness. The error of the best LAI estimations was also 0.7% [J2540]

"Signal Decomposition by Using the S-Method With Application to the Analysis of HF Radar Signals in Sea-Clutter"

This paper presents a new approach to the time-frequency signal analysis and synthesis, using the eigenvalue decomposition method. It is based on the S-method, the time-frequency representation that can produce a distribution equal or close to a sum of the Wigner distributions of individual signal components. The new time-frequency signal decomposition method is evaluated on the simulated and experimental high-frequency surface-wave radar (HFSWR) data. Results demonstrate that it provides an effective way for analyzing and detecting maneuvering air targets with significant velocity changes, including target signal separation from the heavy clutter. The analysis shows that this method can provide additional insight into the interpretation and processing of radar signals, with respect to the traditional Fourier transform based methods currently used by the HFSWRs. The proposed method could also be used in other signal processing applications [J2541]

"Bayesian Surface and Underwater Navigation"

A common framework for maritime surface and underwater (UW) map-aided navigation is proposed as a supplement to satellite navigation based on the global positioning system (GPS). The proposed Bayesian navigation method is based on information from a distance measuring equipment (DME) which is compared with

the information obtained from various databases. As a solution to the recursive Bayesian navigation problem, the particle filter is proposed. For the described system, the fundamental navigation performance expressed as the Crameacuter-Rao lower bound (CRLB) is analyzed and an analytic solution as a function of the position is derived. Two detailed examples of different navigation applications are discussed: surface navigation using a radar sensor and a digital sea chart and UW navigation using a sonar sensor and a depth database. In extensive Monte Carlo simulations, the performance is shown to be close to the CRLB. The estimation performance for the surface navigation application is in comparison with usual GPS performance. Experimental data are also successfully applied to the UW application [J2542]

"Unsupervised Variational Image Segmentation/Classification Using a Weibull Observation Model"

Studies have shown that the Weibull distribution can model accurately a wide variety of images. Its parameters index a family of distributions which includes the exponential and approximations of the Gaussian and the Raleigh models widely used in image segmentation. This study investigates the Weibull distribution in unsupervised image segmentation and classification by a variational method. The data term of the segmentation functional measures the conformity of the image intensity in each region to a Weibull distribution whose parameters are determined jointly with the segmentation. Minimization of the functional is implemented by active curves via level sets and consists of iterations of two consecutive steps: curve evolution via Euler-Lagrange descent equations and evaluation of the Weibull distribution parameters. Experiments with synthetic and real images are described which verify the validity of method and its implementation [J2543]

"Tunable thin radar absorber using artificial magnetic ground plane with variable backplane"

Experimental verification is provided of the frequency tuning capability of a low-profile radar absorber material based on the high impedance surface principle. The absorber consists of an artificial magnetic ground plane with surface mount resistors interconnecting a textured surface of square patches. It is shown that by displacing the ground plane of the textured surface substrate from 0 to 0.04lambda obetter than -15 dB return loss, -42 dB best case, from 3.55 to 5.47 GHz can be obtained when the surface is illuminated by a linearly polarised signal at normal incidence to the surface. In addition, the response of the surface in terms of its axial ratio performance under circular polarised signal excitation at normal incidence is investigated for a fixed ground displacement [J2544]

"Meetings and simposia"

{no data available} [J2545]

"New titles in Antennas & Propagation from Wiley and the IEEE press"

{no data available} [J2546]

"SAIC From science to solutions"

{no data available} [J2547]

"Mobile Wireless Communication [JBook Review]"

{no data available} [J2548]

"Off-highway obstacle detection"

The biggest conclusion is that intensity of radar backscatter returns is a poor indicator of danger to a vehicle despite the attempts of several projects to show otherwise. Still, our method violates this finding at some level. An image of backscatter intensities is filtered with various image processing techniques then is thresholded as if it has become an image of risks or confidences. Current research is investigating discriminant functions that allow arbitrary numbers of classes and can use separability and discriminability as confidences instead of a filtered version of intensity. It cannot be overemphasized that this system was designed as an add-on sensor to an already operable autonomous vehicle. As such, it is not sufficient as a primary or stand-alone sensor in an unstructured environment. Radar techniques to detect road edges [Kaliyaperumal et al., 2001], [Nikolova and Hero, 2000] or terrain quality would fill these gaps and allow a radar-only, all-weather autonomous platform. Autonomous radar navigation is possible with proper scoping of the problem. On highways this means ignoring cross-sections smaller than a motorcyclist. Off highway the solutions must be a little more creative, but still exist. Applying image processing techniques already well developed by the computer vision field and avoiding the assumption that intensity of backscatter is a feature directly related to obstacle danger will help advance this

goal. Small radar systems have recently become very good, but they do not solve the problem alone. Just as other sensors like cameras and LIDAR require algorithms to convert from raw data to obstacle classifications, so too should radar users not expect to achieve good performance by simply thresholding the output from hardware. If radar is seen as just another imaging source like a camera, much work can be accomplished using the existing arsenal of image processing [J2549]

"Beamforming for Phased Arrays on Vibrating Apertures"

A beamforming approach for phased arrays on vibrating apertures is proposed. The essence is to dynamically calibrate the antenna element position errors due to aperture vibrations. This is achieved by estimating element positions through the aid of a few near field reference sources attached to the antenna. The reference sources need to be mounted on rigid frames and be impervious to vibrations. The estimated position information is then substituted into the beamforming process to correct the distorted pattern of the antenna array. To validate the proposed concept, a 5.8 GHz eight-element array with artificially displaced element positions is built to emulate the vibration effect. The proposed calibration approach gives, a close estimate of position errors with deviations under 4% of the free space wavelength. Based on the estimated information, an array pattern with desired features is constructed [J2550]

"Radar Signal Processing and its Applications [JBook Review]"

{no data available} [J2551]

"Ground Target Recognition Using Rectangle Estimation"

We propose a ground target recognition method based on 3-D laser radar data. The method handles general 3-D scattered data. It is based on the fact that man-made objects of complex shape can be decomposed to a set of rectangles. The ground target recognition method consists of four steps; 3-D size and orientation estimation, target segmentation into parts of approximately rectangular shape, identification of segments that represent the target's functional/main parts, and target matching with CAD models. The core in this approach is rectangle estimation. The performance of the rectangle estimation method is evaluated statistically using Monte Carlo simulations. A case study on tank recognition is shown, where 3-D data from four fundamentally different types of laser radar systems are used. Although the approach is tested on rather few examples, we believe that the approach is promising [J2552]

"Multiresolution MAP Despeckling of SAR Images Based on Locally Adaptive Generalized Gaussian pdf Modeling"

In this paper, a new despeckling method based on undecimated wavelet decomposition and maximum a posteriori (MAP) estimation is proposed. Such a method relies on the assumption that the probability density function (pdf) of each wavelet coefficient is generalized Gaussian (GG). The major novelty of the proposed approach is that the parameters of the GG pdf are taken to be space-varying within each wavelet frame. Thus, they may be adjusted to spatial image context, not only to scale and orientation. Since the MAP equation to be solved is a function of the parameters of the assumed pdf model, the variance and shape factor of the GG function are derived from the theoretical moments, which depend on the moments and joint moments of the observed noisy signal and on the statistics of speckle. The solution of the MAP equation yields the MAP estimate of the wavelet coefficients of the noise-free image. The restored SAR image is synthesized from such coefficients. Experimental results, carried out on both synthetic speckled images and true SAR images, demonstrate that MAP filtering can be successfully applied to SAR images represented in the shift-invariant wavelet domain, without resorting to a logarithmic transformation [J2553]

"The Multidimensional Phase Unwrapping Integral and Applications to Microwave Tomographical Image Reconstruction"

Spatial unwrapping of the phase component of time varying electromagnetic fields has important implications in a range of disciplines including synthetic aperture radar (SAR) interferometry, MRI, optical confocal microscopy, and microwave tomography. This paper presents a fundamental framework based on the phase unwrapping integral, especially in the complex case where phase singularities are enclosed within the closed path integral. With respect to the phase unwrapping required when utilized in Gauss-Newton iterative microwave image reconstruction, the concept of dynamic phase unwrapping is introduced where the singularity location varies as a function of the iteratively modified property distributions. Strategies for dynamic phase unwrapping in the microwave problem were developed and successfully tested in simulations and clinical experiments utilizing large, high contrast targets to validate the approach [J2554]

"A century-bandwidth antenna reinvented and patented after eighteen years with only a decade bandwidth"

The goal of this communication is to point out that 18 years after it was first developed, a century-bandwidth antenna has apparently been reinvented with only a decade bandwidth, and patented [J2555]

"Spatial Variability of Barrow-Area Shore-Fast Sea Ice and Its Relationships to Passive Microwave Emissivity"

Aircraft-acquired passive microwave data, laser radar height observations, RADARSAT synthetic aperture radar imagery, and in situ measurements obtained during the AMSR-Ice03 experiment are used to investigate relationships between microwave emission and ice characteristics over several space scales. The data fusion allows delineation of the shore-fast ice and pack ice in the Barrow area, AK, into several ice classes. Results show good agreement between observed and Polarimetric Scanning Radiometer (PSR)-derived snow depths over relatively smooth ice, with larger differences over ridged and rubbled ice. The PSR results are consistent with the effects on snow depth of the spatial distribution and nature of ice roughness, ridging, and other factors such as ice age. Apparent relationships exist between ice roughness and the degree of depolarization of emission at 10, 19, and 37 GHz. This depolarization would yield overestimates of total ice concentration using polarization-based algorithms, with indications of this seen when the NT-2 algorithm is applied to the PSR data. Other characteristics of the microwave data, such as effects of grounding of sea ice and large contrast between sea ice and adjacent land, are also apparent in the PSR data. Overall, the results further demonstrate the importance of macroscale ice roughness conditions such as ridging and rubbling on snow depth and microwave emissivity [J2556]

"Schedulability Envelope for Real-Time Radar Dwell Scheduling"

This paper proposes novel techniques for scheduling radar dwells in phased array radar systems. In order to handle complex physical characteristics such as dwell interleaving, transmitting duty cycle constraint, and energy constraint, we propose a notion of schedulability envelope. The schedulability envelope designed offline hides the details of complex radar dwell scheduling and provides a simple measure for the schedulability check. Using the schedulability envelope, the proposed technique can efficiently perform the admission control for dynamic target tracking tasks. The simulation results show that the proposed approach can significantly improve the system utilization by taking advantage of dwell interleaving while guaranteeing the schedulability and physical constraints [J2557]

"Effect of phase and range gate pull-off delay quantisation on jammer signal"

The analysis of jamming signals emitted by electronic countermeasure (ECM) systems after phase quantisation, performed by radio frequency digital memory devices, and after introduction of increasing time delay, is approached. The analysis shows the exact expression of the spectrum of a phase-quantised jamming signal when the quantisation levels are equally spaced. The spectrum of the signal presents a main term that is simply an attenuated version of the signal received by the ECM system, and spurious terms whose amplitude and position depend on the number of quantisation levels. The effect of time delay quantisation introduced by range gate pull-off devices is analytically evaluated, in combination to the phase quantisation. Results show that this second distortion can be generally neglected with respect to the spurious terms because of the phase quantisation, particularly when the number of phase quantisation bits is low [J2558]

"Sea Ice Roughness From Airborne LIDAR Profiles"

Light detection and ranging (LIDAR) data acquired during the AMSR-Ice03 Arctic flights are used to observe and characterize the spectral behavior of sea ice roughness. Height distributions and roughness spectral densities are derived from surface profiles measured over a variety of sea ice types. The spectral densities are fit to Lorentzian curves to obtain the correlation length and root-mean-square height of roughness within the sampling bandpass of the LIDAR profiler. The utilization of these spectral parameters outside of their bandpass is also discussed [J2559]

"Imaging Simulation of Polarimetric SAR for a Comprehensive Terrain Scene Using the Mapping and Projection Algorithm"

A novel approach to polarimetric image simulation for synthetic aperture radar (SAR) observation over comprehensive terrain scenes is developed based on mapping and projection principles. It incorporates penetrable and impenetrable objects, volumetric and surface scatterers in the imaging space with extinction,

attenuation, shadowing, and multiple-scattering effects. Scattering of the vegetation canopy is modeled as a layer of random nonspherical particles by using the vector radiative transfer model, and scattering from the ground surface and building objects is calculated by using the integral equation method. As an example, polarimetric SAR images at L-band and C-band and the different spatial resolutions for a virtual terrain scene composed of tree canopies, farmland, buildings, rough land surface, hills, and rivers are simulated. The imaging simulation results demonstrate the feasibility of the mapping and projection approach and the potential utilities of SAR imaging simulation [J2560]

"Forest Structure Dependency of the Relation Between L-Band and Biophysical Parameters"

Biophysical parameters and L-band polarimetry synthetic aperture radar observation data were taken for 59 test sites in Tomakomai national forest, which is located in the northern part of Japan. Correlations between the derived sigmaHH0, sigmaHV0, and sigmaVV0and the biophysical parameters are investigated and yield the following results. 1) The above-ground biomass-sigma0curves saturate above 50 tons/ha for sigmaVV0, 100 tons/ha for sigmaHH0, and over 100 tons/ha for sigmaHV0when all forest species are included in the curves. 2) The sigmaHH0-above-ground biomass curve for one forest species indicates a higher saturation level than that for the other forest species. Dependence on the forest species was absent for VV polarization and low for HV polarization. 3) A simple three-component scattering model indicates that volume scattering accounts for 80%-90% when the above-ground biomass exceeds 50 tons/ha. The surface-scattering components are up to ~20% for young stands, and the volume-scattering components are down to 70%. The origin of the dependency among the forest species was examined for the sigmaHH 0-above-ground biomass. It is concluded that a possible cause of the dependency is the different characteristics of the stands rather than forest species [J2561]

"Assessment of the AMSR-E Sea Ice-Concentration Product at the Ice Edge Using RADARSAT-1 and MODIS Imagery"

Imagery from the C-band synthetic aperture radar (SAR) aboard RADARSAT-1 and the Moderate Resolution Imaging Spectroradiometer (MODIS) was used to evaluate the performance of the Advanced Microwave Scanning Radiometer-EOS (AMSR-E) ice-concentration product near the sea ice edge in the Bering Sea for four days during March 2003, which is concurrent with the AMSRIce03 field/aircraft campaign. The AMSR-E products were observed to perform very well in identifying open-water and pack-ice areas, although the AMSR-E products occasionally underestimate ice concentration in areas with thin ice. The position of the ice edge determined from AMSR-E data using a 15% concentration threshold was found to be, on average, within one AMSR-E grid square (12.5 km) of the ice edge determined from the SAR data, with the AMSR-E edge tending to be outside the SAR-derived edge [J2562]

"Supervised SAR Image MPM Segmentation Based on Region-Based Hierarchical Model"

This letter presents a novel method of supervised multiresolution segmentation for synthetic aperture radar images. The method uses a region-based half-tree hierarchical Markov random field model for multiresolution segmentation. To form the region-based multilayer model, the watershed algorithm is employed at each resolution level independently. The nodes of a quadtree in the proposed model are defined as regions instead of pixels. The relationship over scale is studied, and the region-based upward and downward maximization of posterior marginal estimations are deduced. The experimental results for the segmentation of homogeneous areas prove the region-based model much better in terms of robustness to speckle and preservation of edges compared to the pixel-based hierarchical model and the Gibbs sampler with the single-resolution model [J2563]

"An Adaptive and Iterative Method of Urban Area Extraction From SAR Images"

