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

# ТЕМАТИЧЕСКИЙ РЕФЕРАТИВНЫЙ СБОРНИК № 5-2/2

## “Doppler Effect”
## («Доплеровский эффект»)

Публикации в трудах конференций

**Источник**: *Digital Library IEEEXplore*
**Язык**: *английский*
**Глубина поиска**: *2001 – 2006 гг.*
**Дата формирования**: *март 2011 г.*
**Составитель**: *В.И. Карнышев*

**Томск – 2011**

# ТЕМАТИЧЕСКИЙ РЕФЕРАТИВНЫЙ СБОРНИК № 5-2/2

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## "Performance Analysis of Partially Coherent Frequency-Selective Channels with Doppler Shift"

Simulation results are presented to demonstrate the effect of Doppler frequency shift on the error rate performance of partially coherent PSK systems in frequency-selective environment. Frequency-selective fading channels are modeled as two-ray Rayleigh fading in where the presence of the delayed ray cases intersymbol interference (ISI). We consider diversity system with L-branch signals that being detected using postdetection equal-gain combining (EGC) receiver. The effect of ISI on the system performance is assessed using exhaustive method in where a truncated pulse train of the ISI signal is considered. Square root raised-cosine filters are used in both the transmitter and receiver for an optimum performance in a band-limited channels. The results are discussed and specified using a useful time-reduction quasi-analytical simulation technique [C1059]

## "Effect of Dummy elements on a Monopole Array-assisted Doppler Spread Compensator for Digital Terrestrial Television Broadcasting Receiver"

In this paper, we propose a monopole array-assisted Doppler spread compensator with dummy elements for digital terrestrial television broadcasting receiver. Although authors are already proposed an array antenna assisted Doppler spread compensator, it is sensitive to mutual coupling among elements in terms of compensation performance. In order to solve this problem, dummy elements, placed at either end of an array antenna, mitigate performance degradation arising from the mutual coupling among monopole array elements. Computer simulation results show that the dummy elements can reduce performance degradation due to mutual coupling as well as expand the operating bandwidth of a Doppler spread compensator [C1060]

## "Throughput optimization of cooperative UAVs using adaptive channel assignment"

The wireless link represents the bottleneck in the communication of a group of cooperative unmanned airborne vehicles (UAVs). Due to the high speed of the UAVs, the nature of the environments where they are usually deployed and the possible intentional jamming that might exist, the effect of phenomena such as multipath propagation and Doppler spread is more pronounced. In this paper, we propose an adaptive channel assignment (ACA) strategy for allocating the available bandwidth, which is divided into a number of sub-channels, over a number of communications links in a network of UAVs. The proposed ACA algorithm has two main advantages over the static channel assignment (SCA) approach. First, it maximizes the overall throughput of the UAVs network and second, it significantly reduces the probability of outage in the system defined as the percentage of time the links are incapable of supporting a minimum required transmission rate that is determined by the application. The ACA approach is formulated in terms of a binary optimization problem that is solved using the branch-and-bound method. We assume that the links in the network are Rayleigh faded and we use a finite state Markov chain (FSMC) for their modeling. Using Monte Carlo simulations, we show that the proposed channel assignment approach provides a significant gain in the overall throughput and reduction in the outage probability compared to the SCA [C1061]

## "Incorporating Pulse-to-Pulse Motion Effects into Side-Looking Array Radar Models"

A technique is presented for incorporating pulse-to-pulse (inter-pulse) motion effects into side-looking array radar data models yielding a motion-sensitive space-time snapshot. Low flying, highly-maneuverable unmanned aerial vehicles (UAV) represent a potential worst case application scenario given their roll, yaw, and pitch rates are primarily limited by structural integrity. High degrees of maneuverability during the coherent processing interval (CPI) allow clutter and target returns to change significantly. The technique presented uses M coordinate transformations to describe platform attitude variations throughout the CPI. Ward's model then is extended to incorporate maneuver-induced changes in spatial frequency and Doppler. The new motion-sensitive space-time snapshot is used to characterize space time adaptive processing (STAP) performance without motion-compensation applied. Results clearly show motion-induced clutter-null broadening with measurable degradation of STAP algorithm minimal discernable velocity [C1062]

## "B-field diagnostics in transient plasmas"

Summary form only given. Measurements of magnetic fields are a key issue in many studies of equilibrium and transient laboratory plasmas. However, the traditional techniques are not useful in situations where the magnetic field has no definite direction during the time of observation, or for magnetic fields with amplitudes that vary in time or space, e.g. in laser-produced or pinch plasmas. To overcome these difficulties, a new spectroscopic approach was proposed, applicable to measurements of such "isotropic" magnetic fields. The technique is based on the spectroscopic analysis of line-shapes of different fine-structure components of the same atomic multiplet that undergo different splitting under the B-field. Another advantage of this method is that, when coupled with detailed line-shape calculations, it allows for an accurate B-field determination even when the line-shapes are strongly influenced by Stark and Doppler broadenings in the plasma. Here we report on an experimental implementation of the proposed method to measure the magnetic field in a laser-produced plasma injected into a coaxial vacuum transmission line carrying a 200-kA current. The pulsed magnetic and electric fields, generated in the transmission line, are of spatially varying orientations at the plasma boundary. This causes a complex motion of the plasma particles, that is further complicated due to the 3-D geometry of the experimental setup. This results in a twisting and a depolarization of the magnetic field lines in the plasma. The profiles of spectral lines emitted by the plasma demonstrate complex shapes due to the combined inhomogeneous Stark, Zeeman, and Doppler broadenings. Nevertheless, using the method presented, the magnetic field is determined unambiguously. Magnetic-field penetration into the plasma that is faster than the diffusing rate expected from the Spitzer resistivity is observed. The results here presented demonstrate the powerfulness of the method as a tool for single-sho--t measurements of magnetic fields with complex geometries [C1063]

## "Intercarrier interference analysis for wireless OFDM in mobile channels"

Orthogonal frequency division multiplexing (OFDM) employs a set of subcarriers for the information symbol transmission in parallel via the multipath fading channels. Due to its spectral efficiency and robustness over multipath channels, OFDM has been adopted for broadband communications. However, for high-speed mobility, the time-varying channels pose a performance limitation to the wireless OFDM systems. In this paper, we investigate the OFDM system performance in the time-varying channels where the intercarrier interference (ICI) occurs; we study the impacts of the time-varying multipath fadings together with the multiple Doppler spreads. According to our analysis and simulation results, the maximum OFDM symbol normalized Doppler frequency must be less than 0.04 to achieve the signal-to-interference ratio (SIR) = 20 dB or larger. As the maximum OFDM symbol normalized Doppler frequency increases, the OFDM system performance degrades dramatically. Different irreducible symbol error rate (SER) floors about 10-2for QPSK-OFDM schemes and 10-1for 16QAM-OFDM schemes would arise in case that the maximum OFDM symbol normalized Doppler frequency is fixed at 0.06 [C1064]

## "SISO-OFDM channel estimation in the presence of carrier frequency offset"

In this paper, we consider the effect of CFO (carrier frequency offset) on the performances of LS (least square) and LMMSE (linear minimum mean square error) channel estimation algorithms for SISO (single input single output) OFDM (orthogonal frequency division multiplexing) systems. Compact analytical expressions on the MSE (mean square error) of the channel estimation under the effect of CFO are derived, while conventional works mainly rely on Cramer-Rao bound or Monte Carlo simulations. Based on the expressions derived, it is observed that the MSE contributed by CFO increases at the rate about the square of CFO and it can not be reduced by using more training symbols. What is more, it is also found that LMMSE is more resistant to CFO compared to LS [C1065]

## "Maximum-likelihood carrier frequency offset estimation for OFDM systems in fading channels"

Carrier frequency offset (CFO) is a major contributor to the inter-carrier interference in OFDM systems. This effect becomes more severe when compounded by the presence of Doppler fading in wireless channels. This paper presents two maximum-likelihood CFO estimation schemes, one in frequency domain and another in time-domain, both under Doppler fading. The properties of the estimators are analyzed and simulation results showing the performance gain of the proposed estimators over other estimation schemes are presented. Apart from improved accuracy, the time-domain maximum likelihood estimator features significantly reduced complexity [C1066]

## "LS FFT-based channel estimators using pilot-embedded data-bearing approach in space-frequency coded MIMO-OFDM systems"

Multiple-input multiple-output (MIMO) orthogonal frequency division multiplexing (OFDM) is one prominent

communication system for realizing high speed data transmission services. One critical issue for such systems is channel estimation. In this paper, we first develop a pilot-embedded data-bearing (PEDB) approach for joint channel estimation and data detection. Then we propose a least square (LS) FFT-based channel estimator by employing the concept of FFT-based channel estimation to improve the performance of the PEDB-LS channel estimation. Also, the effects of model mismatch error when considering non-integer multipath delay profiles, and its performance are investigated. We further propose an adaptive LS FFT-based channel estimator that employs the optimum number of significant taps. Simulation results reveal that the adaptive LS FFT-based estimator provides superior performance under quasi-static channels or low Doppler's shift regimes [C1067]