This letter presents a new method for unsupervised urban area extraction from synthetic aperture radar (SAR) images based on the ffmax algorithm proposed by C. Gouinaud specially for acquiring urban areas in SPOT imagery. According to the statistical characteristics of urban areas, an adaptive and iterative method based on the low-level extraction given by the ffmax algorithm using a large window is proposed. Experimental results on real SAR images show that the proposed automatic method works quickly and can preserve the borders of urban areas as well as avoid the disturbance of other classes and the extractions of urban areas are reliable and precise [J2564]

"On the Characterization of Buried Targets Under a Rough Surface Using the Wigner–Ville Transformation"

This letter considers the problem of detecting and characterizing a target buried beneath a rough surface separating two homogeneous half spaces. The problem of detecting the target is tackled by analyzing the

frequency-averaged Wigner-Ville function, the purpose of which is to filter out rough surface scattering. Characterization of the target is performed using the iterative solution derived from the Newton-Kantorovitch algorithm as applied to the Wigner-Ville function instead of the scattered field as is usually done. In addition, the scattering model involved in the inversion scheme assumes a flat interface, and surface roughness is handled as clutter. The efficiency of the approach is illustrated through numerical experiments, and the comparison between inversions from the scattered field and the Wigner-Ville function is reported [J2565]

"Multi-range-resolution radar using sideband spectrum energy"

A radar range resolution is generally determined by its transmitted pulse width and is thus a constant parameter unrelated to the detection range. However, a method has been proposed for greatly improving a radar range resolution by using signal-processing techniques to reduce the received pulse width at the expense of a high target signal-to-noise ratio. In this method, an autocorrelation output is first obtained from a time-series representation of the received signal, and this autocorrelation output is then processed using a least-squares error-shaping filter. This creates a corresponding increase in the bandwidth of the principal frequency spectrum, thereby improving the range resolution. The relationship between this spectral distribution and the range side-lobes in cases where the transmitted signal is a simple pulse or a plain phase-modulated wave is investigated. The interference cancelling effect achieved when a radar based on the proposed scheme receives interference is also investigated [J2566]

"HFSWR based on synthetic impulse and aperture processing"

A novel high-frequency surface wave radar (HFSWR) has been proposed, which is based on the principles of synthetic impulse and aperture processing. It uses multiple omnidirectional transmit antennae to simultaneously transmit a set of orthogonal waveforms, and the echoed signals are received and processed by one or multiple reception arrays. Although the transmit beam pattern is omnidirectional, by proper processing, the received signal multiple equivalent directional transmit beam patterns can be simultaneously formed. The signal processing scheme to obtain equivalent directional transmit beam pattern is investigated in detail. Considerations for system parameter selection to achieve an overall best system performance are proposed and discussed. In particular, for the novel HFSWR, target range and angle estimates are coupled together due to the orthogonality of the transmitted waveforms. A necessary and sufficient condition on the transmit antenna array geometry and transmit frequencies, which ensures that target range and angle estimates are uncoupled, is presented [J2567]

"Reducing the noise variance in ensemble-averaged randomly scaled sonar or radar signals"

Ensemble-averaged randomly scaled radar or sonar pulses are considered and the statistical theory for the corresponding phase and amplitude modulations are developed. Random scaling expresses varying radar cross-sections for scattering objects or varying antenna gain of a sweeping emitter. The noise variance of the modulations depends on the distribution function of the scaling, and how to minimise the variance by rejecting pulses below a certain amplitude threshold is shown. The theory is asymptotic in the sense that it is more accurate for increasing signal-to-noise ratios (SNRs). In a test case with uniformly distributed scaling, sufficient accuracy is reached for an average SNR larger than ~5 for the phase average and ~15 for the amplitude average [J2568]

"Likelihood function for a simple cardioid sonobuoy"

A common sonobuoy configuration comprises two horizontal dipoles mounted orthogonally together with an omnidirectional sensor. Under the assumption that, within a narrow frequency band of interest, the acoustic power impinging on the sonobuoy consists of uncorrelated Gaussian noise processes, the author examines how data collected by the sensor can be used to infer the directional distribution of the incident power, as characterised by its spherical harmonic coefficients. The results cover arbitrary directional distributions and are applicable to small, as well as large, sample sizes. The form of the likelihood function for the spherical harmonic coefficients, as required for Bayesian inference methods such as particle filtering, is particularly examined. Specific attention is given to the case of a single point source superimposed on azimuthally isotropic noise. In this case it is shown that the maximum likelihood estimator for target bearing differs from, and can be considerably more efficient than, the bearing estimator traditionally used for this sensor configuration [J2569]

"Improved clutter mitigation performance using knowledge-aided space-time adaptive processing"

This paper presents a framework for incorporating knowledge sources directly in the space-time beamformer of airborne adaptive radars. The algorithm derivation follows the usual linearly-constrained minimum-variance (LCMV) space-time beamformer with additional constraints based on a model of the clutter covariance matrix that is computed using available knowledge about the operating environment. This technique has the desirable

property of reducing sample support requirements by "blending" the information contained in the observed radar data and the a priori knowledge sources. Applications of the technique to both full degree of freedom (DoF) and reduced DoF beamformer algorithms are considered. The performance of the knowledge-aided beam forming techniques are demonstrated using high-fidelity simulated X-band radar data [J2570]

"Candidates for Election to AESS Board of Governors"

{no data available} [J2571]

"Strategy of GPR Searching for Low Radar Contrast Plastic Pipes in Ground"

The results of computer simulation of pulse signal scattering by a plastic pipe buried in the ground as well as simulation results of ground penetrating radar (GPR) image of ground-filled trenches have been represented in the work. The "skeleton diagram" of a trench image has been developed. The strategy of GPR searching for low radar contrast plastic pipes in ground (in back-filled trenches) has been considered on the basis of indirect criterion which is the existence of a trench containing buried pipes [J2572]

"Preventing Damage by Hidden Objects in Vegetation"

The paper presents the experimental radar-based sensor to operate in environment with vegetation cover for detection and discrimination there the small-sized invisible dielectric and metallic objects. This sensor constitutes a vehicle-housed emergency system for surveillance of area with vegetation ahead on the path of moving vehicle to prevent its contact with hidden objects. The emergency system functioning in basically implemented by real-time electromagnetic imaging of the scene of interest and its following image processing to enhance the target responses. The developed and tested experimental radar techniques are under consideration. The results of experimental examinations in field are presented and discussed [J2573]

"Fred Nathanson Memorial Radar Award"

{no data available} [J2574]

"Candidates for Election to AESS Board of Governors"

{no data available} [J2575]

"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 until 12 GHz. Novel principle of human being detection is considered and verified experimentally [J2576]

"Warren D. White Award for Excellence in Radar Engineering"

{no data available} [J2577]

"Warren D. White Award for Excellence in Radar Engineering Nominations Wanted"

{no data available} [J2578]

"Fred Nathanson Memorial Radar Award Nominations Wanted"

{no data available} [J2579]

"Inspection of Internal Structure of Walls by Subsurface Radar"

This paper deals with the application of ultra-wide band time-domain subsurface radars, equipped with special signal processing techniques, to realize non-invasive image testing of the building walls' internal structure that are made with brick, stone, concrete, reinforced concrete, and other construction materials. There are two normally associated problems: qualitative and quantitative, considered. Limitations and shortcomings of radar imaging, due to inherent physical features as well as signal processing improving the quality of radar images, are discussed. Actual field data are used to illustrate applications of subsurface radar for non-destructive testing of

walls' internal regions [J2580]

"Distinguished Tutorials Program"

{no data available} [J2581]

"Mobile Diagnostic Laboratory Measurements of the Transient Scattering Characteristics of a NASA Shuttle Booster Separation Motor Plume"

Field-level RCS measurements are difficult to perform in rugged, unimproved environments, even under the best of conditions. Recently, NASA tasked AFRL to measure the scattering characteristics of a solid rocket booster (SRB) booster separation motor (BSM) plume at China Lake's "Skytop" measurement facility, as part of characterizations needed to return the shuttle to safe flight. AFRL's Mobile Diagnostic Laboratory (MDL) was used to measure the RCS of six sequential booster separation motor plume firings, a major technical challenge since each burn lasts only 0.8 s. The residual smoke plume RCS was also measured during the post-firing period. The experimental setup and scattering results are described [J2582]

"The Fourth IASTED International Conference on Antennas, Radar, and Wave Propagation"

{no data available} [J2583]

"Cognitive Dynamic Systems"

{no data available} [J2584]

"Fred Nathanson Memorial Radar Award"

{no data available} [J2585]

"Richard Silberstein 100 on September 18, 2006 [JPropagation Corner]"

{no data available} [J2586]

"Solicitation for Measurements Corner / Introducing Brian Fischer and Ivan LaHaie, Associate Editors for the Measurements Corner"

{no data available} [J2587]

"Poisson representation and monte carlo estimation of generalized marcum Q-function"

We derive a new relationship which links the generalized Marcum Q-function to a probabilistic comparison of a pair of independent Poisson random variables. Consequently, a new expression for the detection probability of a series of incoherently integrated pulses, in Gaussian cluster is also derived. These results lead to simple Monte Carlo estimators of the Marcum Q-function. We thus investigate if Monte Carlo techniques are useful in the estimation of the Marcum Q-function [J2588]

"Should my daughter become an engineer?. 2 [JEthically Speaking]"

{no data available} [J2589]

"Coherence- and Amplitude-Based Analysis of Seismogenic Damage in Bam, Iran, Using ENVISAT ASAR Data"

The sensitivity of synthetic aperture radar (SAR) and interferometric SAR (InSAR) to surface properties, especially changes in height and roughness, combined with an all-weather capability, makes radar remote sensing a potential tool for mapping urban damage caused by earthquakes. With InSAR, surface displacement has been mapped successfully and in detail, but for urban-damage mapping, results have so far been less conclusive. ENVISAT Advanced SAR images of Bam, Iran, that were acquired before and after the 2003 earthquake were used. Between preseismic and coseismic image pairs, coherence decreased with increasing damage levels. However, contrary to previous studies, earthquake damage caused both increases and decreases in amplitude. Therefore, its absolute value, which correlated with damage level, was used. Individually, coherence difference led to better results than absolute amplitude change, although still with limited accuracy. The combination of both resulted in an overall accuracy of 52%. Since vegetation causes decorrelation, a predisaster Advanced Spaceborne Thermal Emission and Reflection Radiometer image was used to mask out vegetated

areas, which improved the accuracy by 4%. The ground-truth map showed damage levels per district instead of per pixel. Therefore, the ratio of pixels classified as “damage” and “nondamage” was calculated for each damage class of the map, and a clear relation was found. This shows that the aggregation level of the map partly explains the low-accuracy figures of the pixel-based evaluation. Although improvement was made, InSAR techniques for urban-damage mapping do not yet provide the accuracy levels needed for disaster mitigation. However, substantial improvements can be expected from instruments with higher spatial resolution, such as the recently launched Phased Array type L-band SAR and Terra SAR-X. [J2590]

"The early history of radio communications through the photos of the Italian Navy archives [JHistorical Corner]"

In June 2005, a special selection of images concerning the development of telecommunications, kept in the archives of the Italian Navy, were collected, selected, and organized in a panel exhibition held at the Italian Navy Academy. A selection of the rarest of these images is presented here [J2591]

"Theory and measurement of backscattering from RFID tags"

This paper presents a method for measuring signal backscattering from RFID tags, and for calculating a tag's radar cross section (RCS). We derive a theoretical formula for the RCS of an RFID tag with a minimum-scattering antenna. We describe an experimental measurement technique, which involves using a network analyzer connected to an anechoic chamber with and without the tag. The return loss measured in this way allows us to calculate the backscattered power and to find the tag's RCS. Measurements were performed using an RFID tag operating in the UHF band. To determine whether the tag was turned on, we used an RFID tag tester. The tag's RCS was also calculated theoretically, using electromagnetic simulation software. The theoretical results were found to be in good agreement with experimental data [J2592]

"An Instantaneous-Frequency Filtering Technique for High-Frequency Radar Oceanography"

High-frequency (HF) radar systems are remote sensing tools that can be used to measure oceanographic parameters. Problems can occur when using the conventional periodogram (PG) method for computing power spectral estimates from backscattered radar signals. Temporal and spatial inhomogeneities within the radar measurement region can cause distortion in the spectra. This paper describes an instantaneous-frequency (IF) filtering technique that has been developed to measure the first-order modulation contained within the radar signal. Successful removal of this modulation is shown to yield an increased quality and quantity of ocean measurements [J2593]

"Distortion of a received radar pulse due to high target velocity"

This paper presents a method to determine the signal received for the general radar problem, i.e., velocity, translation/rotation, displacement, and modifications caused by the target. In addition to the velocity and spatial/rotation, displacement effects of the radar receiver are included. The narrow-band restriction of the signal does not apply. Once the received signal is determined, it can be compared to the original transmitted signal and the changes in the radar parameters can be determined. These changes are incorporated in the matched filter processing to produce the same output wave forms as if the transmitted wave form was not modified by the motion of the target. The method uses the Poincare transform and a mathematical representation of the reflection and modifications created by the moving target. The solution for the monostatic radar case is presented in detail. Three examples are given to demonstrate the use of the method in the monostatic radar case. [J2594]

"Warren D. White Award; for Excellence in Radar Engineering"

{no data available} [J2595]

"Target Classification and Remote Sensing of Ocean Current Shear Using a Dual-Use Multifrequency HF Radar"

In this paper, we describe a high-frequency (HF) radar capable of multifrequency operation over the HF band for dual-use application to ship classification and mapping ocean current shear and vector winds. The radar is based on a digital transceiver peripheral component interconnect (PCI) card family that supports antenna arrays of four to 32 elements with a single computer, with larger arrays possible using multiple computers and receiver cards. The radar makes use of broadband loop antennas for receive elements, and a number of different possibilities for transmit antennas, depending on the operating bandwidth desired. An option exists in the choice of monostatic or multistatic operation, the latter providing the ability to use several transmit sites, with all radar echo signal reception and processing conducted at a single master receiver site. As applications for such a

multifrequency radar capability, we show measurement and modeling examples of multiple frequency HF radar cross section (RCS) of ships as an approach to ship target classification. Results of using 32 radar frequencies to measure the fine structure in ocean current vertical shear are also shown, providing evidence of one edge of a 1-3-m deep uniform flow masked at the surface by wind-driven current shear in a different direction. Other applications of current-shear measurements, such as vector wind mapping and volumetric current estimation in coastal waters, are also discussed [J2596]

"Radix-2 DIF fast algorithms for polynomial time-frequency transforms"

The polynomial time-frequency transform (PTFT) converts a one-dimensional polynomial-phase signal (PPS) into a multi-dimensional (MD) output array in the frequency domain from which the phase coefficients are estimated. To significantly reduce the prohibitive computational complexity to deal with high order PPSs, effective decomposition of the overall computational task is important for any practical applications. This paper derives a radix-2 decimation-in-frequency (DIF) fast algorithms for any order of the PPSs by using the periodic and symmetric properties of the PTFT. Compared with other reported fast algorithms, the proposed one is simple in concept and achieves a significant reduction of the required computational complexity [J2597]

"Noncoherent approach to through-the-wall radar localization"

A noncoherent through-the-wall radar system approach, based on stepped-frequency signal synthesis and trilateration technique, is presented. This approach involves multiple independent monostatic radar units and as such, provides flexibility in positioning the units with various standoff distances and inter-element spacing. The performance of the proposed noncoherent localization system was demonstrated using simulated and real data. The results show that the radar is able to detect and locate multiple targets behind walls [J2598]

"Operational Wave, Current, and Wind Measurements With the Pisces HF Radar"