## "Effect of bonding pressure on transducer ultrasonic propagation in thermosonic flip chip bonding"

As one of the key bonding parameters for thermosonic flip chip bonding, bonding pressure plays an important role for the bonding process. Moreover, as the load of the ultrasonic transducer system, bonding pressure affects directly the process of ultrasonic propagation, so it will influence the bonding quality. In this paper, in the condition that the bonding pressure was tuned regularly, the impedance characteristics of ultrasonic transducer were measured by a impedance analyzer, and the ultrasonic energy was measured by a laser Doppler vibrometer, and the shear bonding strengths at different bonding pressure settings were attained. It is shown that when the bonding pressure increases, the resonance frequency and resistance of transducer will increase, while the conductance and ultrasonic energy will turn down, and a stable and satisfied bondability can be found at a moderate pressure window. The impedance model for ultrasonic transducer was created by an equivalent circuit, and used to analyze the experimental effect of bonding pressure on ultrasonic propagation for transducer [C1068]

## "An Non-Parametric Rotating Angle Acquisition Method for Optimal ISAR Imaging"

Inverse synthetic aperture radar (ISAR) imaging usually consists of two stages. The first is motion compensation applied for transforming the relative motion between radar and moving target into the radar's rotation motion around the target on the turntable. The second is range-Doppler (R-D) image formation of target. Conventional R-D imaging requires that during the coherent integrated time period, the migration of scatters on target should not be through one resolution cell, otherwise the focusing of edge scatters may be degraded. However, in case of high-speed angular motion like a plane's big-maneuver flight and ship motion with roll, pitch and yaw, at this time the rotating angle may suddenly be increased greatly within the fixed coherent time which may results in scatter migration through a resolution cell. Therefore, it is necessary to select an appropriate rotating angle for imaging to ensure ISAR imaging results to be focused. Although some research have been reported on this issue, these methods usually need estimation of parameters to realizing ISAR imaging at large rotating angles. In this paper a new idea of acquiring rotating angle for optimal ISAR imaging is presented which is no longer based on the estimation of parameters like rotating angle, rotating speed, etc. The method is described and an example is also given to show the efficiency of new method with good focusing effect in ship ISAR imaging [C1069]

## "On Possibility of Two-Frequency Regime of Terahertz Circular Laser Generation"

Terahertz gas-discharge lasers usually work with active substance pumping through the resonator. Movement of active substance particles along the resonator axis causes Doppler shift of radiation frequency. Using this effect, it is possible to create the circular terahertz laser generating two frequencies simultaneously. In the paper the estimation of some parameters of two-frequency regime has been made and potential of two-frequency terahertz laser scheme proposed has been shown [C1070]

## "Experimental identification of parasitic vibrations on ultrasonic bonding transducer"

Vibration in the end of transducer affects the quality of fine pitch thermosonic bonding. Based on the experimental data acquired by laser Doppler vibrometer, vibration coupling along the different directions is analyzed. The bonding tool on/off test was performed to determine the bonding tool's effect on the transducer vibration. This work can be used for tool length selection for the better performance [C1071]

## "Prismspect and pegasys: plasma simulation and experimental analysis codes"

Summary form only given. PrismSPECT is a collisional-radiative spectral analysis code designed to simulate the atomic and radiative properties of LTE and non-LTE plasmas spanning a wide range of conditions. For a grid of user-specified plasma conditions, PrismSPECT computes spectral properties (emission and absorption), ionization fractions, atomic level populations, and line intensities and ratios. PrismSPECT supports calculations for plasmas irradiated with external radiation fields, and plasmas with non-Maxwellian electron distributions. In designing PrismSPECT, a strong emphasis has been placed on ease of use. It features a user-friendly, graphical

interface for setting up problems, monitoring the progress of simulations, and viewing results. The collisional-radiative modeling in PrismSPECT includes: collisional ionization, recombination, excitation, deexcitation, photoionization, stimulated recombination, photoexcitation, stimulated emission, spontaneous decay, radiative recombination, dielectronic recombination, autoionization, and electron capture. Line profiles include Doppler, natural (incl. autoionization contributions), and Stark broadening. Energy levels, cross sections and rate coefficients are based on the ATBASE suite of codes, which incorporates NIST atomic level energies and oscillator strengths when available. PEGASYS is a software tool used in the analyses of experimental spectra. Operating on an imported experimental spectrum, PEGASYS supports continuum background subtraction, wavelength calibration, and fitting to spectral lines. In addition, PEGASYS computes the best fit of an experimental spectrum to PrismSPECT results, thereby finding temperatures and densities most representative of the plasma. Examples from these two interrelated applications will be discussed through their application to specific problems of interest in the areas of basic plasma physics and high-energy-density plasmas. Recent enhancements to PEGASYS, including line identif--ication and curve fitting, will be discussed [C1072]

## "Interaction of light beams propagating in 2S, 2P atomic hydrogen ; I spectroscopy"

Summary form only given. The light-matter interactions are classified in two sets: the quantified interactions in which matter performs transitions between stationary states, and the parametric interactions for which matter excited by the light returns to its initial stationary state after the interaction. Strong parametric interactions require a space-coherence of the light beams, that is the same phase between each wave and molecular dipole of same frequency at each implied molecule. With different frequencies producing generally different wavelengths, it is difficult to get the space-coherence. Therefore, except for refraction, the observation of parametric interactions requires particular conditions. Parametric interactions allowing frequency multiplications, combinations, shifts, etc often use two indices of refraction of crystals. G. L. Lamb Jr. (Rev. Mod. Phys., 43, 99 (1971)) describes another general trick allowing parametric interactions: the use of "ultrashort light pulses" defined as "shorter than all relevant time constants". Thus, the qualifying "ultrashort", generally bound to femtosecond light pulses, applies NOT to the light only but to the set of the light and the refracting medium. Therefore, ordinary light whose coherence time is some nanoseconds is made of ultrashort pulses when it propagates in low pressure gases having a Raman resonance of the order of 100 MHz. Unhappily it is difficult to find a gas having so low a Raman frequency in a well populated state. Among common gases, only neutral atomic hydrogen in states 2S and (or) 2P (say H*) works well. Refraction and most parametric effects work without threshold of energy: the experiments show that the weakest light beam excites transitorily all molecules of a big prism, making a global non-stationary state, enough for a regular refraction. A frequency shifting interaction may be considered as produced by an interaction between several non-stationary states produced by the refraction of the c--orresponding electromagnetic beams; as these non-stationary states have the same symmetry, they interact through Raman type resonances. Thus, the effect is named "space-coherent Raman effect on time-incoherent light" (CREIL). An efficient interaction requires an increase of the entropy of the system, that is a flood of energy from modes having a high temperature (deduced from Planck's law) to colder modes. Consequently, the light is generally redshifted while the radio, thermal radiations are blueshifted. The frequency shifts, produced by thermodynamically allowed transfers of energy "catalyzed" by a refraction in H*, may be confused with Doppler shifts, the relative frequency shifts being constants if the dispersion of the polarisability of the gas is neglected. Usually, the blueshift of the radio frequencies is not detected, so that only the redshift of light is considered [C1073]

## "Nonlinear behaviors of transducer dynamics for thermosonic bonding"

Energy for deformation, metamorphism and interconnection of metals, is mainly from high frequency pressure/shear loads via a PZT transducer assembly. Dynamical characteristics of PZT actuated transducer assembly are the key to reliable fine pitch bonding and basic understanding of metal interconnection. By using high frequency recording electronics devices and a powerful Polytec laser Doppler vibrometer, a systematic experimental observations and analysis clearly exhibit that, rich phenomena and effects like the negative cubic stiffness, dynamical coupling between transducer main body and tool, may be explained by nonlinear features of PZT transducer assembly on its bonding targets. It will be possible to explore their mechanism and effects to bonding quality by identifying and decoding them from experimental data [C1074]

## "Application of Pendulum Swing Model for Explanation of Radiowaves Backscattering from Biological Objects in SHF and HF Wavebands"

In this paper, the model considering biological object motion, which allows explaining the peculiarities of scattered signals spectra, which are caused by their frequency modulation are proposed. The approach proposed allows formulating information features in order to distinguish reflection from human and animals [C1075]

## "A New Construction of Multiple Target Sonar and Extended Costas Arrays with Perfect Correlation"

Previously there were no multiple target perfect families of Costas and sonar arrays. In this paper using the Welch Costas array and some results from design theory we construct four perfect auto and cross-correlation families of sonar and of extended Costas arrays. [C1076]

## "A new optimal double periodical construction of one target two-dimensional arrays"

There are known infinite classes of construction for Costas sequences due to Welch, Lempel-Golomb. Also sonar sequence constructions due to Taylor, Games, and Moreno. We present here a new construction of a more general type which is double periodical. [C1077]

## "Mobile Location Based on Scatterer Information"

Mobile location techniques in wireless communication networks have received significant attention in recent years. However, accurate location estimation using geolocation techniques is impeded by the non-line-of-sight (NLOS) propagation and hearability issues. In this paper, we propose a single station location technique based on the assumptions that the scatterers are single reflection and geometrically fixed during the measurement period. Two sets of measurements corresponding to two separate positions of the same mobile station are required. Since the scatterer scenario is considered, this method is less sensitive to NLOS effect and more accurate than the conventional methods [C1078]

## "Meteor Trail Interference Model in HF Environment"

Some radio equipments work in high-frequency of 3 MHz-30 MHz to detect target. In this band, the real data has indicated that there is obvious meteor trail interference. The interference has adverse effect on the range and Doppler information detection of the target which may lead to these equipments not working normally. Based on the scatter feature of meteor trail, combined with such signal processing technique as ADBF, the meteor trail interference model is built. This model can help to research the technique for suppressing the meteor trail interference. Compared simulation results with real data, it verified that the model is validity [C1079]

## "Design and Realization of Fast Code Acquisition for Long PN Code Spread Spectrum Communication in LEO Satellite"

Based on the discrete-time signal processing, the representation of Doppler effect on code acquisition performance is analyzed and the principle of combining partial-matched filter with FFT is given in this paper. A fast code acquisition architecture by using partial-matched filter with FFT for the large Doppler offset frequency and long PN code spread spectrum communication system is designed and realized in FPGA and DSP. This architecture provides a very good trade-off between acquisition performance and complexity. Application results show this architecture is very attractive for LEO satellite communication [C1080]

## "Switching Between Beamforming and Space-Time Block Coding for Correlation-Varying Channel"

As the spatial correlation increases, the performance of space-time block coding (STBC) degrades to the extent that the communication breaks off. On the other hand, receive beamforming can exploit the spatial correlation. In order to avoid the blackout caused by the high correlation, we propose a scheme that switches between beamforming and STBC (SBS) with explicit switching criteria to dynamically accommodate the changing channel correlation. In the further discussion, we find that the switching criterion results in the undesirably frequent switching when the Doppler frequency increases. As a result, we propose a statistical criterion to achieve a much lower switching frequency while keeping almost the same performance as the previously proposed scheme. Simulation results are provided to confirm the validity of our proposed schemes [C1081]

## "Integrated Radio Frequency Design Environment"

There is currently no all-encompassing RF analysis tool on the market that allows for complete end-to-end military and commercial RF communications system analysis and simulation. While myriad tools exist to provide specific functional analysis within this scope, there is no tool to pull all of these functions together, while providing additional functions and algorithmic control over everything in the meantime. The BAE systems integrated RF design environment (IRFDE) software system is designed to do precisely this. It is an all-encompassing RF analysis integration environment that can be used to analyze any communications system or element within, from individual radio communications, to individual platform systems, to complex deployed

systems comprising a variety of radios across a wide area, to the most complex system of systems including variants of everything. The end-to-end communication system analysis and simulation that IRFDE enables includes static or mobile scenario creation and communication link analysis at any location in the world, taking into consideration terrain and clutter effects, rain and atmospheric losses (including HF), multipath fading, Doppler shifting and shadowing [C1082]

## "Channel Characterisation for an OFDM-MISO Train Communications System"

To design an OFDM train communications system it is essential to characterize and consider the channel parameters. For a high train scenario the transmission channel is frequency selective as well as time variant. Thus, delay spread and Doppler spread are investigated as crucial parameters for the OFDM system performance. Using a ray-tracing tool realistic impulse responses of the transmission channels are simulated. The investigated system includes three base stations operating in common frequency mode along a railway track and one mobile station situated on a high-speed train. Mobile station antennas with different patterns are included in the simulation model. The results are compared and assessed with respect to delay spread and Doppler spread [C1083]

## "On the efficiency of time-varying channel models"

We consider the form of a physically motivated simple one path time-varying channel in the time-varying impulse response, time-frequency characterization and time-scale characterization settings. The focus, in general, is to determine which setting allows for the most efficient (i.e., sparse) discrete channel representation. We measure how well the discrete representation reconstructs the channel when a limited number of discrete coefficients are available and compare the result among the channel models. [C1084]

## "Pseudo-Random Code Phase Modulation and LFM Combined Pulse Trains Ranging System"

A new combined signal-pseudo-random binary-phase code phase modulation and LFM combined pulse trains signal is proposed, and the frequency spectrum function, the ambiguity function and the range correlation function are deduced. The working principle of combined ranging system is illustrated in detail and the formula of signals in each stage is deduced and the Doppler signal and it's effect on the correlation output of combined ranging system is analyzed. Finally, the resolution, ambiguity characteristics and the range cut-off characteristic are studied. Research shows that the new combined ranging system is feasible and has advantageous performance [C1085]

## "Frequency Effective Mobile Communication System"

One of possible options to achieve good frequency efficiency in mobile communication is the OFDMA method. It provides rather good performance for the point-to-multipoint transmission in systems without considerable Doppler frequency offset. However, increasing of the used frequency band and permanent growing of the traffic make Doppler shift influence more and more critical point in radio modems design. Here a principally new method of multiple access-so called frequency bank signal (FBS)-is proposed. FBS combines the phase shift compensation used in the PAL-TV system, OFDMA principle and spread spectrum idea with Walsh functions. This method allows mitigating influence of multipath propagation and Doppler shift. The main FBS advantage is that the error probability is almost totally non-sensitive to the Doppler effect, separate signals delay and reflected signals influence. FBS signal don't need of special pilot, synchronization or equalization signals [C1086]

## "Visualization of Unstable Regions in High PRF Doppler Using Baker Diagrams"

First Page of the Article [C1087]

## "A Maximum Likelihood Doppler Frequency Estimator for OFDM Systems"

This paper derives a maximum likelihood Doppler frequency estimator for orthogonal frequency division multiplexing (OFDM) systems in time-varying multipath channels. The proposed scheme is a frequency-domain approach that utilizes pilot subcarriers, which are commonly implemented in most practical systems. Time-varying fading causes intercarrier interference (ICI) in OFDM systems. Thus, in the proposed estimator, the effect of ICI is taken into consideration with a proper model for accurate results. The estimator can be implemented using a finite impulse response (FIR) filter bank whose coefficients can be pre-calculated and stored in order to lower the computational complexity. We evaluate various methods to improve the estimation accuracy and analyze their complexity-performance tradeoffs. We also derive the CramГґB©r-Rao bound and provide simulation results to quantify the performance of the proposed algorithm. [C1088]

## "Modelling the Performance of TCP/ARQ over MIMO Rayleigh Fading Channels"

In this paper we describe a general framework for the modelling of the TCP performance over MIMO wireless systems including parameters such as fading, space-time transmission schemes, multiple antenna size, modulation schemes, channel coding and ARQ. We apply the framework to analyze the performance, the optimal channel coding rate and the effect of Doppler on the TCP throughput over the BLAST MIMO system and the orthogonal space-time block coded (STBC) system. We use the network simulator ns-2 to demonstrate the accuracy of the proposed analytical framework in characterizing various parameters of the TCP performance. We apply our framework to study of the buffer occupancy for TCP over MIMO systems and to a system that does not follow the AIMD TCP principle: CBR video transmission over MIMO channels. [C1089]

## "Frequency Offset Estimation Technique Based on Error Characterization for OFDM Communications on Time-Varying Multipath Fading Channels"

A novel frequency offset estimation technique based on maximum-likelihood estimation (MLE) for wireless OFDM communications over a doubly-selective fading channel is proposed. By taking advantage of subcarrier-level differential operation and coherent error characterization, the proposed estimator can effectively overcome frequency-selective fading effects. Frequency error characterization is achieved by pseudo-noise (PN) matched filters (MF) in the frequency direction; thus, the proposed estimation technique exploits frequency diversity with the maximum ratio combining (MRC). In addition, the proposed technique can combat the rapid time-selectivity caused by a wide Doppler spread because it requires channel stationarity for only a short duration due to the exploitation of both a single preamble in its training operation and the following semi-blind estimation aided from several pilot subchannels. The proposed technique can not only easily switch between training mode and semi-blind mode, but also easily swap from a coarse frequency offset estimation operation to a fine frequency offset estimation operation by sharing the same preamble block and the same system architecture. Extensive simulation results in conjunction with statistical analysis verify the superiority of the proposed technique. [C1090]

## "IDRA: IRCTR Drizzle Radar"

Little is known on the impact of the increase in anthropogenic aerosols on the global climate. It can potentially have a cooling effect via the second indirect aerosol effect which is poorly understood because of the lack of sound measurements. A radar devoted to the observation of the spatial distribution of drizzle, in combination with other sensors, would certainly give a better insight to this phenomenon. IRCTR is currently developing such radar, which will be placed in Cabauw (The Netherlands) a meteorological site that will provide synergy with other instruments. This paper describes the requirements, the system design and the products obtained [C1091]

## "Parallel OFDM Signal Generation for UWB Systems"

A parallel signal generation scheme for OFDM signals is presented. Conventionally, the generation of OFDM signals is implemented by computing an inverse discrete Fourier transform (IDFT). If the bandwidth is very large, as in ultra-wide band (UWB) systems, preferably integrated solutions are used to generate the communication signals. Additionally, the output of the IDFT is protected against multipath propagation effects with either a cyclic extension or zero-padding. The system described in this paper enables the implementation of a UWB OFDM signal on low complexity and low cost hardware by generating subband OFDM signals. We show that additional errors are introduced on the subband edges, however. A performance study in terms of symbol error rate (SER) has been conducted. The results show that similar SER performance is achieved when either using a highly integrated solution or our parallel signal generation approach [C1092]

## "Optical Clocks Based on Quantum Emitters"

In this report, we discuss the new feature of optical clocks based on quantum emitters, including clock operating above threshold, which is a laser essentially used as an active optical clock, and clock operating under threshold. Comparing with the active microwave clock, hydrogen maser, excellent performance of optical clock based on quantum emitter is expected. Comparison between configurations of atomic beam and lattice trapped atoms is analyzed. Moreover, we also present the discussion on the possibility of Ramsey laser, a laser operating at the configuration of Ramsey separated oscillating fields [C1093]

## "Doubly Periodic Arrays and a New Construction of Multiple Target Sonar and Extended Costas Arrays with Perfect Correlation"

There are only a few multiple target families of Costas and sonar arrays with perfect correlation property. In this paper using the Welch Costas array and some results from design theory we construct perfect auto and cross-

correlation families of sonar and extended Costas arrays [C1094]