This paper presents results of a trial of a Pisces HF radar system aimed at assessing its use as a component of a wave-monitoring network being installed around the coasts of England and Wales. The radar system has been operating since December 2003 and the trial continued to June 2005. The data have been processed in near-real time and displayed on a website. Radar measurements of the directional spectrum and derived parameters are compared with those measured with a directional waverider and with products from the Met Office, United Kingdom, operational wave model. Radar measurements of currents and winds are also compared with Met Office model products and, in the case of winds, with the QuikSCAT scatterometer. Statistics on data availability and accuracy are presented. The results demonstrate that useful availability and accuracy in wave and wind parameters are obtained above a waveheight threshold of 2 m and at ranges up to 120 km at the radar operating frequencies (7-10 MHz) used. Waveheight measurements above about 1 m can be made with reasonable accuracy (e.g., mean difference of 2.5% during January-February 2004). Period and direction parameters in low seas are often contaminated by noise in the radar signal. The comparisons provide some evidence of wave model limitations in offshore wind and swell conditions [J2599]

"A Microwave Tomographic Imaging Approach for Multibistatic Configuration: The Choice of the Frequency Step"

This paper deals with the application of a frequency-domain microwave-tomography-imaging algorithm to a multibistatic configuration in ground-penetrating-radar applications. First, the authors formulate the inverse problem as a linear one by exploiting the Born approximation. Then, the reconstruction capabilities of the solution algorithm are investigated, and an optimal frequency step to be adopted for the reconstruction is discussed and determined. Finally, inversion results are presented with synthetic data obtained from time-domain simulations and then Fourier transformed in frequency domain [J2600]

"Family of multicarrier bi-phase radar signals represented by ternary arrays"

A K times L ternary array, comprised of the elements {0, 1,-1}, with some unique features, represents a multicarrier radar signal with favorable autocorrelation and ambiguity functions. Constructing such an array using Galois fields is described. As in a Costas binary array, only one frequency is transmitted at any time slot, but in our array the same frequency is repeated in several time slots, yielding a signal with considerably larger pulse compression than a Costas signal that uses the same number of frequencies [J2601]

"Resolution of signal sources via spectral moment estimation"

In different practical situations it is desired to estimate the number of signal sources and their positions in space or in frequency domain. The first problem is known as the detection or the order estimation and the second one

as the resolution. For the resolution problem techniques such as nonlinear least squares (NLSM), high-order Yule-Walker method (HOYW), multiple signal classification (MUSIC), Pisarenko harmonic retrieval method, min-norm method, estimation of signal parameters by rotational invariance technique (ESPRIT), were proposed (Marple, 1987 and Stoica and Moses, 1997). All these high-resolution methods are based on the analysis of the signal covariance matrix. But the covariance matrix is not the only choice to represent the signal spectrum. In different applications (weather radars, synthetic aperture radar (SAR) signal processing, ultrasound imaging in medicine, atmospheric turbulence measurements) the signal spectrum can be modeled through its algebraic moments. Recently a number of efficient nonparametric methods have been proposed to estimate the algebraic spectral moments (Monakov, 1999). The presented paper is an attempt to solve the direction of arrival (DOA) problem via estimation of the algebraic spectral moments. A method proposed in the article is comparable in its accuracy with the MUSIC method. At the same time its computational burden is much lower. The method permits to estimate the signal power of sources easily to complete the full spectral line analysis. Additionally the method shows good robustness in situations when signal sources have noticeable spatial extend [J2602]

"From Russia without English"

First Page of the Article [J2603]

"Forward-looking radar GMTI benefits using a linear frequency diverse array"

The ability to suppress range ambiguous clutter is difficult for forward-looking arrays in GHTI processing. Use of linear frequency diverse array (FDA) is proposed, whereby each array channel operates at a different frequency and produces a range dependent pattern. The FDA significantly increases output signal-to-interference plus noise ratio (SINR) at the range ambiguous clutter Doppler, suggesting detection improvement. Output SINR is shown to increase by as much as 40 dB when compared to a constant frequency array [J2604]

"Fast convergent robust range estimator for surface-to-air missiles"

To cope with the intermittent unavailability of ground radar measurements due to jamming, a linear robust range estimation scheme utilising seeker measurements only is devised. Aside from the conventional approaches, it directly extracts range information from Doppler mismatch and line-of-sight rate measurements. The proposed filter shows good estimation performance and fast convergence with very small computational load [J2605]

"Classic Works in RF Engineering: Combiners, Couplers, Transformers, and Magnetic Materials [JBook Review]"

{no data available} [J2606]

"Implementing digital terrain data in knowledge-aided space-time adaptive processing"

Many practical problems arise when implementing digital terrain data in airborne knowledge-aided (KA) space-time adaptive processing (STAP). This paper addresses these issues and presents solutions with numerical implementations. In particular, using digital land classification data and digital elevation data, techniques are developed for registering these data with radar return signals, correcting for Doppler and spatial misalignments, adjusting for antenna gain, characterizing clutter patches for secondary data selection, and ensuring independent secondary data samples. These techniques are applied to select secondary data for a single-bin post-Doppler STAP algorithm using multi-channel airborne radar measurement (MCARM) program data. Results with the KA approach are compared with those obtained using the standard sliding window method for choosing secondary data. These results illustrate the benefits of using terrain information, a priori data about the radar, and the importance of statistical independence when selecting secondary data for improving STAP performance [J2607]

"Stap using knowledge-aided covariance estimation and the fracta algorithm"

In the airborne space-time adaptive processing (STAP) setting, a priori information via knowledge-aided covariance estimation (KACE) is employed in order to reduce the required sample support for application to heterogeneous clutter scenarios. The enhanced FRACTA (FRACTA.E) algorithm with KACE as well as Doppler-sensitive adaptive coherence estimation (DS-ACE) is applied to the KASSPER I & II data sets where it is shown via simulation that near-clairvoyant detection performance is maintained with as little as 1/3 of the normally required number of training data samples. The KASSPER I & II data sets are simulated high-fidelity heterogeneous clutter scenarios which possess several groups of dense targets. KACE provides a priori information about the clutter covariance matrix by exploiting approximately known operating parameters about the radar platform such as pulse repetition frequency (PRF), crab angle, and platform velocity. In addition, the DS-ACE detector is presented which provides greater robustness for low sample support by mitigating false

alarms from undernulled clutter near the clutter ridge while maintaining sufficient sensitivity away from the clutter ridge to enable effective target detection performance [J2608]

"Multistatic adaptive pulse compression"

A new technique denoted as multistatic adaptive pulse compression (MAPC) is introduced which exploits recent work on adaptive pulse compression (APC) in order to jointly separate and pulse compress the concurrently received return signals from K proximate multistatic radars operating (i.e., transmitting) within the same spectrum. For the return signal from a single pulse of a monostatic radar, APC estimates the particular receive filter for a given range cell in a Bayesian sense reiteratively by employing the matched filter estimates of the surrounding range cell values as a priori knowledge in order to place temporal (i.e., range) nulls at the relative ranges occupied by large targets and thereby suppress range sidelobes to the level of the noise. The MAPC approach generalizes the APC concept by jointly estimating the particular receive filter for each range cell associated with each of several concurrently-received radar return signals occupying the same spectrum. As such, MAPC is found to enable shared-spectrum multistatic operation and is shown to yield substantial performance improvement in the presence of multiple spectrum-sharing radars as compared with both standard matched filters and standard least-squares mismatched filters [J2609]

"Design and analysis of a knowledge-aided radar detector for doppler processing"

In this paper we discuss the combined use of a priori information and adaptive signal processing techniques for the design and the analysis of a knowledge-aided (KA) radar receiver for Doppler processing. To this end, resorting to the generalized likelihood function (GLF) criterion (both one-step and two-step), we design and assess data-adaptive procedures for the selection of training data. Then we introduce a KA radar detector composed of three elements: a geographic-map-based data selector, which exploits some a priori information concerning the topography of the observed scene, a data-adaptive training selector which removes dynamic outliers from the training data, and an adaptive radar detector which performs the final decision about the target presence. The performance of the KA algorithm is analyzed both on simulated as well as on real radar data collected by the McMaster University IPIX radar. The results show that the new KA system achieves a satisfactory performance level and can outperform some previously proposed adaptive detection schemes [J2610]

"An approach to knowledge-aided covariance estimation"

This paper introduces a parametric covariance estimation scheme for use with space-time adaptive processing (STAP) methods operating in heterogeneous clutter environments. The approach blends both a priori knowledge and data observations within a parameterized model to capture instantaneous characteristics of the cell under test (CUT) and reduce covariance errors leading to detection performance loss. We justify this method using both measured and synthetic data. Performance potential for the specific operating conditions examined herein include: 1) averaged behavior within roughly 2 dB of the optimal filter, 2) 1 dB improvement in exceedance characteristic relative to the optimal filter, highlighting improved instantaneous capability, and 3) impervious ness to corruptive target-like signals in the secondary data (no additional signal-to-interference-plus-noise ratio (SINK) loss, compared with 10 dB or greater loss for the standard STAP implementation), with corresponding detections comparable to the optimal filter case [J2611]

"Knowledge-aided signal processing: a new paradigm for radar and other advanced sensors"

Recently, significant progress has been made in the development of physics-based, knowledge-aided (KA) signal processing strategies supported by improvements in real-time embedded computing architectures. These developments provide designers of advanced sensor systems an unprecedented degree of flexibility when implementing next generation adaptive sensor systems. In the case of radar, this has been manifested in the first ever, real-time, KA space-time adaptive processing (KA-STAP) system for advanced clutter/interference suppression. This paper provides exemplars of real-world effects giving rise to the need for "intelligent" adaptation schemes and overviews the KA approach to sensor signal processing in some detail. Moreover, we survey a collection of papers describing recent KA sensor research that follow in this issue [J2612]

"Spectral-domain covariance estimation with a priori knowledge"

A knowledge-aided spectral-domain approach to estimating the interference covariance matrix used in space-time adaptive processing (STAP) is proposed. Prior knowledge of the range-Doppler clutter scene is used to identify geographic regions with homogeneous scattering statistics. Then, minimum-variance spectral estimation is used to arrive at a spectral-domain clutter estimate. Finally, space-time steering vectors are used to transform the spectral-domain estimate into a data-domain estimate of the clutter covariance matrix. The proposed

technique is compared with ideal performance and to the fast maximum likelihood technique using simulated results. An investigation of the performance degradation that can occur due to various inaccurate knowledge assumptions is also presented [J2613]

"Nathaniel B. Nichols"

First Page of the Article [J2614]

"Dual-band dual-polarised microstrip antenna array for SAR applications"

A novel dual-band dual-polarised microstrip antenna array for synthetic aperture radar applications with a dual-frequency ratio of about 1:3 is presented. Microstrip dipoles and square patches are used as the radiating elements at S- and X-bands, respectively. The measured bandwidth of VSWR<2 reaches 8.9% and 17% for S- and X-bands, respectively. The measured cross-polarisation levels are <-26 dB for the S-band and <-31 dB for the X-band [J2615]

"Synthetic aperture radar-moving target indicator processing of multi-channel airborne radar measurement data"

Coherent signal processing methods for combining the data that are collected via a multi-channel airborne radar system for moving target detection and image formation, are examined. Methods that convert multi-channel radar data into dual along-track monopulse synthetic aperture radar (SAR) signals of the radiated scene, are studied. A two-dimensional adaptive filtering method that projects the data in one synthesised SAR channel into the signal subspace of the other, is used for blind calibration of the monopulse SAR signals and generation of the moving target indication statistic. The merits of these algorithms are studied using the data from the multi-channel airborne radar measurement system that has been developed by the Air Force Research Laboratory at Rome, New York [J2616]

"Training strategies for joint domain localised-space-time adaptive processing in a bistatic environment"

Optimum space-time adaptive processing (STAP) requires knowledge of the true interference covariance matrix. In practice, this matrix is not known and must be estimated from training data, which must be target free and statistically homogeneous with respect to the range gate under test. These conditions are often not satisfied, which degrades the detection performance. Particularly for bistatic ground moving target indication radar, the clutter Doppler frequency depends on range for all array geometries. This range dependency leads to problems in clutter suppression through STAP techniques. The main aim in this paper is to access the relative merits of several strategies associated with STAP weight training for bistatic airborne radar applications. In particular, the issues associated with applying reduced-dimension conventional STAP and in-the-gate processing are studied. Simulation results show that, for a bistatic radar environment, in-the-gate processing approach performs better than conventional STAP approaches [J2617]

"Ambiguity function analysis of digital radio mondiale signals for hf passive bistatic radar"

Presented is an ambiguity function analysis of Digital Radio Mondiale signals in the HF band to demonstrate their suitability for HF passive bistatic radar. The ambiguities and interference floor are studied for different integration times. It is shown that interference floors of -40 dB are achieved with a 5 s integration time and that the ambiguity function properties are virtually independent of broadcast content, resulting in a very useful illuminator of opportunity [J2618]

"Review of Airport Surface Movement Radar Technology"

Runway incursion is defined by the FAA as "any occurrence at an airport involving an aircraft, vehicle, person or object on the ground that creates collision hazard or results in a loss of separation with an aircraft taking off, intending to take off, landing or intending to land." A summary of how severe this problem is can be found in a 2001 hearing before the Subcommittee on Aviation. Surface movement radar (SMR) technology has evolved over the years as part of an effort to mitigate runway incursion risks and enhance airport capacity. Surface movement surveillance systems of various types have been installed in major airports as early as the 1960s, and have kept evolving. The most recent system currently being deployed in the US by the FAA is the airport surface movement detection equipment model X (ASDE-X) system. In this system, unlike previous systems, the surface movement radar is just one of several sensors that are used in addition to transponder multilateration and GPS-based position reports, referred to as automatic dependent surveillance-broadcast or ADS-B; however, the SMR is a key subsystem. This paper contains an overview of the state-of-the-art SMR technology and provides an

introduction on the use of radar technology for this commercial application. It focuses on the architecture, characteristics and technology of the radar sensor, the characteristics of the clutter and how it affects the performance, effects of multipath, automatic detection and comparison of several sensor architectures. Sensis Corporation has recently completed the testing of a new, improved SMR, which is now part of ASDE-X system. This paper summarizes the main features of this radar [J2619]

"Nostradamus: An OTH Radar"

ONERA, funded by the French Ministry of Defence has conducted the realization and experimentations of the Doppler Skywave OTH radar called NOSTRADAMUS. One of the main characteristics of Skywave OTH radar is the dependence to the ionosphere for successful operation. The use of the HF band allows Skywave OTH radar to bounce radio waves from the ionosphere, receiving tiny signals back from reflecting surfaces as the sea, islands, ships and aircraft. The knowledge of the behavior of the ionosphere in a real time configuration is of primary importance because it influences on the choice of frequencies. Radars systems require developing a real-time frequency management system (FMS) using prediction program or measurements supplied by vertical or oblique sounders. The French OTH radar concept has been developed and implemented so that the radar could be completely autonomous with respect to others "ionospheric information providers." This paper presents the NOSTRADAMUS system, the frequency management system, and shows some results obtained during the past years [J2620]

"Ordered and chaotic electrical solitons: communication perspectives"

While the use of sinusoidal electromagnetic waves as information carriers is taken as one of the principal axioms of today's wireless system design, certain nonsinusoidal waves may further enrich the scope and capacity of modern wireless engineering. Two notable nonsinusoid examples are impulses and chaotic signals. The short temporal width of impulses has enabled applications such as ranging radars and ultra wideband (UWB). The complex nature of chaotic signals offers a new means of encrypted communication. Here we review a new circuit paradigm, the electrical soliton oscillator, which can self-generate both impulse and chaotic signals of very large bandwidth by leveraging the singular dynamics of a nonlinear wave known as the electrical soliton. By combining a nonlinear transmission line with a unique amplifier that can "tame" the inherently unruly dynamics of solitons, the oscillator self-generates a stable, periodic train of short impulses. If the taming functions of the amplifier are turned off, the circuit self-generates chaotic signals by positively exploiting solitons' unruly nature. While still in its early stages, this soliton circuit may one day serve as the heartbeat of both impulse and chaotic wireless systems [J2621]