## "Remote Voice Acquisition in Multimodal Surveillance"

Multimodal surveillance systems using visible/IR cameras and other sensors are widely deployed today for security purpose, particularly when subjects are at a large distance. However, audio information as an important data source has not been well explored. One of the reasons is because audio detection using microphones needs installation close to the subjects in monitoring. In this paper, we investigate a novel "optical" sensor, called laser Doppler vibrometer (LDV), for capturing voice signals in a very large range to realize a truly remote and multimodal surveillance system. Speech enhancement approaches are studied based on the characteristics of LDV audio. Experimental results show that remote voice detection via an LDV is promising when choosing appropriate targets close to human subjects in the environment [C1095]

## "Twin-cell detection for spread spectrum code in the presence of fractional Doppler frequency offset"

In this paper, a novel detection method called the twin-cell detection is addressed for spread spectrum code acquisition in the presence of fractional Doppler frequency offset (FDFO). When the FDFO exists, the correlation peak used for detection during the acquisition process is split into two smaller neighboring peaks, resulting in severe degradation in the detection performance (and, consequently, in the overall acquisition performance). In the twin-cell detection, a decision variable for detection is formed by combining two consecutive correlator outputs, so that the reduction in the correlation value due to the FDFO can be alleviated. The simulation results show that the proposed scheme can offer better acquisition performance over the conventional scheme based on the cell-by-cell detection. [C1096]

## "Evaluating the Performance of ARQ and HARQ I Over Nakagami Fading Channels"

In this paper, we evaluate the average number of transmissions and the throughput performance of ARQ and HARQ I over Nakagami fading channels. The analysis is carried using a block fading and a two-states Markov channel models. These results are used to study the effects of the Nakagami-m parameter and the Doppler frequency on the performance of ARQ and HARQ I [C1097]

## "Robust least squares method for interference cancellation in high frequency surface wave radar"

External skywave interference from natural or man-made sources typically masks the entire range-Doppler search space in high frequency surface wave radar (HFSWR), a robust least squares interference cancellation algorithm based on the dual-polar receiver was proposed in this paper. We modify the sample of horizontal auxiliary channel, and get the best performance of interference cancellation in the worst case error circumstance under the limit of maximum error bound while not decreasing the angular response of the target signal. Converting the convex optimization question to simple one dimension search, we get the effective method to settle the optimal weight coefficient. The experimental result shows that the proposed method is very effective. [C1098]

## "On the robustness of a joint source-channel coding scheme for image transmission over non frequency selective Rayleigh fading channels"

The aim of this paper is to present a joint source channel coding scheme for image transmission over a non frequency selective Rayleigh fading channel. Because of the very high BER, a JPEG or JPEG2000 compressed image cannot be transmitted without major visual degradation quality. On the one hand we use a compression algorithm based on wavelet transform and vector quantization called WTSOM (wavelet transform self organized map), and on the other hand we combine differential modulation, symbol interleaving, unequal error protection and antenna diversity to improve the performance of the transmission. The results show a relation between the received images PSNR and the normalized Doppler frequency of the Rayleigh channel. The performance of this joint source channel scheme allows us to obtain a good visual quality of the images even with very bad transmissions conditions [C1099]

## "Cancellation of clutter and multipath in passive radar using a sequential approach"

The paper deals with the cancellation of direct signal, multipath and clutter echoes in passive radar, where the transmitted waveform is not under control of the radar designer and the sidelobes of the ambiguity function mask even targets largely displaced in range and Doppler from the disturbance. A sequential approach is presented for disturbance cancellation and target detection based on projections of the received signals in a subspace orthogonal to both disturbance and previously detected targets. Modeling the clutter spread on few Doppler bins

allows complete clutter cancellation. The approach is shown to be effective against typical scenarios with a limited number of iterations. [C1100]

## "Cramer-Rao bounds for target Doppler and power in space based radar"

In this paper, the Cramer-Rao bound for target parameters from a space based radar platform is derived. In particular, the bounds for target Doppler and power are derived under a variety of conditions-target in white noise, target in clutter and noise case. In the later case, the performance is analyzed with range foldover and in the presence/absence of earth's rotation. When both these phenomena are present, the bound is shown to be inferior compared to other situations where only either effect is present. In the general case, methods such as waveform diversity should be considered for superior target detection. [C1101]

## "Focusing ISAR images using the AJTF optimized with the GA and the PSO algorithm-comparison and results"

Algorithms based on the genetic algorithm (GA) and the particle swarm optimization (PSO) algorithm were designed for focusing inverse synthetic aperture radar (ISAR) images that suffered from degradation due to Doppler smearing. These algorithms optimized the adaptive joint-time frequency (AJTF) algorithm by replacing the exhaustive search as the primary search tool used to determine focusing parameters. The use of the PSO for ISAR image focusing is a unique application of this evolutionary search. Performance of the GA and the PSO were compared with the PSO producing the optimal results of being able to focus a 211pulse ISAR image in 9 seconds or 24% of the cost function calculations required for an exhaustive search. This paper also introduces a new method of determining basis function suitability using the fast Fourier transform. [C1102]

## "IWRAP: the Imaging Wind and Rain Airborne Profiler for remote sensing of the ocean and the atmospheric boundary layer within tropical cyclones"

IWRAP, the Imaging Wind and Rain Airborne Profiler, is the first high-resolution dual-band airborne Doppler radar designed to study the inner core of tropical cyclones (TCs). IWRAP is currently operated from a National Oceanic and Atmospheric Administration (NOAA) WP-3D aircraft during missions through TCs and severe ocean storms. The system is designed to provide high-resolution, dual-polarized, multi-beam C- and Ku-band reflectivity and Doppler velocity profiles of the atmospheric boundary layer within the inner core precipitation bands of TCs and to study the effects precipitation has on ocean wind scatterometry as it applies to TCs. This dual-wavelength system also provides for the use of differential attenuation techniques to derive the rainfall rate and to characterize the dropsize distribution (DSD) within TCs. This prototype has demonstrated its capability to measure the wind field and the rainfall rate over the range of winds and rain rates usually present in this kind of scenario, and has served as a proof of concept for the design of similar instruments aboard other platforms such as unmanned aerial vehicles (UAV) flying at high altitudes, as well as for spaceborne applications. IWRAP implements a very unique measurement strategy, it profiles simultaneously at four separate incidence angles (approximately 30, 35, 40 and 50 degrees) while conically scanning at 60 RPM. A summary of the principles of operation and the system design of the instrument is given, and examples of IWRAP's unique imaging capabilities are presented and compared against high density sequencies of GPS dropsondes and other radars aboard the aircraft. To our knowledge, the examples that will be presented include the highest-resolution measurements of the boundary layer winds in a hurricane ever obtained [C1103]

## "Mixed hardware-software testbed for IEEE-802.11n"

In this paper, the design and implementation of a new high performance hardware channel emulator is presented. The purpose of the developed emulator is to efficiently reproduce in a laboratory environment the accurate behaviour of several effects of the radio channel over a multiple antennas wireless communication system, including AWGN (additive white Gaussian noise), multipath, attenuation and Doppler shift. The main application target is the test and the performance evaluation of a new 802.11n transceiver. The resulting hardware platform is very flexible, allowing, for example, the simulation of systems with variable numbers of input/output antennas, and a programmable number of considered paths as well as their relative delays. The prototype has been implemented on a board including both an ARM processor and a field programmable gate array (FPGA), and it supports the simulation of a 40 MHz radio frequency bandwidth. This paper describes the main issues related with the design of this emulator and reports the laboratory measurements on the first implemented prototype [C1104]

## "Concept of an algorithm to determine the signal delay time for telepresence space applications"

The vision of a space robot as an extended arm of the human operator on ground is a key component for on-

orbit robotic service missions. This concept of telepresence requires a high-quality sensor feedback from the space environment to the operator including stereo video and force-feedback. For the force feedback channel the knowledge of the signal delay time during operation is an important factor to increase the immersiveness of the system. In case of radio contact to space segments which are not in GEO, the signal delay time varies according to the distance between the spacecraft and the ground station. This paper proposes a method for deriving the required signal delay from the Doppler frequency shift alone which is readily available from the receiver since the actual signal delay is an input value for the control loop in the haptic channel [C1105]

## "Mechanical Responses of the Fingerpad and Distal Phalanx to Friction of a Grooved Surface: Effect of the Contact Angle"

The fingertip angle of incidence at contact in lateral touch is a determinant of its mechanical responses at different scales. In the experiment, we made use of a grooved pulley to stress regions of the finger pulp defined by the contact angle at a 1N applied force. Non-contact measurement of velocities were first performed with a LASER Doppler Vibrometer focused on an adjacent zone. Using wavelets to process signals, we experimentally identified three different kind of vibration which amplitudes were functions of the index finger posture. Additional measurements with an accelerometer glued on the nail permitted to discover that the composite material structure of the fingerpad was not able to damp the tribologic shocks at high angles. This resulted in an actuation of the distal interphalangeal joint. [C1106]

## "Calculating Line Profiles of Non-Spherical Stars"

We present a method for calculating synthetic line profiles for rapidly rotating, non-spherical stars. This parallel code includes the effects of the Doppler shift produced by the surface rotation, and is capable of simultaneously calculating the observed line profile for several different degrees of inclination between the observer and the star's rotation axis. As expected, we find a significant difference between the line profile of a rapidly rotating star viewed pole on and the same star viewed equator on. This is a result of the increasing component of the rotational velocity along the line of sight, leading to a larger Doppler broadening. Using this code, we hope to model several line profiles and compare with observed spectra for rapidly rotating stars. Based on the shapes of these line profiles, it may be possible to constrain the inclination of the star, and other properties such as the latitudinal temperature variation. [C1107]

## "Effect of dummy elements on a monopole array-assisted Doppler spread compensator for digital terrestrial television broadcasting receiver"

In this paper, we propose a monopole array-assisted Doppler spread compensator with dummy elements for digital terrestrial television broadcasting receiver. Although authors are already proposed an array antenna assisted Doppler spread compensator, it is sensitive to mutual coupling among elements in terms of compensation performance. In order to solve this problem, dummy elements, placed at either end of an array antenna, mitigate performance degradation arising from the mutual coupling among monopole array elements. Computer simulation results show that the dummy elements can reduce performance degradation due to mutual coupling as well as expand the operating bandwidth of a Doppler spread compensator. [C1108]

## "Effect of prolonged pressure on flowmotion: An Investigation Using an in vivo Rat Model"

The objectives of this study is to assess the effect of prolonged loading on the skin blood flowmotion in rats as measured by laser Doppler flowmetry (LDF) using wavelets transform and power spectral in the rat skin microcirculation. External pressure of 13.3kPa (100 mmHg) was applied to the trochanter area and the distal lateral tibia of Sprague-Dawley rats via two specifically designed pneumatic indentors. The loading duration was 6 hours/day for 4 consecutive days. The results showed that 1) spontaneous rhythmic activities were present in skin blood flow of anesthetized rats, 2) significant decrease of flowmotion power (p=0.023 for trochanter and p=0.043 for tibia) was found in the frequency range of 0.01-0.04Hz after prolonged loading. Our results suggested that reduced vasomotion in the frequency of 0.01-0.04 Hz might be involved in the mechanisms leading to pressure ulcer formation [C1109]

## "Non-stationarity analysis of real X-Band clutter data at different resolutions"

This work deals with the problem of providing a statistical model of the backscattering from marine surface for low-grazing angle and high resolution radar systems. Based on the electromagnetic two-scale model, we analyzed both the amplitude and frequency modulations induced on the small-scale Bragg resonant waves by the large-scale surface tilt and advection, due to the swell presence. Evidence of marine clutter non-stationarity and the relationship between the variations of clutter texture, Doppler centroid and bandwidth have been

investigated by processing measured data, recorded by the IPIX radar of McMaster University in Grimsby, Ontario, Canada. Our results demonstrate that sea/lake clutter at different range resolutions is non-stationary and is better modeled by a hybrid AM/FM modulated process. [C1110]

## "High-sensitivity and high-mobility compact DVB-T receiver for in-car entertainment"

A compact DVB-T receiver with better than -94 dBm sensitivity for in-car usage is presented. Dual tuners are included in the receiver to reduce multi-path effects as well as realize the diversity technique. A robust audio/video interface (AVIO) is defined to accommodate different kinds of in-car displays with a variety of A/V specs. In addition, a protection circuit is proposed to provide the convenience that either active antennas or passive antennas can be plugged in the same antenna sockets. Field trials proved that the receiver works perfectly when the car is running over 180 Km/hr. [C1111]

## "Feasibility analysis of a HAP-LEO optical link for data relay purposes"

The aim of the paper is to prove the technical feasibility and the advantages of a joint RF and optical communication system. The reference scenario foresees the use of a HAP (high altitude platform) or multiple HAPs for data relay purposes. HAPs are based on airships or balloons placed at about 20 km height and they combine both the advantages of terrestrial networks (the highest mast in the town) and of satellites (a LEO in very low orbit). As earth observation (EO) satellites need the download of huge amount of data, HAPs could establish an optical link with a LEO EO satellite in order to exploit the high data rate. Optical space communications offer a wide bandwidth and low interference channel. By the use of this system, it is possible to increase the amount of information downloaded by a high altitude platform from a LEO satellite, reaching data rate up to 10 Gbit/s. There are some critical points to face in order to dimension this link. First of all, a fast pointing acquisition and tracking procedure must be implemented. Another point is related to the high relative speed between LEO satellite and HAP that leads to an important contribution of Doppler shift in the received signal spectrum, this phenomenon is not stochastic and it can be managed by a tunable filter. The third point to focus on, strictly related to the transmitter design, is the optical carrier choice. It is important to take into account the atmospheric layer from 20 to 100 km, in terms of absorption and scattering spectra, temperature and refractive index variations in altitude and time varying phenomena. The transmitter is designed choosing the best performing technology in different optical window frequencies in which the channel presents low absorption and scattering, this choice involves the modulation format, as well. Three optical windows are available: 850nm, 1064nm and 1550nm. The first one is the most affected by Doppler effect but offers high gain telescope and low cost components;-- devices that work in the second window can transmit high amount of power but the modulation constraints of laser source can make the design more complicated; the third window is the most used in terrestrial communication systems and many devices are available, the Doppler effect is lower than at other frequencies and for this carrier it is possible to carry out DPSK (differential phase shift keying) modulation schemes other than classical OOK (on off keying) techniques. Moreover, HAPs could use terrestrial electronics equipments in order to store the data received by the optical link (e.g. hard disks). The link between HAP and ground can be exploited by the use of high data rate RF links in Ka-band or X-band (mainly used in EO satellites), V-band (allocated for HAPs) or W-Band (the new frontier). Despite the impact by weather and atmospherics, it was demonstrated that the availability of W-band satellite links is at least 95% (Fragale, 2004). This scenario overcomes the limits imposed by the short time window for EO satellites data download, using an advanced "store and forward-data relay" concept [C1112]

## "Single-channel receiver limitations in Doppler radar measurements of periodic motion"

Periodic motion, such as that resulting from cardiopulmonary activity can be measured by direct-conversion microwave Doppler radar. In a direct-conversion receiver, motion is measured as phase modulation, and the baseline phase relationship between the received signal and local oscillator signal for a given position has a significant effect on the demodulation sensitivity, resulting in optimum and case extreme target positions. Presented here is a mathematical analysis of this target-position sensitivity verified with measurements using a custom compact Doppler radar transceiver with separate quadrature outputs. The results indicate that increased error in respiration and heart rate measurements can be expected for case positions due to significant changes in mathematical conditions as well as reduced sensitivity, and that these limitations can be accommodated using two receiver channels in quadrature. [C1113]

## "Optimal beam-selection algorithm for reception performance improvement of ATSC 8-VSB DTV"

This paper proposes an optimal beam-selection DTV receiver which uses switched beam-selection techniques. Usually the ATSC DTV receiver uses equalizer for compensating channel distortion. But multipath signals and Doppler effect easily affected performance of the receiver. A proposed optimal beam-selection DTV receiver

reduces multipath signals so a burden of equalizer is reduced. Channel compensation is easier than a conventional DTV receiver which uses only equalizer. Simulation results show that performance of the proposed system is better than a conventional DTV receiver [C1114]

## "Suppression of Doppler ambiguities for linear sparse arrays"

A key trade-off in airborne or spaceborne synthetic aperture radar (SAR) design involves the pulse repetition frequency (PRF) and the number and location of range and Doppler ambiguities. The associated design issues are complicated further when the system involves a sparse array. A methodology is formulated based on selecting the PRF to avoid range ambiguities in the envelope mainbeam. The effects of the Doppler ambiguities falling within the envelope mainbeam are mitigated by using an optimal algorithm to generate weights that place s in the pattern of the (sparse or contiguous) array in the directions of the Doppler ambiguities. This approach can be used for the analysis and design of airborne or spaceborne SAR systems with contiguous or sparse arrays. [C1115]

## "Cancellation of ICI by Doppler Effect in OFDM Systems"

This paper observes the inter-carrier interference (ICI) by Doppler effect in time domain in orthogonal frequency division multiplexing systems. This observation allows us to propose a new time domain two-stage equalization scheme that iteratively cancels the ICI. The proposed scheme consists of the following two stages. First, we apply low-complexity linear minimum mean squared error (MMSE) employing partial rank of time impulse response matrix to shorten the ICI components into diagonal region. Second, we propose new parallel interference cancellation with hard decision feedback to remove the residual ICI. Performance evaluations and complexity analyses show that the bit error rate and the signal-to-interference-plus-noise ratio performances of the proposed scheme are very close to those of the classical frequency domain linear MMSE equalization scheme with much reduced complexity [C1116]

## "Experimental Evaluation of Eigenbeam MIMO-OFDM Implemented in FPGA for Wireless LAN"

This paper describes the experimental performance of eigenbeam multi-input multi-output with orthogonal frequency division multiplexing (MIMO-OFDM) systems as measured in a testbed implemented with field programmable gate arrays (FPGA). The testbed offers 1/5-scale real time signal processing. Extensive experiments on the testbed confirm the basic operation and performance of eigenbeam MIMO-OFDM with 16QAM. From the PER performance, we confirm that the eigenbeam scheme with permutation matrix and three transmit antennas (Mt= 3) drastically improves the required carrier-to-noise power ratio (CNR) by approximately 5.6 dB over the scheme without eigenbeam with Mt= 2. Furthermore, to determine the impact of Doppler frequency, we focus on the transmission interval between the MIMO channel estimation and data transmission. To suppress the required CNR degradation to within 1.5 dB, it is found that the eigenbeam scheme with permutation matrix and Mt= 3 permits a transmission interval of approximately 15.5 ms when fd= 5 Hz [C1117]