"On the optimality of equal gain combining for energy detection of unknown signals"

In this letter, the optimally of equal gain combining (EGC) for energy detection of unknown signals in a system with receive-diversity is studied. It is shown that EGC results in an optimal test statistic for infinitesimally small signal-to-noise ratios (SNRs); however, it does not yield the optimal test for all SNR values according to the Neyman-Pearson criterion. In other words, EGC does not induce a uniformly most powerful (UMP) test for unknown signal detection [J2622]

"A -Band FMCW Radar Front-End With Adaptive Leakage Cancellation"

Monostatic frequency modulation continuous wave radars that use one antenna to simultaneously transmit and receive can result in compact and lightweight synthetic aperture radar systems. One of the greatest challenges in designing a continuous-wave monostatic radar is realizing enough isolation between the transmitter and the receiver. A novel real-time digital signal processing scheme is proposed to cancel the transmitter leakage at the receiver front-end and to achieve high isolation. With the digital implementation, the proposed scheme shows a much more precise control of the leakage cancellation when compared to conventional analog implementations. The dc-offset problem in analog mixers that affects the cancellation performance is eliminated. A radar test bed at 26 GHz has been built and tested in several radar modes. The measurement shows a leakage suppression of more than 30 dB over a 1.7-GHz sweeping bandwidth [J2623]

"Analysis of the Optimum Configuration of Roadside Units and Onboard Units in Dedicated Short-Range Communication Systems"

With the aid of a simple relation, which is analogous to the radar equation, the uplink signal strength received by the receiving module of a roadside unit (RSU) and emitted from the radiation module of an onboard unit (OBU) can be described. Setting the scale of this relation arbitrarily and determining the signal strength threshold from experimental measurements, and combined with the simulation of the radiation and the receiving pattern by cosinenfunction, the relative signal strength emitted from the OBU and received by the RSU can be calculated

successfully. From this computed relative signal strength and the threshold, the influence of the RSU and OBU mounting parameters, such as the mounting angles and mounting height, on the available communication region is analyzed. The effect of windshield fading is also considered. With the help of the analysis results, an optimum RSU and OBU mounting configuration can be easily obtained. This method can be used conveniently and successfully for very short wavelengths. This includes visible light, infrared, and even submillimeter-wave ranges. For millimeter-wave and microwave systems, this method can, in some cases, also provide a rudimentary estimation [J2624]

"Parking 2.0"

A host of new smart parking technologies are helping municipalities meet their twin aims of collecting revenue for city services and preventing a small number of cars from monopolizing a limited number of parking slots. These advances are also benefiting motorists by making the tasks of finding a space and paying to park less of a hassle. Some examples include the solar-powered smart meters which allow drivers to pay for parking with coins, credit or debit cards, or smart cards preloaded with money, and the use of wireless communications to let drivers pay for parking in advance, reserve a space, or add additional time from wherever they are. Other innovations allow drivers to use their personal computers or cellphones to select and reserve parking slots well in advance [J2625]

"Radar target identification using a likelihood ratio test and matching pursuit technique"

On the basis of likelihood ratio test (LRT) theory, a new method for radar target identification with matching pursuits, including the estimation method for target scattering response and the extraction technique for the reference atom dictionary to characterise the target scattering, is introduced. When compared with the generalised LRT (GLRT) target identification method, there is a very important contribution in our method that the whole scattering waveform, not only a few main poles, is used to identify targets without any prior parameterisation model hypothesis. Furthermore, the identification to candidate targets can be performed in an almost aspect-independent manner over a full aspect angle in white Gaussian noise through a finite size reference atom dictionary. Simulation results using scattered responses synthesised from weighted sums of some exponentially damped sinusoids and calculated scattering signatures of three thin wires through a time-domain electric field integral equation are presented to contrast the performance of our method to the GLRT and the best LRT target identification method as a function of signal-to-noise ratio [J2626]

"Range/Doppler ambiguity elimination in high-frequency chirp radars"

Range/Doppler ambiguity is an important problem in chirp radar operations with all the existing schemes for ambiguity elimination relying on multiple waveform switching. Now, a new method for ambiguity elimination is proposed. It is based on a single waveform and only involves a series of software computations associated with the instantaneous amplitudes of the target under consideration at adjacent range bins. Besides the ambiguity factor, the instantaneous range of the target is also estimated. The method can greatly improve the target detection and tracking capability of high-frequency chirp radars. Both simulation and real data processing results are demonstrated to validate of the method [J2627]

"A closed-form solution for the distribution of the sum of Nakagami-m random phase vectors"

The distribution of the modulus of the sum of random phase vectors, is of great practical importance in several applications which deal with sums of sinusoidal signals (wireless multipath transmissions, radars, optical communications, etc). In this letter, simple closed-form expressions are presented for the probability density function (PDF), the cumulative distribution function (CDF), the moment generating function (MGF) and the moments of the envelope distribution of the sum of L non-identical random Nakagami-m phase vectors with integer fading parameters. Moreover, the average over this distribution of the Gaussian Q-function and of the squared Q-function, are also presented in closed-form [J2628]

"Analysis of Surface Roughness Heterogeneity and Scattering Behavior for Radar Measurements"

The use of a theoretical backscatter model to analyze medium to low spatial resolution microwave data is still very complicated, particularly because of the difficulty in defining a unique roughness parameter, capable of adequately representing heterogeneous terrain. In this paper, an approach is proposed for roughness analysis and the modeling of backscattering, under conditions of surface heterogeneity. This paper is based on the use of a semiempirical backscattering model, defined with a single roughness parameter Zs=s2/l (s being the root mean square surface height and l the correlation length). The proposed backscattering model has been validated with integral equation model simulations, for high radar incidence angles, and within its domain of roughness validity. A range of experimental measurements was used to validate the model expressions. The effective low spatial

resolution roughness, inferred from signals backscattered from a surface of heterogeneous roughness, is defined for different roughness classes [J2629]

"Doppler Spectra From a Two-Dimensional Ocean Surface at L-Band"

An approximate time-harmonic three-dimensional electromagnetic boundary-integral method, the small-slope integral equation, is combined with a series expansion of the Creamer surface representation at second order with respect to the height, denoted by Creamer (2). The resulting model provides at low numerical cost simulations of the nonlinear ocean surface Doppler spectrum at L-band. As a result of approximations, the model is designed for a low-wind speed, typically up to 5 m/s. It is shown that applying directly a second-order model such as Creamer (2) to a semiempirical sea surface spectrum induces an unrealistic magnification of small-scale roughness that is involved in the scattering process at microwave frequencies. This paper thus proposes an undressed version of the Pierson-Moskowitz spectrum that corrects this artifact. Full-polarized Doppler simulations at L-band and 70deg incidence are presented. Effects of the surface nonlinearities are outlined, and the simulated Doppler spectra show correct variations with respect to wind speed and direction [J2630]

"Modeling and Migration of 2-D Georadar Data: A Stationary Phase Approach"

This paper presents the basic kinematic and dynamic imaging and migration equations for zero-offset two-dimensional georadar profiling. The kinematic equations are derived from simple considerations of spatial impulse responses and a generating function. The dynamic equations follow from a multidimensional stationary phase approximation to the infinite spectral integrals. They show how the radar signal (amplitude and phase) depends on the shape and curvature of the reflector. The imaging equations are evaluated for the special cases of a point scatterer, a continuous reflector, and a terminating reflector. A general formula is developed by which to migrate an arbitrary shaped event of variable amplitude on the georadar section [J2631]

"Melt Detection in Antarctic Ice Shelves Using Scatterometers and Microwave Radiometers"

Ku-band dual-polarization radar backscatter measurements from the SeaWinds-on-QuikSCAT scatterometer are used to determine periods of surface freeze and melt in the Antarctic ice shelves. The normalized horizontal-polarization radar backscatter (sigmao) and backscatter polarization ratio are used in maximum-likelihood estimation of the ice state. This method is used to infer the daily ice-surface conditions for 25 study locations located on the Ronne, Ross, Larsen, Amery, Shackleton, and other ice shelves. The temporal and spatial variations of the radar response are observed for various neighborhood sizes surrounding each given location during the study period. Criteria for determining the dates of melt onset and freeze-up for each Austral summer are presented. Validation of the ice-state and melt-onset date estimates is performed by analyzing the corresponding brightness temperature (Tb) measurements from Special Sensor Microwave/Imager (SSM/I) radiometers. QuikSCAT sigmaomeasurements from 1999 to 2003 are analyzed and found to be effective in determining periods of melt in Antarctic ice sheets at high temporal and spatial resolutions. These estimates can be used in studies of the climatic effects of the seasonal and interannual melting of the Antarctic ice sheets [J2632]

"Comments on “Compact Polarimetry Based on Symmetry Properties of Geophysical Media: The Mode”"

For original paper see Souyris et al., ibid., vol.43, no.3, p.634 (2005). In their paper Souyris et al. discussed the pi/4 mode of polarimetric SAR. Weizu Xiong feels that the calibration model used by Souyris et al. may be wrong and derives a calibration model using polar theory [J2633]

"Automatic Construction of Building Footprints From Airborne LIDAR Data"

This paper presents a framework that applies a series of algorithms to automatically extract building footprints from airborne light detection and ranging (LIDAR) measurements. In the proposed framework, the ground and nonground LIDAR measurements are first separated using a progressive morphological filter. Then, building measurements are identified from nonground measurements using a region-growing algorithm based on the plane-fitting technique. Finally, raw footprints for segmented building measurements are derived by connecting boundary points, and the raw footprints are further simplified and adjusted to remove noise caused by irregularly spaced LIDAR measurements. Data sets from urbanized areas including large institutional, commercial, and small residential buildings were employed to test the proposed framework. A quantitative analysis showed that the total of omission and commission errors for extracted footprints for both institutional and residential areas was about 12%. The results demonstrated that the proposed framework identified building footprints well [J2634]

"Correction for Rain Path Specific and Differential Attenuation of X-Band Dual-Polarization Observations"

The accuracy of attenuation correction for X-band reflectivity (Z H) and differential reflectivity (ZDR) measurements in rainfall is analyzed using coincident X-band and S-band polarimetric radar observations collected during the International H2O Project in the period of May-June 2002 at northwestern Oklahoma. Two distinct attenuation correction techniques that use the differential propagation phase shift (PhiDP) information, which is not a power-dependent measurement, as a means to provide independent estimates of path-integrated attenuation are assessed. The study is facilitated by nonattenuated X-band ZHand ZDR profiles simulated based on raindrop size distribution parameters retrieved from matched multiparameter (ZH, ZDR, and KDP) S-band observations. The major outcome of this assessment is that PhiDP-based attenuation correction for both techniques can reach almost unbiased measurements (within 5% mean relative error) and low random error (15-20% relative standard deviation). The study shows moderate differences in the error statistics of the evaluated techniques. The sensitivity of attenuation correction uncertainty with respect to the assumed variability in raindrops' oblateness-size relation and the noise in PhiDPmeasurement is also shown [J2635]

"TOPSAR: Terrain Observation by Progressive Scans"

In this paper, a novel (according to the authors' knowledge) type of scanning synthetic aperture radar (ScanSAR) that solves the problems of scalloping and azimuth-varying ambiguities is introduced. The technique employs a very simple counterrotation of the radar beam in the opposite direction to a SPOT: hence, the name terrain observation with progressive scan (TOPS). After a short summary of the characteristics of the ScanSAR technique and its problems, TOPSAR, which is the technique of design, the limits, and a focusing technique are introduced. A synthetic example based on a possible future system follows [J2636]

"Validating the SAR Wavenumber Shift Principle With the ERS–Envisat PS Coherent Combination"

Continuity of the European Remote Sensing Satellite Synthetic Aperture Radar (ERS SAR) archive by means of Envisat Advanced SAR (ASAR) data acquired from March 2002 has introduced the problem of the coherent combination of images coming from sensors with slightly different frequencies. The spectral shift principle states that in case of extended distributed targets, the frequency shift is equivalent to a change of looking angle. In this paper, the same principle is exploited to analyze the behavior of permanent scatterers (PSs) with an extension that is smaller than the ground resolution cell. The conditions under which the PSs identified by ERS can be continued by Envisat are then theoretically determined and experimentally validated. Moreover, this analysis shows that acquisitions characterized by different frequencies can be used to identify the slant-range position of scatterers with high subcell accuracy (tens of centimeters). From the processing side, a very precise images coregistration step is required to get the results described in this paper [J2637]

"Integration of Radar Interferometry and Laser Scanning for Remote Monitoring of an Urban Site Built on a Sliding Slope"

The Alpine village of Lamosano, Belluno, Italy, located near a wide and active landslide, has been seriously threatened by ground instabilities since 1960. In this paper, the results obtained by two different remote-monitoring techniques, synthetic aperature radar interferometry and three-dimensional laser-scanner imaging, planned for Lamosano hazard assessment, are presented. Both techniques compare images taken at different times to map and classify changes that occurred on the imaged scenario. The radar and laser data are gathered at the same dates with about ten-month temporal separation. The displacements measured separately by each of the two techniques highlight a similar sliding motion on the Lamosano village area, providing a good validation to each other and contributing to the definition of the village instability hazard [J2638]

"Two-Dimensional Variation Algorithm for Fractal Analysis of Sea SAR Images"

This paper proposes a novel algorithm for estimating the fractal dimension of sea synthetic aperture radar (SAR) images. The algorithm is based on the variation method, and it is suitably designed for the analysis of sea SAR images. The SAR image fractal dimension is a feature that provides a measure of the image roughness. Such a feature can play an important role in the classification process for recognizing the presence of anomalies on the sea surface. The innovation aspects of this paper are listed as follows: (1) an extension of the variation method, which was proposed for the fractal analysis of one-dimensional signals, to the case of two-dimensional (2-D) functions; (2) a numerical formulation of the variation method, which is suitable for processing 2-D discrete signals; and (3) an optimization of the algorithm for sea SAR image analysis. The algorithm is tested and validated both on simulated and real ERS-1/2 Precision Image sea SAR images and compared with the classical estimation algorithm based on spectral analysis [J2639]

"Landmines Ground-Penetrating Radar Signal Enhancement by Digital Filtering"

Until now, humanitarian demining has been unable to provide a solution to the landmine removal problem. Furthermore, new low-cost methods have to be developed quickly. While much progress has been made with the introduction of new sensor types, other problems have been raised by these sensors. Ground-penetrating radars (GPRs) are key sensors for landmine detection as they are capable of detecting landmines with low metal contents. GPRs deliver so-called Bscan data, which are, roughly, vertical slice images of the ground. However, due to the high dielectric permittivity contrast at the air-ground interface, a strong response is recorded at an early time by GPRs. This response is the main component of the so-called clutter noise, and it blurs the responses of landmines buried at shallow depths. The landmine detection task is therefore quite difficult, and a preprocessing step, which aims at reducing the clutter, is often needed. In this paper, a difficult case for clutter reduction, that is, when landmines and clutter responses overlap in time, is presented. A new and simple clutter removal method based on the design of a two-dimensional digital filter, which is adapted to Bscan data, is proposed. The designed filter must reduce the clutter on Bscan data significantly while protecting the landmine responses. In order to do so, a frequency analysis of a clutter geometrical model is first led. Then, the same process is applied to a geometrical model of a signal coming from a landmine. This results in building a high-pass digital filter and determining its cutoff frequencies. Finally, simulations are presented on simulated and real data, and a comparison with the classical clutter removal algorithm is made [J2640]