## "Waveform Scheduling in Wideband Environments"

The time-variation due to Doppler scaling effects, coupled with scattering due to multipath propagation, can severely limit the performance of wideband systems. In this paper, we examine the dynamic configuration of transmitted waveforms for agile sensing to increase tracking performance in wideband environments. Using wideband frequency modulated waveforms, we present an algorithm for predicting the mean square tracking error and selecting the waveform that minimizes it in a target tracking application with a nonlinear observations model. The algorithm is based on the Cramer-Rao lower bound on the measurement errors that is computed using the wideband ambiguity function. Using simulations, we demonstrate the improved performance provided by scheduling over fixed configurations [C1118]

## "Adaptive Pilot-Embedded Data-Bearing Approach Channel Estimation in Space-Frequency Coded MIMO-OFDM Systems"

In this paper, we study the effects of model mismatch error inherently in the FFT-based channel estimation approach when considering the multipath delay profiles with non-integer delays. We propose an adaptive FFT-based channel estimator that employs the optimum number of significant taps such that the average total energy of the channels dissipating in each tap is completely captured in order to compensate the model mismatch error. Furthermore, our proposed pilot-embedded data-bearing approach is employed for joint channel estimation and data detection. Simulation results reveal that the adaptive FFT-based channel estimator is superior to the FFT-based and LS channel estimators; however, in nonquasi-static fading channels under high Doppler's shift regimes, the performances of all three channel estimators are quite close resulting from the influence of the channel mismatch error that dominates all factors causing the detection error [C1119]

## "MMSE Receiver for Multiuser Interference Cancellation in Uplink OFDMA"

In uplink orthogonal frequency division multiple access (OFDMA) systems, multiuser interference (MUI) occurs due to different carrier frequency offsets (CFO) of different users at the receiver. In this paper, we present a minimum mean square error (MMSE) based approach to MUI cancellation in uplink OFDMA. We derive a recursion to approach the MMSE solution. We present a structure-wise and performance-wise comparison of this recursive MMSE solution with a linear PIC receiver as well as other detectors recently proposed in the literature. We show that the proposed recursive MMSE solution encompasses several known detectors in the literature as special cases [C1120]

## "Recursive space-time decoding for MIMO OFDM systems"

In this paper, we propose a recursive space time decoding method for orthogonal frequency division multiplexing (OFDM) systems exploiting multiple transmit antenna diversity when the channels are fast fading. We first develop a computationally efficient space-time decoding method involving a matrix inversion to mitigate the channel variation effect. We then further reduce the computational complexity of the matrix inversion decoding method via a recursive formulation. Computer simulation results show that the proposed recursive decoding has much better BER performance than Alamouti decoding, requiring much less computation than the matrix inversion decoding. Moreover, the relative advantage in BER performance of the proposed scheme over Alamouti decoding stands out as the Doppler frequency increases [C1121]

## "Time-variant doppler frequency estimation and compensation for mobile OFDM systems"

In mobile OFDM communication systems, Doppler spread leads to the loss of orthogonality between the sub-carriers, limiting the achievable throughput of the moving transceivers. In this paper, the effect of Doppler spread in Rayleigh fading channels is investigated, and a method of time-variant Doppler frequency estimation and compensation is proposed for mobile OFDM systems. Computer simulation results are included to support our developments [C1122]

## "Study for Various Array Antenna assisted Doppler Spread Compensator with MRC Diversity of ISDB-T Receiver"

Digital television terrestrial broadcasting (DTTB) based on OFDM (orthogonal frequency division multiplexing) is sensitive to Doppler spread and multi-path propagation in mobile environment. A part of authors has already proposed a Doppler spread compensator based on linear array antenna. However, the proposed linear array antenna assisted Doppler spread compensator did not take into account an effect of electromagnetic coupling amongst elements. Also, it did not have diversity function while it has a several elements. This paper proposes two types of array antenna assisted Doppler spread compensators, which employ dipole array and monopole array, and which work as a maximum ratio combining (MRC) diversity as well as the Doppler spread compensator. Computer simulation results confirm that the dipole-array receiver outperforms the monopole-array receiver [C1123]

## "A multiuser interference cancellation scheme for uplink OFDMA"

In uplink orthogonal frequency division multiple access (OFDMA) systems, multiuser interference (MUI) occurs due to different carrier frequency offsets (CFO) of different users at the receiver. In this paper, we present a multistage linear parallel interference cancellation (LPIC) approach to mitigate the effect of this MUI in uplink OFDMA. The proposed scheme first performs CFO compensation (in time domain), followed by K DFT operations (where K is the number of users) and multistage LPIC on these DFT outputs. We scale the MUI estimates by weights before cancellation and optimize these weights by maximizing the signal-to-interference ratio (SIR) at the output of the different stages of the LPIC. We derive closed-form expressions for these optimum weights. The proposed LPIC scheme is shown to effectively cancel the MUI caused by the other user CFOs in uplink OFDMA [C1124]

## "A Non-Search Optimal Control Solution for a Team of MUAVS in a Reconnaissance Mission"

We consider a team of miniature unmanned air vehicles (MUAVs) in a multi-static radar scenario. Time delay and Doppler measurements made at the UAVs are transmitted to a base station which is tracking a target. The base then transmits heading commands to the MUAVs to reduce the tracking error. Optimal solutions that attempt to minimise a function of the error covariance or maximize the observability of the system are computationally difficult to implement. We present a simpler approximate method that yields a closed-form solution and performs comparably to the optimal approaches [C1125]

## "Correlation Dimension Analysis of the Healty and Stenosed Carotid Artery Doppler Signals"

In this study, correlation dimension analysis was performed on the Doppler signals taken from healthy, mild and serious degree stenosed carotid artery. Correlation dimension is the number of a dynamic system's freedom degrees and is a indicator of the system complexity. Correlation dimension have computed on 8 embedding dimension using the time delay value determined through mutual information function for each Doppler signal, t-test has been performed and a statistically significant difference ($p<0.0001$) was obtained [C1126]

## "Equalization of a Time-Varying Channel in the Presence of Doppler Rate"

In this paper, we consider the problem of equalizing a time-varying channel in the presence of Doppler rate. Blind estimation of a time-varying channel in the presence of Doppler frequency alone based on a complex-exponential, basis expansion model (CE-BEM) has been studied by several researchers in the field. Recently, we proposed a fractionally spaced channel model that does not require basis expansion and possesses a structure that models Doppler rate. We presented a data-aided, LS method for channel estimation. In this work we analyze the performance of the channel estimator using exact and perturbed Doppler estimates. We present a symbol-by-symbol based, decision-feedback equalizer for the time-varying channel and assess its performance in terms of BER [C1127]

## "The effects of Doppler and pulse eclipsing on sidelobe reduction techniques"

Radar sidelobe reduction techniques based on deconvolution generally rely on an accurate estimate of the system point spread function (PSF). Targets traveling at nonzero velocity induce a Doppler shift and have an altered PSF, which reduces sidelobe reduction performance. Also, in situations where a target is close to the radar, pulse eclipsing occurs- reflected energy arrives at the receiver while it is switched off during transmission. Eclipsing has the effect of a range-varying PSF, which also reduces sidelobe reduction performance. This paper describes a method to account for both Doppler and pulse eclipsing using the thresholded minimum mean square error (MMSE-T) sidelobe reduction algorithm. A new procedure for estimating noise power, which is required by the algorithm, is presented. Simulation results show the modified algorithm is able to reduce sidelobes such that a weak target obscured by the sidelobes of a 40 dB stronger target is clearly revealed, assuming the weak target would be detectable alone. These results hold when the true target velocities are not known as long as a reasonable estimate is obtained through tracking or Doppler processing of the strongest targets. A qualitative comparison of MMSE-T with the iterative re-weighted least squares (IRLS) algorithm shows it to be the better of the two. [C1128]

## "AUV navigation through turbulent ocean environments supported by onboard H-ADCP"

Frequently, autonomous underwater vehicles (AUVs) must operate in turbulent ocean environments with complex spatio-temporal variability. Energetic flows, instabilities and currents can strongly perturb safety conditions and development of AUVs operations. A priori knowledge of this ocean variability would allow to adequately plan AUV missions, minimizing the possible negative effects of the environment on its operation. Unfortunately, present oceanographic technology is only capable to forecast large and slow components of the ocean variability, being fast and small scales of variability still unpredictable. This partial knowledge about future environmental conditions degrades AUV robustness, reducing its autonomy and safety. In this article, we propose a class of real-time algorithm to support AUVs navigation in strong turbulent ocean environments characterized by unpredictable small scale variability. The algorithm infers the two-dimensional structure of the current field in a limited region in front of the AUV, using the one-dimensional information obtained from an horizontal acoustic doppler current profiler (H-ADCP). Then, a planner locally optimizes the performance of the AUV in the inferred field. In this work reducing travelling time was of interest. The proposed procedure has been tested on simulated turbulent environments. Results indicate that, although sub-optimals, solutions provided by the algorithm required significantly less travelling time than straight line paths. An example where the proposed methodology increases AUV safety and autonomy is also provided [C1129]

## "Channel Estimation and Windowed DEF for OFDM with Doppler Spread"

Multicarrier systems are seriously affected by time-varying frequency-selective channels. Recently, windowing and decision-feedback equalization (DFE) have separately been proven to boost the performance of minimum mean-squared error (MMSE) block equalization, while maintaining a very low complexity by capitalizing on a band LDL factorization. This paper jointly considers receiver windowing and DFE, as well as the impact on the performance of a pilot-based frequency-domain channel estimation technique that relies on a basis expansion model (BEM) approach. We show that the combination of windowing and DFE still allows the use of a low-complexity band LDL factorization. Therefore, we can further improve the BER of OFDM systems affected by

severe Doppler spread, while preserving linear complexity in the number of subcarriers [C1130]

## "Performance of Spatially Distributed Large Interference Relay Networks"

In this paper we consider a special type of wireless ad hoc network, called interference relay network, where a set of source-destination pairs concurrently communicate through a set of half-duplex relays. We study the performance of the large interference relay network, when the network nodes are spatially distributed. We introduce a new weighted relaying protocol generalizing the recently proposed protocols and an efficient method for allocating relays to the communicating pairs. We investigate the performance scaling in an interference relay network with low number of communicating pairs and study the effect of spatial separation and different network topologies. Our results show that spatial separation can improve the performance of interference relay networks and that the behavior largely depends on the network topology [C1131]

## "A Quartic Algorithm For Squint Sar Imaging"

In this paper some improvements of non-linear chirp scaling (NCS) approach are proposed and a modified algorithm based on the NCS is described. The improvements include three main aspects. A quartic polynomial model is adopted to represent SAR signal in range-Doppler domain and 2-D frequency domain to improve precision. A constant scaling factor is employed to replace the reference frequency in the NCS, which makes NCS more flexible. A second chirp scaling operation is added to the end of the NCS so as to remove scaling effect on range direction of SAR image. Those improvements make NCS applicable to process highly squinted SAR data from a large range swath at a fine resolution [C1132]

## "A Pilot-Less Sample-Time Synchronization Algorithm for High-Mobility DVB-T Receiving"

The OFDM system receiver is well-performed only when the transmitter and the receiver are precisely synchronized. The sampling clock offset causes a symbol-time drift and even introduces inter-carrier and inter-symbol interference (ICI and ISI), which become not negligible in the systems with large OFDM symbol sizes, e.g. in the terrestrial digital video broadcasting system (DVB-T). The sample-time synchronization (STS) algorithm becomes difficult in the high-mobility wireless transmission because of the Doppler effect. In this paper, we propose an innovative STS algorithm especially suitable for DVB-T receiving in the high-mobility environment. Simulation results show that the proposed algorithm can accurately recover the sample-time when the DVB-T signals are received in a fast moving vehicle [C1133]

## "An EM-MAP-Block Algorithm for Semi-Blind Channel Estimation"

In this paper, we propose a semi-blind MAP (maximum "a posteriori") channel estimation method based on an expectation-maximization block algorithm (EM-MAP-block). In the OFDM communication context, our algorithm still have a linear arithmetical complexity. However, it yields to an SNR improvement going up to 3.5 dB compared to classical training sequences based channel estimation method in the context of 5 GHz OFDM WLANs. The new algorithm performs better than already existing recursive algorithms and block algorithms [C1134]

## "Blood Flow Velocities in Common Carotid Artery Changes with Age and Exercise Study by using of telemetry method"

Measurement of blood flow velocity using Doppler ultrasound has become an important noninvasive tool not only in the diagnosis of cardiovascular disease but also in physiological measurement. Physiological blood flow velocities in common carotid artery (CCA) is altered markedly with advancing age. It is unknown that regular aerobic exercise training can alter and improve blood flow velocity waveforms in either healthy young or healthy older individuals. Blood flow velocities were measured in 89 putatively healthy volunteers with age range of 20-76 years: 65 subjects were sedentary and 24 subjects were regular exercise-trained. Blood flow velocity spectra were measured at resting using our newly developed portable telemetry Doppler ultrasound velocimeter (TDUV) with real-time monitoring. Blood flow velocity waveforms were obtained from the spectral blood flow velocities of instantaneous peak-velocities. As a result, blood flow in peak systolic SI, end-diastolic d, and peak diastolic velocities D decreased with aging by the following yearly rate: 7.18 mm/s/year, 2.64 mm/s/year, and 1.24 mm/s/year, respectively. Thus the indices of d/S1, S1/S2, and D/I had a significant change with age. However, resting heart rate (HR) and second systolic velocities S2 were not significantly changed with aging. Blood flow velocities in SI were higher in the exercise-trained, whereas S2, D, and d velocities had no difference between trained and sedentary adults. However, the index of D/I had a marked higher in exercise-trained adults. As anticipated to exercise effect, the resting heart rate (HR) were significantly lower in exercise-trained. There were no differential effects in three age-groups (P= NS, by multivariate analysis). In conclusion, an age-associated decrease blood flow velocities in CCA was altered and improved in the healthy middle-aged and older individuals

who regularly performed aerobic exercise. The blood flow patterns in three age-groups design had no markedly change-- with age in regular aerobic exercise-trained adults. The adaptations of blood flow velocities to regular exercise were not different with aging. [C1135]

## "InSAR Image Registration Using Modified Correlation Coefficient Algorithm"

In this paper, a modified correlation coefficient algorithm is proposed to accomplish image-registration for repeat-pass SAR interferometry. This algorithm utilizes a new definition of correlation coefficient to improve the calculation accuracy of offset between two images. Our simulation shows that Doppler centroid has a significant influence on the correlation coefficient and it should be removed before registration. SIR-C/X X- band experimental data has been processed to demonstrate the effect of the proposed algorithm. Also quantitative comparison between this paper's results and the results from the maximum-spectrum method is presented to show the improvement. [C1136]

## "P3B-4 In Vitro Investigation of Blood-Flow Velocity Patterns Near a Fine Mesh"

Recently there have been advances in endovascular therapy to reduce stroke risk. These advances include: clinical trials of stent-assisted carotid angioplasty for treatment of atheroscerlosis, and self- or balloon-expanding stents that produce a more gradual reduction in carotid stenosis. Unfortunately, past in vivo studies have indicated that the introduction of a stent into the carotid bifurcation alters the Doppler blood-velocity measurements within the stent. These situations may benefit from quantitative measurements of Doppler velocity spectra near (or through) fine mesh structures. In this study, we compared Doppler velocity-based diagnosis of stenosis severity, with and without the presence of a stent using an in vitro system with controlled model geometry of a 50% eccentric stenosis, controlled flow and controlled Doppler parameters. Our hypothesis is that Doppler ultrasound properties are affected by the introduction of a stent and therefore have an effect on Doppler velocity measurements. We have performed an in vitro investigation using a rigid Teflon phantom of a 50% eccentric carotid artery stenosis. A Cordis PRECISE self-expanding Nitinol carotid stent was used in this study to determine the affect of a stent implant on Doppler velocity measurements. A 4-MHz Doppler probe was used to acquire velocity spectra within a 1-mm sample volume. The Doppler parameters were set as follows: 60deg Doppler angle, 50 Hz wall filter, 18519 Hz pulse repetition frequency, 100% power, and 78% gain. We acquired Doppler velocity data over 10 cardiac cycles at 1024 sample points within a centrally located transverse plane of the phantom, with and without a stent implant. All data was digitized at 44.1 kHz for off-line analysis. Doppler velocity spectra were extracted and peak velocity, mean velocity and turbulence intensity (TI) were calculated. Our results indicate that the introduction of a self-expanding carotid stent did not have a significant effect on the measuremen--ts of peak and mean velocities when geometry, flow rate, and Doppler parameters were maintained. We also found that the stent was able to conform to the complex curvature of a diseased 50% eccentric carotid stenosis. Finally, measurements of TI were found to be significantly increased within the internal carotid artery ($p < 0.05$) and external carotid artery ($p < 0.0001$) when comparing normal and stented phantoms [C1137]

## "P3B-5 Investigation of Doppler Ultrasound Velocity-Based Indices for Carotid Plaque Ulcerations Using In Vitro Flow Models"

Previous studies have shown that the presence of surface irregularities, known as ulcerations, in carotid plaque is an independent risk factor for stroke. Doppler ultrasound (DUS) has not been implemented as a diagnostic tool for carotid plaque ulcerations. We employed carotid bifurcation flow models that differed only with respect to the presence of ulceration to study the sole effect of surface roughness on Doppler-derived flow parameters. A pair of in vitro flow models were fabricated, each based on an idealized carotid bifurcation geometry of 50% eccentric stenosis. For one of these models, a 2-mm diameter hemi-spherical ulcer was incorporated at the level of the apex on the non-flow divider wall. DUS measurements were acquired using a 4-MHz probe and 1.0-mm sample volume, delivering 4-D Doppler velocity data sets with 11.7-ms temporal resolution and 1.3-cm s-1 velocity resolution. Velocity data was analyzed for several indices. Teflon flow phantom facilitated both the direct machining of realistic vessel geometries with varying surface roughness (plusmn 0.05-mm) and compatibility with Doppler ultrasound. The small 2-mm hemi-spherical ulcer did not introduce any significant differences in downstream velocity patterns, as indicated by turbulence intensity, peak velocity, or mean velocity. We have developed a DUS technique to characterize carotid plaque ulceration, and have shown that DUS velocity-based measurements of turbulence intensity are feasible with conventional systems. This approach will allow us to extend our paired comparison studies to other ulcer shapes and sizes [C1138]

## "Using New Material to Analyze the Effect of Ionospheric Disturbance on Short-wave Communication"

Various of abrupt physical phenomena of earth-atmosphere can bring various of irregular changes of ionosphere, and it make different influences on short-wave communication. In this paper, we use new test material to discuss the effect of ionospheric disturbance on short-wave communication. This new method is using Doppler shift curve of standard radio wave recorded by HF-Doppler detector. And at the end we point out that use selective-frequency system is a practical way to resolve the problem of long-distance short-wave communication. [C1139]