"Late-Season Rural Land-Cover Estimation With Polarimetric-SAR Intensity Pixel Blocks and -Tree-Structured Near-Neighbor Classifiers"

Synthetic aperture radar (SAR) image classification for late-season rural land-cover estimation is investigated. A novel tree-structured nearest neighbor-like classifier is applied to polarimetric SAR intensity image pixel blocks. The novel tree structure, called a sigma-tree, is generated by an ordered summation of unweighted template refinements. Computation and memory costs of a sigma-tree classifier grow linearly. The reduced costs of sigma-tree classifiers are obtained with the tradeoff of a guarantee of nearest neighbor mappings. Causal-anticausal refinement-template design methods, combined with causal multiple-stage search engine structures, are shown to yield sequential search decisions that are acceptably near-neighbor mappings. The performance of a sigma-tree classifier is demonstrated for rural land-cover estimation with detected polarimetric C-band AirSAR pixel data. Experiments are conducted on various polarization/pixel block size combinations to evaluate the relative utility of spatial-only, polarimetric-only, and combined spatial/polarimetric classifier inputs [J2641]

"On the Extension of the Minimum Cost Flow Algorithm for Phase Unwrapping of Multitemporal Differential SAR Interferograms"

In this paper, an extension of the minimum cost flow (MCF) algorithm dealing with a sparse data grid, which allows the unwrapping of multitemporal differential synthetic aperture radar (SAR) interferograms for the generation of deformation time series, is presented. The proposed approach exploits both the spatial characteristics and the temporal relationships among multiple interferograms relevant to a properly chosen sequence. In particular, the presented solution involves two main steps: first of all, for each arc connecting neighboring pixels on the interferometric azimuth/range grid, the unwrapped phase gradients are estimated via the MCF technique applied in the temporal/perpendicular baseline plane. Following this step, these estimates are used as a starting point for the spatial-unwrapping operation implemented again via the MCF approach but carried out in the azimuth/range plane. The presented results, achieved on simulated and real European Remote Sensing satellite SAR data, confirm the effectiveness of the extended MCF unwrapping algorithm [J2642]

"Reply to Comments on “Compact Polarimetry Based on Symmetry Properties of Geophysical Media: The Mode”"

For original paper see Souyris et al., ibid., vol.43, no.3, p.634 (2005) and for comment see Weizu Xiong, ibid., vol.44, no.9, p.2617 (2006). In their paper Souyris et al. discussed the pi/4 mode of polarimetric SAR. In the comment Weizu Xiong felt that the calibration model used by Souyris et al. could be wrong and derived a calibration model using polar theory. Souyris responds to these remarks [J2643]

"International Radar Symposium in Krakow, Poland IRS 2006"

{no data available} [J2644]

"Correspondence"

{no data available} [J2645]

"Three-dimensional tracking of humans using very low-complexity radar"

First Page of the Article [J2646]

"Radar Conference 2007"

{no data available} [J2647]

"Foreword"

{no data available} [J2648]

"Radar: A Case History of an Invention was prepared as a Term Report for a Research Seminar in Technological Innovation"

{no data available} [J2649]

"Radar: A Case History of an Invention [JThe Evolution of an Innovation] John B. McKinney"

{no data available} [J2650]

"A new DOA estimation technique based on subarray beamforming"

A new direction-of-arrival (DOA) estimation technique using subarray beamforming is proposed. Two virtual subarrays are used to form a signal whose phase relative to the reference signal is a function of the DOA. The DOA is then estimated based on the computation of the phase shift between the reference signal and its phase-shifted version. Since the phase-shifted reference signal is obtained after interference rejection through beamforming, the effect of cochannel interference on the estimation is significantly reduced. The proposed technique is computationally simple, and the number of signal sources detectable is not bounded by the number of antenna elements used. Performance analysis and extensive simulations show that the proposed technique offers significantly improved estimation resolution, capacity, and accuracy relative to existing techniques [J2651]

"Immunity tests of implantable cardiac pacemaker against CW and pulsed ELF fields: experimental and numerical results"

The aim of the present work is to investigate pacemaker (PMK) immunity against high-level extremely low frequency (typically 50 Hz) magnetic fields that can be found in industrial environment where high power machines operate. To that purpose, a test bench has been set up using a Helmholtz coil for producing extremely low frequency magnetic fields and a trunk simulator rightly fed by cardiac signals. A widely used PMK was tested, and results have been reported, under different operating conditions, for both continuous waves and variously pulsed excitations. A numerical tool has also been developed to analyze the realized test bench, based on a proper discretization of a human trunk simulation and on the construction of an equivalent three-dimensional (3-D) network. Numerical results have showed a good agreement with the experimental results [J2652]

"RF radiation properties of printed-circuits boards in a GTEM cell"

The behavior of reradiated fields from printed-circuits boards (PCBs), with the radar cross section being the main parameter of interest, is investigated in this paper. A rigorous approach to predict radiation from PCBs in a gigahertz transverse electromagnetic cell is presented. The analysis is based upon the use of the reciprocity theorem in combination with the method of moment applied to the scattered field, thus yielding a generalized impedance matrix, whose determinant represents the characteristic polynomial of the scattering system. The effectiveness of the method is demonstrated by investigating some canonical circuit configurations and structures illustrating sources of fundamental electromagnetic interference mechanism. The validity and the accuracy of the analysis becomes obvious in view of the one-to-one correlation with measurements [J2653]

"Statistics of the radio-frequency signal based on K distribution with application to echocardiography"

We study in this paper the statistics of the radio frequency (RF) signal in the case of partially developed speckle. Using the K distribution framework, we give the probability density function of the associated distribution, the corresponding moments, and estimators for the parameters of the distribution. The consistency of the proposed estimators is evaluated in terms of their bias and variance through numerical simulations. The ability of the

proposed distribution to model RF echographic signals from cardiac tissues is evaluated from data acquired in vivo [J2654]

"Advance Path Measurement for Automotive Radar Applications"

Millimeter-wave automotive radars are currently being used for adaptive cruise control. To extend their application to collision warning and collision avoidance, increased capability is required in the assessment of hazards and the environment. A signal processing scheme called the advance path measurement (APM) algorithm, which extracts the trajectory of the road path ahead of a radar-equipped vehicle, is presented as a step toward increasing current capabilities. A millimeter-wave radar-equipped vehicle with data logging facilities was used to record real-time millimeter-wave radar data. The recorded data were used as the primary input to the algorithm discussed in this paper. The data were signal processed to generate an image, which was then analyzed using image processing techniques to extract road edge features, using thresholding, peak detection, and Hough transformation. The performance of the APM algorithm was examined by comparing the radar-derived radius of curvature with a digital map database, global positioning system (GPS) position, and yaw-rate data. The results obtained from the radar-derived APM algorithm provide an encouraging basis for continuing its development [J2655]

"Improvements of Complex-Valued Hopfield Associative Memory by Using Generalized Projection Rules"

In this letter, new design methods for the complex-valued multistate Hopfield associative memories (CVHAMs) are presented. We show that the well-known projection rule proposed by Personnaz can be generalized to complex domain such that the weight matrix of the CVHAM can be designed by using a simple and effective method. The stability of the proposed CVHAM is analyzed by using energy function approach which shows that in synchronous update mode the proposed model is guaranteed to converge to a fixed point from any given initial state. Moreover, the projection geometry of the generalized projection rule (GPR) is discussed. In order to enhance the recall capability, a strategy of eliminating the spurious memories is also reported. The validity and the performance of the proposed methods are investigated by computer simulation [J2656]

"July 2006 Distinguished lecturers"

First Page of the Article [J2657]

"SAR Sensor Trajectory Deviations: Fourier Domain Formulation and Extended Scene Simulation of Raw Signal"

Synthetic aperture radar (SAR) raw signal simulation is a useful tool for SAR system design, mission planning, processing algorithm testing, and inversion algorithm design. A two-dimensional (2-D) Fourier domain SAR raw signal simulator, exploiting the efficiency of fast Fourier transform algorithms, has been presented some years ago and is able to generate the raw signal corresponding to extended scenes. However, it cannot account for the effects of sensor trajectory deviations with respect to the nominal straight-line path. This paper explores the possibility of extending the efficient Fourier domain simulation approach to the case of sensor trajectory deviations, which is more realistic for airborne SAR systems. We first of all obtain a general and compact Fourier domain formulation of the SAR raw signal in the presence of arbitrary trajectory deviations, and show that in this general case no efficient simulation scheme can be devised. However, we demonstrate that, if a narrow beam and slow trajectory deviation assumption is made, a full 2-D Fourier domain simulation can be used. This approach can be applied only to some SAR systems and/or trajectory deviations, but it has the advantage that processing time is practically not increased with respect to the nominal trajectory case. The validity limits of the approach are analytically evaluated. Some simulation results are finally presented in order to verify the effectiveness of the proposed simulation scheme. In another paper, which is the second part of this work, it will be shown that the narrow beam-slow deviation assumption can be relaxed, at the expense of computation efficiency, if a one-dimensional azimuth Fourier domain processing followed by a range time-domain integration is used [J2658]

"Closed-form solutions for number of beams in static and rotating phased array radars"

Closed-form solutions for the number of beams required to scan a volume of space for both static and rotating phased array radars are presented. The total number of array beams for n-array faces to perform a 360° volume surveillance can then be obtained in a straightforward manner. [J2659]

"Correspondence"

{no data available} [J2660]

"Blind Calibration and DOA Estimation With Uniform Circular Arrays in the Presence of Mutual Coupling"

In smart antenna systems, mutual coupling between elements can significantly degrade the performance of array processing algorithms. Based on the special structure of coupling matrix, this letter presents a subspace-based blind calibration method for uniform circular arrays. The method uses the incident signals to carry out both direction of arrival (DOA) estimation and array calibration simultaneously. In addition, the parameter identifiability condition is also provided. Finally, representative computer simulation results are given to demonstrate the effectiveness and behavior of the proposed method [J2661]

"Effective bandwidth SF-CW SAR increase using frequency agility"

The use of a frequency-agile waveform is proposed as a way of providing significantly increased bandwidth for a stepped frequency continuous wave (SF-CW) SAR, than is provided by traditional imaging schemes. The range resolution is set by the bandwidth of the transmitted waveform, and is built up as a set of monotonically increasing stepped frequencies. As these frequencies are sampled sequentially, a constraint with SF-CW waveforms is the time restriction available to build up the bandwidth, imposed by the spatial sampling requirements along the aperture to avoid grating-lobe effects. To address this problem, an approach is outlined which allows the frequency spectrum to be greatly undersampled to provide a greater effective bandwidth. It was found that randomizing the set of frequencies omitted from sweep to sweep allowed significant thinning before the appearance of significant unwanted image artifacts due to the under-sampling. This scheme allows great flexibility in the choice of bandwidths that can be realized for a particular imaging scenario. Their application is considered from the point of view of operation from UAV SAR platforms [J2662]

"Meetings"

{no data available} [J2663]

"Radar moves to Boston for 2007"

{no data available} [J2664]

"Waveform diversity & design"

First Page of the Article [J2665]

"Titan, fractals, and filtering of Cassini altimeter data"

Fractal behavior of one Titan profile acquired by the Cassini altimeter during its first flyby is demonstrated and quantitatively analyzed. The inadequacy of popular nonfractal models to represent scale-dependent behavior is also discussed. Our results lead to the conjecture that a proper geometrical model of the Titan surface is provided by the fractional Brownian motion stochastic process and that the particular acquired profile has a fractal dimension of about 2.4. In addition, use of the developed statistical model allows the design of model-based filters for a significant improvement of the measurement accuracy, at the expense of the horizontal resolution [J2666]

"Detecting scene changes using synthetic aperture Radar interferometry"

In repeat-pass interferometric synthetic aperture radar (SAR), man-made scene disturbances are commonly detected by identifying changes in the mean backscatter power of the scene or by identifying regions of low coherence. Change statistics such as the sample mean backscatter-power ratio and the sample coherence, however, are susceptible to high false-alarm rates unless the change in the mean backscatter power is large or there is sufficient contrast in scene coherence between the changed and unchanged regions of the image pair. Furthermore, as the sample mean backscatter-power ratio and sample coherence measure different properties of a SAR image pair, both change statistics need to be considered to properly characterize scene changes. In this paper, models describing the changed and unchanged regions of a scene are postulated, and the detection problem is expressed in a Bayesian hypothesis-testing framework. Forming the log-likelihood ratio gives a single sufficient statistic, encoding changes in both the coherence and the mean backscatter power, for discriminating between the unchanged- and changed-scene models. The theoretical detection performance of the change statistic is derived and shows a significant improvement over both the sample mean backscatter-power ratio and sample coherence change statistics. Finally, the superior detection performance of the log-likelihood change

statistic is demonstrated using experimental data collected using the Defence Science and Technology Organisation's Ingara X-band airborne SAR [J2667]

"MST-based stepwise connection strategies for multipass Radar data, with application to coregistration and equalization"

This paper proposes a unified framework for predicting optimized pairing strategies for interferometric processing of multipass synthetic aperture radar data. The approach consists in a minimum spanning tree (MST) structure based on a distance function encoding an a priori model for the interferometric quality of each image pair. Using a distance function modeled after the interferometric coherence allows reproducing many "small baseline" strategies presented in the recent literature. A novel application of the method to the processing steps of image coregistration and equalization is illustrated, using a test European Remote Sensing Satellite dataset. Widespread methods used for these two operations rely on the computation of the amplitude cross correlation over a large number of corresponding tie patches distributed over the scene. Geometric shift and radiometric equalization parameters are estimated over the patches and used, respectively, within a polynomial warp model and a radiometric correction scheme. The number of reliable patches available behaves similarly to the interferometric synthetic aperture radar (InSAR) coherence with respect to the baselines, and can be assimilated to a quality figure for the derivation of the MST. Results show an improvement in the quality of the stepwise (SW)-processed image stack with respect to the classical single-master procedure, confirming that the SW approach is able to provide better conditions for the estimation of correlation-related InSAR parameters [J2668]

"Azimuthal anisotropy of scatterometer measurements over land"

Studies of the Earth's land surface involving scatterometers are becoming an increasingly important application field of microwave remote sensing. Similarly to scatterometer observations of ocean waves, the backscattering coefficient (sigma0) response of land surfaces depends on both the incidence and azimuth angle under which the observations are made. In order to retrieve geophysical parameters from scatterometer data, it is necessary to account for azimuthal-modulation effects of the backscattered signal. In the present study, this paper localizes the regions affected by a strong azimuthal signal dependence when observed with the European Remote Sensing Satellite Scatterometer and the SeaWinds Scatterometer on QuikSCAT (QSCAT). The possible physical reasons for the azimuthal effects, relating the very detailed QSCAT azimuthal response to the spatial orientation of special topographic features and land cover within the sensor footprint, were then discussed. Different methods for normalizing the backscattering coefficient with respect of observation azimuth angle were also proposed and evaluated. First, the mean local incidence angle of the sensor footprint using the shuttle radar topography mission digital elevation model (DEM) were modeled and concluded that the resolution of the DEM is too coarse to characterize most of the observed azimuthal effects. A more effective way of normalizing the backscatter with respect to azimuth is then found to be by using historical backscatter observations to statistically determine the expected backscatter at each observation azimuth and incidence angle as well as time of the year. The efficiency of this method is limited to the availability of past measurements for each location on the Earth [J2669]

"Comparison of NASA Team2 and AES-york ice concentration algorithms against operational ice charts from the Canadian ice service"

Ice concentration retrieved from spaceborne passive-microwave observations is a prime input to operational sea-ice-monitoring programs, numerical weather prediction models, and global climate models. Atmospheric Environment Service (AES)-York and the Enhanced National Aeronautics and Space Administration Team (NT2) are two algorithms that calculate ice concentration from SpecialSensor Microwave/Imager observations. This paper furnishes a comparison between ice concentrations (total, thin, and thick types) output from NT2 and AES-York algorithms against the corresponding estimates from the operational analysis of Radarsat images in the Canadian Ice Service (CIS). A new data fusion technique, which incorporates the actual sensor's footprint, was developed to facilitate this study. Results have shown that the NT2 and AES-York algorithms underestimate total ice concentration by 18.35% and 9.66% concentration counts on average, with 16.8% and 15.35% standard deviation, respectively. However, the retrieved concentrations of thin and thick ice are in much more discrepancy with the operational CIS estimates when either one of these two types dominates the viewing area. This is more likely to occur when the total ice concentration approaches 100%. If thin and thick ice types coexist in comparable concentrations, the algorithms' estimates agree with CIS's estimates. In terms of ice concentration retrieval, thin ice is more problematic than thick ice. The concept of using a single tie point to represent a thin ice surface is not realistic and provides the largest error source for retrieval accuracy. While AES-York provides total ice concentration in slightly more agreement with CIS's estimates, NT2 provides better agreement in retrieving thin and thick ice concentrations [J2670]

"Automated delineation of dry and melt snow zones in Antarctica using active and passive microwave observations from space"

This paper presents the algorithms and analysis results for delineating snow zones using active and passive microwave satellite remote sensing data. With a high-resolution Radarsat synthetic aperture radar (SAR) image mosaic, dry snow zones, percolation zones, wet snow zones, and blue ice patches for the Antarctic continent have been successfully delineated. A competing region growing and merging algorithm is used to initially segment the SAR images into a series of homogeneous regions. Based on the backscatter characteristics and texture property, these image regions are classified into different snow zones. The higher level of knowledge about the areal size of and adjacency relationship between snow zones is incorporated into the algorithms to correct classification errors caused by the SAR image noise and relief-induced radiometric distortions. Mathematical morphology operations and a line-tracing algorithm are designed to extract a vector line representation of snow-zone boundaries. With the daily passive microwave Special Sensor Microwave/Imager (SSM/I) data, dry and melt snow zones were derived using a multiscale wavelet-transform-based method. The analysis results respectively derived from Radarsat SAR and SSM/I data were compared and correlated. The complementary nature and comparative advantages of frequently repeated passive microwave data and spatially detailed radar imagery for detecting and characterizing snow zones were demonstrated [J2671]

"Bistatic scattering from three-dimensional layered rough surfaces"

An analytical method to calculate the bistatic-scattering coefficients of a three-dimensional layered dielectric structure with slightly rough interfaces is presented. The interfaces are allowed to be statistically distinct, but possibly dependent. The waves in each region are represented as a superposition of an infinite number of up- and down-going spectral components whose amplitudes are found by simultaneously matching the boundary conditions at both interfaces. A small-perturbation formulation is used up to the first order, and the scattered fields are derived. The calculation intrinsically takes into account multiple scattering processes between the boundaries. The formulation is then validated against known solutions to special cases. New results are generated for several cases of two- and three-layer media, which will be directly applicable for modeling of the signals from radar systems and subsequent estimation of a layered medium subsurface properties, such as moisture content and layer depths [J2672]

"Introduction"

First Page of the Article [J2673]

"Signal Waveform's Optimal-under-Restriction Design for Active Sensing"

We consider Signal Waveform's Optimal-under-Restriction Design (SWORD) for active sensing. In the presence of colored interference and noise with known statistical properties, waveform optimization for active sensors such as radar can significantly increase the signal-to-interference-plus-noise ratio needed for much improved target detection. However, the so-obtained optimal waveforms can result in significant modulus variation, poor range resolution, and/or high peak sidelobe levels. To mitigate these problems, we can constrain the waveform optimization problem by restricting the sought-after waveform to be similar to a desired waveform, which is known to have, for example, constant modulus as well as reasonable range resolution and peak sidelobe level. One example of the desired waveform is the widely used linear frequency modulated waveform or chirp. We will provide a detailed solution to the constrained optimization problem and explain how it is related with the existing waveform optimization methods [J2674]

"On the Fractional Wideband and Narrowband Ambiguity Function in Radar and Sonar"

We construct the wideband ambiguity function for signals represented by their fractional Fourier transforms. Because the reflected signal must be represented as a Doppler scaled version of the transmitted signal, this wideband form of ambiguity does not enjoy many of the same properties as the narrowband form (which is formed from a Doppler shifted version of the signal). We present the general result and also examine an approximation appropriate to wideband signals reflected from slowly moving targets [J2675]

"On the Fourier Transform of Finite Chirps"

In this letter, closed-form expressions for the discrete Fourier transform (DFT) of a finite chirp are derived. It is shown that when the normalized chirp rate is coprime with the chirp length, then the DFT of a finite chirp is again a finite chirp with magnitude, chirp rate, and carrier frequency appropriately scaled. In particular, when the normalized chirp rate is of unit value, then the DFT of a finite chirp is the same chirp, up to a complex scaling factor. Conversely, when the normalized chirp rate has a common factor with the chirp length, then the support

of the DFT of a finite chirp is equal to the ratio of chirp length and the common factor. Among other things, results given here complement certain results, obtained by Janssen, on the computation of time-continuous chirps with rational sweep rates [J2676]

"SAR image filtering based on the heavy-tailed Rayleigh model"

Synthetic aperture radar (SAR) images are inherently affected by a signal dependent noise known as speckle, which is due to the radar wave coherence. In this paper, we propose a novel adaptive despeckling filter and derive a maximum a posteriori (MAP) estimator for the radar cross section (RCS). We first employ a logarithmic transformation to change the multiplicative speckle into additive noise. We model the RCS using the recently introduced heavy-tailed Rayleigh density function, which was derived based on the assumption that the real and imaginary parts of the received complex signal are best described using the alpha-stable family of distribution. We estimate model parameters from noisy observations by means of second-kind statistics theory, which relies on the Mellin transform. Finally, we compare the proposed algorithm with several classical speckle filters applied on actual SAR images. Experimental results show that the homomorphic MAP filter based on the heavy-tailed Rayleigh prior for the RCS is among the best for speckle removal [J2677]

"A Metric for Automatic Word-Length Determination of Hardware Datapaths"

A metric for the automatic determination of word lengths required for implementing DSP algorithms is proposed. The metric is capable of handling several error models computed between the fixed-point and the floating-point simulation results to model the impact of finite word lengths on the overall accuracy. It grades all the word-length combinations and guides a procedure towards the optimal solution. This metric was implemented in an automatic word-length determination tool to guide its search for better hardware implementations. It enables the creation of a framework for architecture and platform exploration [J2678]

"Legislating Entrepreneurship: An Oxymoron?"

Can the passage of a federal law help entrepreneurs? This is not just an academic question. It arises frequently in federal policy discussions regarding the Internet, most recently during the net neutrality debate. Fostering entrepreneurial markets requires decisive commitment to a set of regulatory rules. However, passing major new legislation is rarely decisive; more frequently, it signals the opening of a multiple-act legal and regulatory soap opera. This point is not widely appreciated or acknowledged. Many politicians speak as if they have never thought about the topic. Yet, the events following the passage of the 1996 Telecommunications Act, which is used as an example in this article, amply illustrate the typical response to new legislation [J2679]

"Optimal design of spectrum constrained analog signal sets with correlation analysis"

This paper is concerned with the design of an optimal set of analog signals with prescribed magnitude spectrum and quadratic phase structure such that the maximum cross-correlation is minimized. An analytic expression for the maximum cross-correlation between two signals is derived through mathematical analysis. The optimal set of signals with the lowest maximum cross-correlation is explicitly characterized under certain conditions [J2680]

"Student Crossword Puzzle"

{no data available} [J2681]

"Antennas: state of the art"

Aim of this contribution is to illustrate the state of the art of smart antenna research from several perspectives. The bow is drawn from transmitter issues via channel measurements and modeling, receiver signal processing, network aspects, technological challenges towards first smart antenna applications and current status of standardization. Moreover, some future prospects of different disciplines in smart antenna research are given [J2682]

"Overview of generalized monopulse estimation"

Monopulse is an established technique for radar angle estimation. One can show that monopulse estimation is based on a general approximation derived from maximum likelihood (ML) estimation. This tutorial provides a derivation of this relation and presents extensions of this monopulse principle to multi-dimensional array and parameter estimation problems, in particular to space-time adaptive processing (STAP) with reduced dimension, subarrays and generalized sidelobe canceller (GSLC) configurations. The performance of these monopulse applications can be predicted by exploiting the distribution of the monopulse ratio. It is demonstrated that this

distribution is more realistic than the Cramer-Rao bound (CRB). Several examples of performance of monopulse estimators are given for thinned and fully filled planar arrays, adaptive beamforming with and without low sidelobes, GSLC, and STAP. Finally, conditions for estimates with low variance are discussed [J2683]

"European Microwave Week"

{no data available} [J2684]

"CuTE: curb tracking and estimation"

The number of road accident related fatalities and damages are reduced substantially by improving road infrastructure and enacting and imposing laws. Further reduction is possible through embedding intelligence onto the vehicles for safe decision making. Road boundary information plays a major role in developing such intelligent vehicles. A prominent feature of roads in urban, semi-urban, and similar environments, is curbs on either side defining the road's boundary. In this brief, a novel methodology of tracking curbs is proposed. The problem of tracking a curb from a moving vehicle is formulated as tracking of a maneuvering target in clutter from a mobile platform using onboard sensors. A curb segment is presumed to be the maneuvering target, and is modeled as a nonlinear Markov switching process. The target's (curb's) orientation and location measurements are simultaneously obtained using a two-dimensional (2-D) scanning laser radar (LADAR) and a charge-coupled device (CCD) monocular camera, and are modeled as traditional base state observations. Camera images are also used to estimate the target's mode, which is modeled as a discrete-time point process. An effective curb tracking algorithm, known as Curb Tracking and Estimation (CuTE) using multiple modal sensor information is, thus, synthesized in an image enhanced interactive multiple model filtering framework. The use and fusion of camera vision and LADAR within this frame provide for efficient, effective, and robust tracking of curbs. Extensive experiments conducted in a campus road network demonstrate the viability, effectiveness, and robustness of the proposed method [J2685]

"Channel allocation for priority packets in the GPRS network"

As the general packet radio service (GPRS) network begins to provide such as "push-to-talk" (PTT) service, delay-sensitive packets should be given higher priority in transmission. In this paper, we study two channel allocation schemes that implement priority queues for priority packets in the GPRS network: bitmap channel allocation (BCA) and uplink state flag channel allocation (USFCA). Our study shows that the transmission delay of priority packets in the GPRS network can be better guaranteed using USFCA [J2686]

"Engineering Warms to Frozen Light"

As the last cofferdam holding the waters of China's Yangtze River was blown up in a series of blasts over a 12-second period on June 6, 2006, the 2.5-km wide dam now holds the full force of the river and is ready to ramp up to its total rated electrical capacity of 22,400 megawatts. The caps of the fourteen 700-MW turbines in the generator room of the dam's left bank are now in full operation, and another 18 turbines are set to be installed in a similar room on the dam's right bank. Despite controversy surrounding the project's environmental, social and economic implications, many are optimistic that it will fulfil its prodigious promise [J2687]

"Dependence between standard deviation and measurement length for C-band backscattering signatures of the Baltic Sea ice"

This paper studies whether the standard deviation (std) of the Baltic Sea ice backscattering coefficient (sigmadeg) depends on the length of measurement (l). For many kinds of surfaces, especially for a fractal one, this is the case. The study was conducted using one-dimensional C-band helicopter-borne scatterometer data and ENVISAT synthetic aperture radar (SAR) images. The results with both data sets indicate mostly a strong linear dependence between ln(l) and ln(std(sigmadeg)) up to a distance of at least a few kilometers. Based on the analysis of empirical and simulated data (fractal and nonfractal profiles), it seems that sea ice sigmadeg as a function of l is not completely described either by fractional Brownian motion or by a process with a single-scale autocorrelation function. Neither can the values of sigmadeg be regarded as samples from only one probability distribution. The regression coefficients describing the dependency of ln(l) versus ln(std(sigmadeg)) do not discriminate various ice types better than just mean and std of sigmadeg. However, the use of regression coefficients instead of mean and std is preferred due to their scale-invariant comparability with the results of other studies. The dependence of std(sigmadeg) on l should also be taken generally into account in the data analysis, e.g., when constructing classifiers for sea ice SAR data [J2688]

"A numerical study of the modulation of ShortSea waves by longer waves"

The spatial spectrum of short sea waves is locally modulated by the presence of longer waves or currents; in the remote sensing literature, this process is described by the hydrodynamic modulation transfer function (HMTF). Such modulations are important in understanding radar images of sea waves with water wavelengths longer than the radar range resolution. Existing models for the HMTF utilized in remote sensing are based on approximations derived from consideration of conservation of wave action. However, the accuracy of these approximations has been quantified only through comparison with experimental data; in such comparisons, numerous empirical models for terms such as wind forcing and breaking wave dissipation are required, which make direct evaluation of the hydrodynamic effects difficult. A method for providing direct insight into the hydrodynamic modulation of short sea waves by longer waves is described in this paper, through use of numerical nonlinear hydrodynamic codes for sea surface evolution. The codes applied are reviewed, and a Monte Carlo simulation process based on a stochastic spectrum of short waves propagating over a single deterministic long wave is described, including the data analysis techniques developed to extract a numerical HMTF from the simulated surfaces. HMTF values obtained from the simulations are compared with those from a first-order wave action solution and are found to be in reasonable agreement, although differences on the order of 10% are observed. A numerical evaluation of long wave effects on the short wave dispersion relation is also provided [J2689]

"Azimuth fractional transformation of the fractional chirp scaling algorithm (FrCSA)"

The fractional chirp scaling algorithm (FrCSA) is based on the use of the fractional Fourier transform (FrFT) within the chirp scaling algorithm (CSA). In this paper, a closed-form expression for the azimuth FrFT of the FrCSA is mathematically derived and analyzed from the high-resolution synthetic aperture radar imaging point of view. The azimuth-FrFT expression of the FrCSA is compared to that of the classical fast Fourier transform (FFT)-based CSA. As the FFT is a special case of the generalized FrFT, the derived expression is found to be in total agreement with that of the FFT-based CSA when the transformation order is equal to unity; that is the angle of rotation is equal to pi/2 [J2690]

"Investigations on the polarimetric behavior of a target near the soil"

The polarimetric behavior of the diffracted field from an object located close to the ground is investigated for a varying incidence angle. Here, the field is described by the geometrical theory of diffraction in accordance to its asymptotic formulas (krarrinfin). As a result, a ray system composed of 13 different rays was implemented for the monostatic case by applying the principle of Fermat. The different spatial and creeping waves give a physical insight in the mechanisms involved in the entire scattering process. By varying the angle from perpendicular to grazing incidence 0deg-90deg, geometrical surface shadow boundaries are present for the backscattered field. At such boundaries, the spatial waves are replaced by their corresponding creeping waves, leading to a strong attenuation. The diffracted field for look angles related to the transition zones has a characteristic polarimetric behavior, which can be represented on the Poincare sphere. The typical locations on the sphere can be exploited to get information about the geometrical parameters of the target and its height above the ground [J2691]

"Junction-aware extraction and regularization of urban road networks in high-resolution SAR images"

A general processing framework for urban road network extraction in high-resolution synthetic aperture radar images is proposed. It is based on novel multiscale detection of street candidates, followed by optimization using a Markov random field description of the road network. The latter step, in the path of recent technical literature, is enriched by the inclusion of a priori knowledge about road junctions and the automatic choice of most of the involved parameters. Advantages over existing and previous extraction and optimization procedures are proved by comparison using data from different sensors and locations [J2692]

"A hybrid time-domain model of electromagnetic induction from conducting, permeable targets"

Electromagnetic induction (EMI) is a popular technique to detect and discriminate buried unexploded ordnance (UXO). However, modeling of the EMI response from many types of UXO is difficult due to the small skin depth of the interior fields. In grid-based numerical methods, meshing the target volume or surface to resolve the skin depth is often highly impractical, yet a failure to do so yields inaccurate results. This paper addresses the problem with a time-domain hybrid technique based on thin-skin approximation (TSA) that is very accurate for small skin depths. The TSA method is applied to axisymmetric problems and is shown to be both fast and accurate when the skin depth is small. The method is compared with analytical results, and excellent agreement is obtained. For magnetic materials (such as steel), the TSA method is accurate for the complete time-domain EMI response. In such cases, the TSA method provides an improved accuracy along with an order-of-magnitude

reduction in CPU time compared to a dense-mesh finite-element method (FEM). For nonmagnetic materials, the TSA loses accuracy as time progresses and must be combined with a coarse-mesh FEM. In such cases, the combined method still provides greater accuracy with comparable CPU time [J2693]

"Properties of surface waveguides derived from inversion of fundamental and higher mode dispersive GPR data"

Thin surface layers of high-permittivity material (e.g., water-saturated soil) can cause a pronounced dispersion of ground-penetrating radar waves. The dispersion characteristics depend on the permittivity and thickness of the effective surface waveguide and the permittivity of the material below it. As for the analogous seismic case, the values of these parameters can be estimated by applying a scheme that includes calculating the phase-velocity spectra, picking dispersion curves from the spectra, and inverting the dispersion curves using a combined local and global minimization procedure. Here, this scheme is extended by incorporating higher order modes. Explicit expressions for the cutoff frequencies of the fundamental and higher order transverse electric (TE) and transverse magnetic (TM) modes are derived. These expressions demonstrate that the cutoff frequency decreases as the thickness and/or permittivity of the waveguide increase and/or the permittivity of the lower half-space decreases. In addition, the TE cutoff frequencies are shown to be generally lower than the TM cutoff frequencies. Numerical modeling of realistic models demonstrates the presence of the higher order modes with the correct cutoff frequencies. Application of the modified inversion scheme to synthetic and field data demonstrates its efficacy in providing the required physical property information. In particular, better-constrained models are obtained by including higher order modes in the inversion [J2694]

"Enhanced Simulation of Radar Backscatter From Forests Using LiDAR and Optical Data"

Focusing on a forest dominated by Poplar Box (Eucalyptus populnea) near Injune in Queensland, Australia, light detection and ranging (LiDAR) and optical remote sensing data are integrated with tree- and stand-level information to parameterize a coherent L-band synthetic aperture radar (SAR) imaging simulation that models microwave penetration and interaction with the canopy, understory, and ground. The approach used LiDAR data to generate a three-dimensional representation of the distribution of tree components (leaves and small branches) by species (based on 1-m3voxels) and the ground surface. Tree trunks were mapped across a 7.5-ha forest stand using a LiDAR-derived height-scaled crown openness index. Primary and secondary branches were modeled as tapering cylinders and linked the canopy voxels to the LiDAR trunks. The dimensions of vegetation and soil components and their geometric and dielectric properties required by the model were calibrated with field-based measurements. Visual and numerical comparison between NASA JPL Airborne SAR data and the model simulation suggests the effective modeling of SAR imagery at L-band. The study provides a proof-of-concept approach for integrating LiDAR data in the parameterization of coherent SAR simulation models, and the model presents options for better understanding of the information content of SAR data in real forest situations [J2695]

"Polarimetric Features of Oyster Farm Observed by AIRSAR and JERS-1"

The polarimetric features of an oyster farm in a coastal area are analyzed to verify the applicability of radar polarimetry and interferometry. L-band Airborne Synthetic Aperture Radar (AIRSAR) data and Japan Earth Resources Satellite (JERS-1) data are used to examine the unique structure of an oyster farm located in South Korea. A specific feature of the oyster farm is the presence of numerous arrays of structures of various orientations that consist of exercise-bar-shaped poles protruding above sea level. This paper demonstrates that tide level is strongly correlated with the double-bounce scattering power from the vertical pole structures. This phenomenon is also verified by laboratory measurements using a network analyzer. In the laboratory experiment, double-bounce scattering and total power showed increasing trends with increased height of the vertical poles. Single-bounce scattering is sensitive to the orientation of horizontal poles relative to antenna orientation. HH-polarization is the most effective technique for imaging oyster farms from L-band polarimetric AIRSAR data. The authors were able to use a three-component decomposition of the AIRSAR data to distinguish an exposed tidal flat from a submerged tidal flat. The characteristics of the exposed tidal flat are similar to those of the carbon sponge in the laboratory test, except that the double-bounce scattering power is slightly greater in the real-world example. The single-bounce scattering component in AIRSAR data is generally greater than that in laboratory measurements because of sea-surface conditions and oyster growth. When the horizontal pole was aligned normal to the radar look direction, single-bounce scattering was greater than the double-bounce scattering, even under water-covered conditions. While a difference in tide height of 10 cm contributed approximately 3.0 dB in the laboratory experiment, a difference in tide height of 20 cm contributed to only approximately 1.7 dB in the JERS-1 SAR-- image intensity. JERS-1 SAR image intensity for areas dominated by double- and single-bounce scattering was 0.78 and 0.56, respectively. Results confirm that polarimetric SAR data are useful in selecting areas dominated by double-bounce scattering in oyster farms [J2696]

"Focusing of General Bistatic SAR Configuration Data With 2-D Inverse Scaled FFT"

This paper presents a bistatic focusing solution for the general case, when transmitter and receiver trajectories move along nonparallel trajectories with different velocities. The approach in this paper is based on the point target reference spectrum for an arbitrary bistatic configuration, derived from our previous publications. Based on various simulations, the validity of the formula for both airborne and spaceborne configurations is demonstrated. Focusing for special bistatic azimuth time-invariant configurations, "tandem" and "translationally invariant" constellations are accomplished. All focusing algorithms have been developed in an interactive data language and verified with adequate simulation results. The bistatic algorithm was further successfully applied to real bistatic data acquired by the German Research Establishment for Applied Natural Sciences' PAMIR and AER-II synthetic aperture radar systems. Processing in the general case turns out to be additionally truly azimuth time variant. It is solved by implementing a novel two-dimensional inverse-scaled fast Fourier transform algorithm [J2697]

"Change Detection of Multitemporal SAR Data in Urban Areas Combining Feature-Based and Pixel-Based Techniques"

In this paper, the problem of change detection from synthetic aperture radar (SAR) images is addressed. Feature-level change-detection algorithms are still in their preliminary design stage. Indeed, while pixel-based approaches are already implemented into existing, commercial software, this is not the case for feature comparison approaches. Here, the authors propose a joint use of both approaches. The approach is based on the extraction and comparison of linear features from multiple SAR images, to confirm pixel-based changes. Though simple, the methodology proves to be effective, irrespectively of misregistration errors due to reprojection problems or difference in the sensor's viewing geometry, which are common in multitemporal SAR images. The procedure is validated through synthetic examples, but also two real change-detection situations, using airborne and satellite SAR data over the area of the Getty Museum, Los Angeles, as well as over an area around the city of Bam, Iran, stricken in 2003 by a serious earthquake [J2698]

"Geometrical SAR image registration"

Accurate subpixel registration of synthetic aperture radar (SAR) images is an issue that is again growing interest since its initial developments related to two-pass interferometry. Recent progress in coherent (multichannel) SAR processing raises the need for accurate registration of data takes acquired with large baseline spans, high temporal coverage, and with different frequency and/or operational modes. In this paper, we discuss a SAR image-registration procedure, based on the use of external measures which allows obtaining a very accurate alignment of SAR images. The presented technique makes use of a digital elevation model and of the precise information about the acquisition flight tracks, to compute the warping functions that map the position of each pixel in the different takes, thus avoiding any approximation. The resulting algorithm is simple, robust, precise, and very efficient; as a matter of fact, it may achieve high accuracy even in critical areas, such as steep topography regions. Moreover, the availability of an analytical and exact model allows performing a detailed sensitivity analysis that can be useful in evaluating the applicability of this technique even to future high-precision satellite systems. Extensive testing, carried out on several real European Remote Sensing and ENVISAT datasets, clearly shows the effectiveness of such algorithm in registering critical SAR images [J2699]

"Efficient simulation of airborne SAR raw data of extended scenes"

In a previous paper, a two-dimensional Fourier domain synthetic aperture radar (SAR) raw signal simulator that exploits the efficiency of fast Fourier transform algorithms was presented. It accounts for the effects of sensor trajectory deviations and is able to generate the raw signal corresponding to extended scenes in a few seconds. However, a narrow-beam-slow-deviation assumption is made; hence, the approach can be applied only to some SAR systems and/or trajectory deviations. To overcome this limitation, in this paper, we show that the narrow-beam-slow-deviation assumption can be relaxed, at the expense of computation efficiency, if use is made of one-dimensional azimuth Fourier domain processing followed by range time-domain integration. The latter approach only requires some reasonable assumptions on the sensor motion and on the SAR system features; hence, it can be used for airborne SAR systems, and turns out to be still much more efficient than the time-domain one; hence, extended scenes can still be considered. Validity limits of the approach are also analytically evaluated, and several simulation results are finally presented to verify the effectiveness of the proposed simulation scheme [J2700]

"Partially Supervised Oil-Slick Detection by SAR Imagery Using Kernel Expansion"

Spaceborne synthetic aperture radar (SAR) is well adapted to detect ocean pollution independently from daily or

weather conditions. In fact, oil slicks have a specific impact on ocean wave spectra. Initial wave spectra may be characterized by three kinds of waves, namely big, medium, and small, which correspond physically to gravity and gravity-capillary waves. The increase of viscosity, due to the presence of oil damps gravity-capillary waves. This induces not only a damping of the backscattering to the sensor but also a damping of the energy of the wave spectra. Thus, local segmentation of wave spectra may be achieved by the segmentation of a multiscale decomposition of the original SAR image. In this paper, a semisupervised oil-slick detection is proposed by using a kernel-based abnormal detection into the wavelet decomposition of a SAR image. It performs accurate detection with no consideration to signal stationarity nor to the presence of strong backscatters (such as a ship). The algorithm has been applied on ENVISAT Advanced SAR images. It yields accurate segmentation results even for small slicks, with a very limited number of false alarms [J2701]

"Generalized minimum-error thresholding for unsupervised change detection from SAR amplitude imagery"

The availability of synthetic aperture radar (SAR) data offers great potential for environmental monitoring due to the insensitiveness of SAR imagery to atmospheric and sunlight-illumination conditions. In addition, the short revisit time provided by future SAR-based missions will allow a huge amount of multitemporal SAR data to become systematically available for monitoring applications. In this paper, the problem of detecting the changes that occurred on the ground by analyzing SAR imagery is addressed by a completely unsupervised approach, i.e., by developing an automatic thresholding technique. The image-ratioing approach to SAR change detection is adopted, and the Kittler and Illingworth minimum-error thresholding algorithm is generalized to take into account the non-Gaussian distribution of the amplitude values of SAR images. In particular, a SAR-specific parametric modeling approach for the ratio image is proposed and integrated into the thresholding process. Experimental results, which confirm the accuracy of the method for real X-band SAR and spaceborne imaging radar C-band images, are presented [J2702]

"On the Development of an Integrated CMOS-Based UWB Tunable-Pulse Transmit Module"

A novel low-cost low-power fully integrated tunable transmit module composed of a tunable CMOS monocycle pulse generator and compact uniplanar antenna was designed, built, and tested for ultra-wideband (UWB) impulse systems. The CMOS tunable pulse generator integrates a tuning delay circuit, square-wave generator, impulse-forming circuit, and pulse-shaping circuit in a single chip using a standard low-cost 0.25-mum CMOS process. It can generate a monocycle pulse and Gaussian-type impulse (without the pulse-shaping circuitry) signals with tunable pulse duration. A compact uniplanar UWB antenna was also developed and integrated directly with the CMOS pulse generator chip to form the complete integrated tunable UWB transmit module. Measured results show that the CMOS tunable pulse generator can produce a 0.3-0.6-V peak-to-peak monocycle pulse with 140-350-ps tunable pulse duration and a 0.5-1.3-V peak-to-peak impulse signal with 100-300-ps tunable pulse-duration, and the uniplanar antenna has less than a 18-dB return loss and is suitable for transmitting/receiving UWB time-domain impulse signals covering the entire UWB bandwidth of 3.1-10.6 GHz. Good agreement between measured and calculated performance is also achieved. The UWB transmit module was experimentally characterized and its performance is verified. This UWB module finds applications in various time-domain UWB systems including wireless communications and radar [J2703]

"An Efficient Method of Eliminating the Range Ambiguity for a Low-Cost FMCW Radar Using VCO Tuning Characteristics"

This paper describes a simple method of eliminating the range ambiguity and the design approach for low-cost and small-size homodyne frequency-modulated continuous-wave (FMCW) radars. The range measurement accuracy could be efficiently improved by proper time gating of the beat signal without any closed-loop linearity compensation circuitry for typical varactor-tuned voltage-controlled oscillators (VCOs). The presented selectively gated fast Fourier transformation method is immune to the frequency shift of the VCOs. A W-band FMCW radar using a raw varactor-tuned VCO having the percent linearity of 7.16% was implemented, and achieved less than 2% ranging error of the target lying at 200 m. Owing to the simple structure and fast processing speed, this method is applicable to the various low-cost radar sensors for ranging and detection [J2704]

"Distinguished Tutorials Program-an update"

{no data available} [J2705]

"Acronym Addiction"

This paper presents an alphabetical listing of some of the most commonly used acronyms and abbreviations in

the electronics industry along with brief definitions [J2706]

"Radar cross-section enhancement of dihedral corner reflector using fractal-based metallo-dielectric structures"

Effective use of fractal-based metallo-dielectric structures for enhancing the radar cross-section (RCS) of dihedral corner reflectors is reported. RCS enhancement of about 30 dBsm is obtained for corner reflectors with corner angles other than 90deg. This may find application in remote sensing and synthetic aperture radar [J2707]

"Mobile services interworking for IMS and XML webservices"

An approach for interoperability between IMS and WebServices deployed within the IMS domain through the introduction of session management techniques for stateless WebServices based on existing SIP session management mechanisms is presented. The approach enables integration of WebServices applications into future telecommunications systems without the need for explicit usage of IMS/SIP protocols [J2708]

"Design and implementation"

{no data available} [J2709]

"Wideband Extended Range-Doppler Imaging and Waveform Design in the Presence of Clutter and Noise"

This paper presents a group-theoretic approach to address the wideband extended range-Doppler target imaging and design of clutter rejecting waveforms. An exact imaging method based on the inverse Fourier transform of the affine group is presented. A Wiener filter is designed in the affine group Fourier transform domain to minimize wideband clutter range-Doppler reflectivity. The Wiener filter is then used to form an operator to precondition transmitted waveforms to reject clutter. Alternatively, the imaging and clutter rejection methods are equivalently re-expressed to perform clutter suppression upon reception. These methods are coupled with noise suppression upon reception. Numerical simulations are performed to demonstrate the performance of the proposed approach. Our study shows that the framework introduced in this paper can address the joint design of receive and transmit processing, design of clutter rejecting waveforms, suppression of noise, and reduction of computational complexity in receive processing [J2710]

"Estimating volume change of mountain glaciers using SRTM and map-based topographic data"

This paper describes a method for estimating the volume change of mountain glaciers using the Shuttle Radar Topography Mission (SRTM) C-band data (2000) and a digital elevation model (DEM) generated from topographic maps. This approach was developed with SRTM data and topographic maps of 1: 25 000 scale (1977) from the Akshiirak glaciers (Tien Shan, Central Asia). The DEM for 1977 was generated using 10-m contour lines from 18 map sheets covering the Akshiirak massif and surrounding area. The nominal vertical accuracy of the maps is 3.3 m. The standard deviation of the differences between the map-derived DEM and the SRTM data on glacier-free areas of less than 25deg is 6.3 m. A single localized region in the western periphery of the study area with systematic error in the SRTM data from -20 to 12 m on a 30-km spatial scale was found and excluded from the error analysis. Assuming a 10-m map error on the upper snow-covered glacier areas, the estimated root-mean-square error of the glacier surface change is 8.2 m. From 1977 to 1999, the average glacier surface thinning is 15.1 m, and the estimated volume loss is 6.15 km3. The rate of the Akshiirak glacier volume loss has increased by 2.7 times, compared with historical data from 1943 to 1977. The SRTM data show an opportunity for quantifying climatic and dynamic surface elevation changes in mountain glaciers. Ice, Cloud, and land Elevation Satellite (ICESat) laser altimetry and SRTM data could also be used for the estimation of short-term surface changes of mountain glaciers [J2711]

"Fair polyline networks for constrained smoothing of digital terrain elevation data"

In this paper, a framework for smoothing gridlike digital terrain elevation data, which achieves a fair shape by means of minimizing an energy functional, is presented. The minimization is performed under the side condition of hard constraints, which comes from available horizontal and vertical accuracy bounds in the standard elevation specification. In this paper, the framework is introduced, and the suitability of this method for the tasks of accuracy-constrained smoothing, feature-preserving smoothing, and filling of data voids is demonstrated [J2712]

"A wafer-scale 3-D circuit integration technology"

The rationale and development of a wafer-scale three-dimensional (3-D) integrated circuit technology are described. The essential elements of the 3-D technology are integrated circuit fabrication on silicon-on-insulator wafers, precision wafer-wafer alignment using an in-house-developed alignment system, low-temperature wafer-wafer bonding to transfer and stack active circuit layers, and interconnection of the circuit layers with dense-vertical connections with sub-Omega 3-D via resistances. The 3-D integration process is described as well as the properties of the four enabling technologies. The wafer-scale 3-D technology imposes constraints on the placement of the first lithographic level in a wafer-stepper process. Control of wafer distortion and wafer bow is required to achieve submicrometer vertical vias. Three-tier digital and analog 3-D circuits were designed and fabricated. The performance characteristics of a 3-D ring oscillator, a 1024 times 1024 visible imager with an 8-mum pixel pitch, and a 64 times 64 Geiger-mode laser radar chip are described [J2713]

"2006 IEEE Radar Conference"

{no data available} [J2714]

"Radar modelling to improve CFAR performance in the littoral"

Littoral operation of radars poses severe signal processing difficulties due to the highly stressing, inhomogeneous clutter. This report describes an initial investigation into the feasibility of utilising site specific radar modelling to provide a localized estimate of the clutter statistics which can then be used to predict the required threshold to maintain a given false alarm rate. The technique has been applied to littoral clutter recordings obtained from the experimental S-band phase array radar, MESAR2. Results are presented for the technique in comparison with a conventional, non-adaptive, cell averaging CFAR. The paper concludes that significant performance enhancements are possible through the use of this new technique [J2715]

"Correspondence"

{no data available} [J2716]

"The race with destiny (1935-1939): Phase IV of the invention of radar"

First Page of the Article [J2717]

"The arrival of radar (1930-1935): Phase III of the invention of radar"

First Page of the Article [J2718]

"The rise of radio (1922-1930): Phase II of the invention of radar"

First Page of the Article [J2719]

"Radar becomes operational (1939-1941): Phase V of the invention of radar"

First Page of the Article [J2720]

"Chronology of the Development of Radar [JInside Back Cover]"

{no data available} [J2721]

"Epilogue"

First Page of the Article [J2722]

"Obstacles and roadblocks: a summary"

First Page of the Article [J2723]

"Preface"

First Page of the Article [J2724]

"Radar: a case history of an invention (the evolution of an innovation)"

{no data available} [J2725]

"Radar: a reluctant miracle"

{no data available} [J2726]

"Introduction"

First Page of the Article [J2727]

"The long prelude (1873-1922): Phase I of the invention of radar"

First Page of the Article [J2728]

"What is radar?"

First Page of the Article [J2729]

"The fathers of radar"

First Page of the Article [J2730]

"Integrated beam synthesis and performance analysis of a spaceborne SAR antenna"

A set of tools to accomplish beam synthesis for synthetic-aperture radar antennas is presented. The synthesis process optimizing the beam properties is guided by criteria of the radar performance in terms of range ambiguities and noise-equivalent backscattering coefficient. The tools implemented with MATLABP are validated with examples of beams generated by RADARSAT [J2731]

"Lossless Information Fusion for Active Ranging and Detection Systems"

The authors develop a centralized information fusion architecture from basic principles of information theory and Bayesian statistics. It is well known that any clustering, quantizing, or thresholding of data causes loss of information unless a sufficient statistic is computed in the processing. For the case of wideband active ranging systems, the coherent output of an optimum beamformer and a matched filter is a sufficient statistic that can be transmitted to the fusion center. For unknown target velocity, range, and bearing, the wideband space-time matched filter output can be interpreted as a multidimensional wavelet transform or a delay-scale-bearing map. In this paper, a Bayesian, joint estimation-detection approach is used for computation of sufficient statistics and multisensor information fusion. An approach borrowed from sequential Bayesian processing is used to compute prior densities for joint Bayesian estimation-detection. In this approach, a posteriori densities become priors after a coordinate transformation that transforms the outputs of each sensor to a common reference frame for all sensors. Reproducing prior densities are used to simplify Bayesian computation [J2732]

"Maximum Likelihood Estimation of Compound-Gaussian Clutter and Target Parameters"

Compound-Gaussian models are used in radar signal processing to describe heavy-tailed clutter distributions. The important problems in compound-Gaussian clutter modeling are choosing the texture distribution, and estimating its parameters. Many texture distributions have been studied, and their parameters are typically estimated using statistically suboptimal approaches. We develop maximum likelihood (ML) methods for jointly estimating the target and clutter parameters in compound-Gaussian clutter using radar array measurements. In particular, we estimate i) the complex target amplitudes, ii) a spatial and temporal covariance matrix of the speckle component, and iii) texture distribution parameters. Parameter-expanded expectation-maximization (PX-EM) algorithms are developed to compute the ML estimates of the unknown parameters. We also derived the Cramer-Rao bounds (CRBs) and related bounds for these parameters. We first derive general CRB expressions under an arbitrary texture model then simplify them for specific texture distributions. We consider the widely used gamma texture model, and propose an inverse-gamma texture model, leading to a complex multivariate t clutter distribution and closed-form expressions of the CRB. We study the performance of the proposed methods via numerical simulations [J2733]

"Target Detection and Localization Using MIMO Radars and Sonars"

In this paper, we propose a new space-time coding configuration for target detection and localization by radar or sonar systems. In common active array systems, the transmitted signal is usually coherent between the different elements of the array. This configuration does not allow array processing in the transmit mode. However, space-time coding of the transmitted signals allows to digitally steer the beam pattern in the transmit in addition to the

received signal. The ability to steer the transmitted beam pattern, helps to avoid beam shape loss. We show that the configuration with spatially orthogonal signal transmission is equivalent to additional virtual sensors which extend the array aperture with virtual spatial tapering. These virtual sensors can be used to form narrower beams with lower sidelobes and, therefore, provide higher performance in target detection, angular estimation accuracy, and angular resolution. The generalized likelihood ratio test for target detection and the maximum likelihood and Cramer-Rao bound for target direction estimation are derived for an arbitrary signal coherence matrix. It is shown that the optimal performance is achieved for orthogonal transmitted signals. Target detection and localization performances are evaluated and studied theoretically and via simulations [J2734]

"Imaging Through Unknown Walls Using Different Standoff Distances"

In through-the-wall imaging, errors in wall parameters cause targets to be imaged away from their true positions. The displacement in target locations depend on the accuracy of the estimates of the wall parameters as well as the target position relative to the antenna array. A technique using two or more standoff distances of the imaging system from the wall is proposed for application under wall parameter ambiguities. Two different imaging schemes can then be applied to correct for errors in wall characteristics. The first scheme relies on forming target displacement trajectories, each corresponding to a different standoff distance, and assuming different values of wall thickness and dielectric constant. The target position is then determined as the trajectories crossover point. In the second scheme, an image sequence is generated. Each specific image in this sequence is obtained by summing those corresponding to different standoff distances, but with the same assumed wall parameters. An imaging-focusing metric can then be adopted to determine the target position. The paper analyzes the above two schemes and provides extensive simulation examples demonstrating their effectiveness [J2735]

"Bistatic SAR Processing and Experiments"

Bistatic synthetic aperture radar (SAR) uses a separated transmitter and receiver flying on different platforms to achieve benefits like exploitation of additional information contained in the bistatic reflectivity of targets, reduced vulnerability for military applications, forward-looking SAR imaging, or increased radar cross section. Besides technical problems such as synchronization of the oscillators, involved adjustment of transmit pulse versus receive gate timing, antenna pointing, flight coordination, and motion compensation, the development of a bistatic focusing algorithm is still in progress and not sufficiently solved. As a step to a numerically efficient processor, this paper presents a bistatic range migration algorithm for the translationally invariant case, where transmitter and receiver have equal velocity vectors. In this paper, the algorithm was successfully applied to simulated and real bistatic data. The real bistatic data have been acquired with the Forschungsgesellschaft fur Angewandte Naturwissenschaften (FGAN)'s X-band SAR systems, namely the Airborne Experimental Radar II and the Phased Array Multifunctional Imaging Radar, in October 2003 [J2736]

"Improved Methods for Analysis of Decadal Elevation-Change Time Series Over Antarctica"

In this paper, several techniques to improve the processing and analysis of decadal elevation-change time series (ECTS) constructed using satellite radar altimeter data over the Antarctic ice sheet are described. First, a method that improves both the quality and quantity of ice-sheet ECTS is introduced. By dynamically selecting the reference month used in constructing ECTS for a given local region, the maximum number of elevation-change estimates are used in a matrix processing technique. This can improve ECTS quality while also generating ECTS in new areas, leading to a significant increase in spatial coverage. Next, an improved autoregressive (IAR) approach is presented for modeling nonlinear medium-period variations in decadal Antarctic ECTS. This builds upon previous work where an AR model was used to characterize seasonal and interannual variations in ice-sheet ECTS. The improved approach avoids overdecomposition by adopting an iterative local average filter to estimate nonlinear medium-period trends. Monte Carlo simulations show that the IAR method significantly outperforms the AR method when realistic nonlinear trends are present. Because of these characteristics, the IAR model is able to adequately characterize seasonal, interannual, and medium-period nonlinear signals present in decadal ECTS and extract their long-term trends with very small error. This is important for accurate measurement of decadal elevation change over the Antarctic ice sheet and for assessing the impact of these changes on the global sea level [J2737]

"Fast Approximate Inverse Power Iteration Algorithm for Adaptive Total Least-Squares FIR Filtering"

The presence of contaminating noises at both the input and the output of an finite-impulse-response (FIR) system constitutes a major impediment to unbiased parameter estimation. The total least-squares (TLS) method is known to be effective in achieving unbiased estimation. In this correspondence, we develop a fast recursive

algorithm with a view to finding the TLS solution for adaptive FIR filtering. Given the fact that the TLS solution is obtainable via inverse power iteration, we introduce a novel but approximate inverse power iteration in combination with Galerkin method so that the TLS solution can be updated adaptively at a lower computational cost. We also take advantage of the regular form of the TLS solution to constrain the last element of the filter parameter vector to the negative one. We further reduce the computational complexity of the developed algorithm by making efficient computation of the fast gain vector defined in and using rank-one update of the augmented autocorrelation matrix. The developed algorithm saves seven M MAD's (number of multiplies, divides, and square roots) when compared with the recursive TLS algorithm in . Moreover, unlike the algorithms given in and, the developed algorithm does not deal with the solution to a one-variable quadratic equation and it avoids square root operation. Therefore, it has the simpler structure and may be more easily implemented. We then make a careful investigation into global convergence of the developed algorithm. Simulation results are provided that clearly illustrate appealing performance of the developed algorithm, including its good long-term numerical stability [J2738]

"Generalization of Results on Vector Sampling Expansion"

This paper addresses the problem of parsimonious sampling of filtered signals. A vector of bandlimited signals is passed through a multiple-input multiple-output (MIMO) filter and then sampled. Conditions on the sampling rates are presented that allow for perfect reconstruction of the original signals. We extend previous results in two aspects. First, we allow for different bandwidths in signal vector entries while previous results were restricted to the same bandwidth in all entries. Second, we emphasize the parsimonious aspect of the sampling. Namely, in each case, including those previously treated, we highlight the gains which can be made via downsampling [J2739]

"Short Courses"

{no data available} [J2740]

"ICONIC 2007"

{no data available} [J2741]

"North-American Radio Science Meeting 2007"

{no data available} [J2742]

"Fawwaz T. Ulaby-Receives 2006 IEEE Edison Medal"

{no data available} [J2743]

"On Nonparametric Estimation of 2-D Smooth Spectra"

We consider the problem of smoothed nonparametric estimation of two-dimensional (2-D) spectra. In the one-dimensional (1-D) scenario, several methods have been developed in the past for the computation of nonparametric spectral estimates with lower variance than that of the standard periodogram. Some of these techniques can also be extended to the 2-D case. However, such methods usually require a careful selection of certain design parameters, which can be hard to make. The spectral estimator proposed here is based on cepstrum thresholding and is shown to have significantly lower variance than the standard 2-D periodogram. Moreover, the thresholding is performed in a simple and practically automatic manner without the requirement of extensive prior knowledge about the signal of interest [J2744]

"Optimizing Polyphase Sequences for Orthogonal Netted Radar"

Orthogonal netted radar transmitter signals require a very low aperiodic autocorrelation peak sidelobe level (PSL), low aperiodic cross-correlation, and a good resilience to small Doppler shifts. A new set of polyphase sequences is presented with good correlation properties as well as resilience to Doppler shifts. These sequences are built using numerical optimization based on correlation properties. A structural constraint is imposed on the optimized polyphase sequences, which maintains Doppler tolerance. Cross entropy (CE) technique is used to optimize the sequences. Correlation and Doppler results are compared with best-known sequences on various merit factors and shown to be superior [J2745]

""Flashing Fields" in nearly simultaneous ENVISAT and ERS-2 C-band SAR images"

Large differences are observed between radar backscatter measurements made by the ENVISAT and ERS-2 satellite synthetic aperture radars, within 30 min of each other over certain agricultural fields in Flevoland, The Netherlands. The differences appear to be caused by the presence of highly directive scattering combined with very small variations in the azimuth illumination angle of the two sensors at the degree or subdegree level. There is relatively little awareness of such sensitivity to illumination direction, and it is not predicted by models for microwave interaction usually applied to soils and vegetation. It is, however, to be expected if there are significant contributions from coherent scattering extending over patches of the agricultural fields in question. We present analysis that supports such a conclusion. [J2746]

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с использованием специализированного программного модуля (ПИО ТУСУР)