## "Quasi-Static Channel Estimation for Multiuser STBC-OFDM Systems"

This paper proposes multiuser channel estimation techniques for space time block coded-orthogonal frequency division multiplexing (STBC-OFDM) systems based on simple blocked pilot grid. The estimation of multiuser channels is based on least square (LS) and minimum mean square estimation (MMSE) schemes. Simulation results, for a slowly faded quasi-static channel, reveal that the estimated characteristics closely agree with the actual channel characteristics. Comparison of LS and MMSE performance for various number of users is performed and different Doppler fading effects on MMSE performance are also presented. [C1140]

## "Features of Thermosonic Flip Chip Bonding"

Ultrasonic features in bonding area are of interests for researchers in the field of microelectronics packaging. In this study, the interface characteristics of bonding were detected by using XD7100 X-ray, the velocity of ultrasonic vibration at bonding tool was determined with a PSV-400-M2 high frequency (1.5 MHz) laser doppler vibrometer, microcharacteristics of the specimens of thermosonic flip chip bonding were inspected by using a high resolution transmission electron microscope. Results show that bubbles at the interfaces of reflow soldering flip chip were observed, however they were not discovered during thermosonic flip chip, the interface characteristics of thermosonic flip chip is better than that of reflow soldering flip chip. The acceleration of the ultrasonic vibration was about 500000 m/s2 for a 62.73 kHz bonding frequency. This strong mechanical effect activates dislocations in the metal crystalline lattice and enhances atomic diffusion across the bonding interfaces, and these differ from melting mechanism of reflow soldering [C1141]

## "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 freely choose 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. [C1142]

## "Achievable rates of MIMO downlink beamforming with non-perfect CSI: a comparison between quantized and analog feedback"

We consider a MIMO fading broadcast channel and compare the achievable ergodic rates when the channel state information at the transmitter is provided by "analog" noisy feedback or by quantized (digital) feedback. The superiority of digital feedback is shown whenever the number of feedback channel uses per channel coefficient is larger than 1. Also, we show that by proper design of the digital feedback link, errors in the feedback have a minor effect even by using very simple uncoded modulation. Finally, we show that analog feedback achieves a fraction 1- 2F of the optimal multiplexing gain even in the presence of a feedback delay, when the fading belongs to the class of "Doppler processes" with normalized maximum Doppler frequency shift 0 les F les 1/2. [C1143]

## "P1E-8 Ultrasonic Doppler Measurement of Tissue Vibrations: Opportunities and Limitations"

Doppler measurement of tissue vibrations (ultrasonic vibrometry) can provide clinical information about vascular pathology that may be otherwise difficult to obtain using conventional duplex ultrasound. Vibrometry can provide improved sensitivity, since the scattering strength from tissue is significantly higher than that from blood. In addition, detection of tissue vibrations has reduced angle dependency and does not require visualization of the vessel lumen, making the exam less dependent on operator skill and less time-consuming. The fundamental sources of error that can affect the measurement accuracy of the vibration characteristics are Doppler spectral broadening and tissue acceleration. Parametric simulation studies analyzing the effect of these sources of error and their implications are presented. We also present preliminary results from renal artery stenosis (RAS), demonstrating that a diagnosis based on the characteristics of measured tissue vibrations correlates well with the routine clinical diagnosis [C1144]

## "SAT05-5: PER Evaluation for IEEE 802.16-SC and 802.16e Protocol in HAP Architecture with User Mobility under Different Modulation Schemes"

This paper presents a performance evaluation of IEEE 802.16e protocol. The 802.16e PHY/MAC protocol for wireless MAN has been applied to a high altitude platform (HAP) architecture with another protocol family member: 802.16SC (single carrier). In this work an HAP serves a rural scenario with low multipath effects. Two different time-variant wireless channels have been considered: the first one for a HAP- mobile user link that is characterized by path loss and doppler effects and the second one for a mobile user-mobile user link that presents also multipath fading. Many simulation scenarios with different mobility user speeds and different modulations are reported and interesting results concerning the PER of both channel, the first under single carrier (SC), and the second under an OFDM modulation, a specific multicarrier modulation, are presented. Thus PER evaluation under different modulation and for different payload sizes are presented. Simulation results showed good channel performance if the mobility of the user is low or the mobile user is near the vertical axis of the HAP segment, but also if QPSK modulation is used. Finally Matlab elaboration to obtain PER polynomial function are presented. [C1145]

## "SPC04-6: Channel Estimation for MIMO-OFDM Systems in Rapid Time Variant Environments Based On Channel Statistics Estimation"

This paper examines pilot-aided channel estimation algorithm for multiple-input, multiple-output orthogonal frequency division multiplexing (MIMO-OFDM) systems in rapid time-variant environments. It includes Doppler frequency estimation, delay path profile estimation and interpolation algorithms in time and frequency domains. The algorithm performs channel statistics estimation for each frame and uses the pilot symbols of this frame where all signals pass through the same propagation channel. The proposed algorithm uses separable, interpolation order changing to reduce channel estimation complexity. This algorithm first applies interpolation in the time domain and then in the frequency domain. Hence, for the pilot pattern of IEEE 802.16 e we get twice as many reference symbols for frequency interpolation, which improves the interpolation quality, especially for channels with long delay profiles. Computer simulation of the V-BLAST structure demonstrates high effectiveness of this algorithm and its robustness to increasing subscriber speed. Packet error rate (PER) degradation, in comparison with the ideal channel, is l-2.5 dB for 4 x 4 mode and 0.5-1.5 dB for 2 x 2 mode. Our results show that the performance degradation is acceptable not only up to 250 km/h, but also up to 500 km/h. [C1146]

## "A Pre-Doppler Approach for Reduced Loss Bistatic STAP"

In this paper we investigate the effects of bistatic clutter spectral dispersion on STAP techniques. The use of reduced d.o.f. algorithms is considered since they enable localized training in the range dimension and thus limited effects of clutter non-stationarity. To this aim, the selection of appropriate adaptive degrees of freedom is demonstrated to be a crucial issue. Due to their intrinsic capability to yield reduced adaptivity loss and to their limited computational load, Pre-Doppler STAP techniques are shown to be a very appealing solution for clutter cancellation and slowly moving target detection in bistatic radar systems [C1147]

## "Benefits of Space Time Adaptive Processing for Air to Air operations"

The aim of the paper is to give an overview of capacities and interests of space-time adaptive processing (STAP) for air to air operations. In order to evaluate the benefits of STAP without artifact effects due to the chosen algorithm, a less computation load implementation of the maximum likelihood ratio test has been developed and is detailed in the paper. Results of simulations are shown and point out the expected benefits of STAP for clutter reduction in air to air operations [C1148]

## "WLC43-4: Comparing the effect of Carrier Frequency Offset on OFDM and Single-Carrier Block Transmission in AWGN Channels"

Both OFDM and single-carrier block transmission (SCBT) are promising candidates for the future high date rate communication, which well handle the frequency selective channels with a low implementation complexity. However, the sensitivity to carrier frequency offset, caused by Doppler effect or the carrier frequency difference between transmitter and receiver, is always a major concern of these block transmission systems. Actually, a controversy in comparing the carrier frequency offset effect on OFDM and SCBT systems has already been witnessed in the literature for a long time. In this paper, we first analyze the effects of carrier frequency offset on these two systems, then by carefully investigating existing works, we classify the problem into two categories: carrier frequency offset analysis with compensation and without compensation. Finally, we draw conclusions

based on theoretical and numerical results that the BER performance of OFDM systems is more sensitive to carrier frequency offset than SCBT systems for the BPSK modulation in AWGN channels, although the difference of the BER performance between two systems is much smaller than theoretically predicted in previous works, if a fair comparison environment is used. Moreover, this small performance gap vanishes in higher level constellation like QPSK. [C1149]

## "WSN12-4: Multi-hop Delay Performance in Wireless Mesh Networks"

Multi-hop wireless mesh networks (WMNs) have been actively developed as a flexible and reliable platform to support a wide variety of real-time and best-effort multimedia services and applications. For delay sensitive applications over multi-hop wireless connections, end-to-end delay performance is a crucial performance metric and hence the focus of this paper. We extend the link layer effective capacity (EC) model to derive a lower bound of delay-bound violation probability, or complementary cumulative distribution function over multi-hop wireless communication paths. A fluid traffic model with cross traffic and a Rayleigh fading channel with Doppler spectrum are considered in our study. End-to-end average delay and delay jitter bounds are also obtained. Analytical results are verified by extensive computer simulations under different traffic conditions. [C1150]

## "2B-2 Phase Aberration Correction on a 3D Ultrasound Scanner Using RF Speckle from Moving Targets"

In 1992, Zhao et al. described a variation of the speckle-brightness algorithm for phase correction on moving targets [Zhao et al., 1992 and Bohs et al., 1992], By subtracting two beam-summed consecutive interrogations of a region of interest, they were able to remove effects of reverberation and strong targets from the region of interest. We have modified this approach of image subtraction for use on radio-frequency (RF) signals from the Duke/Volumetrics Medical Imaging real-time 3D ultrasound scanner. We have devised a system to use the 16:1 parallel receive processing capabilities of the 3D scanner to simultaneously acquire RF data from 16 separate receive sub-apertures. We then modify the correlation model matrix to allow correlations only between simultaneous RF lines. By using overlapping sub-apertures and the least-mean-squares approach, we compute an aberration profile with phase closure for the entire aperture. To test this method, we have performed experiments using electronic and physical aberrators. Using an electronic aberrator, root-mean-square strength (RMS) = 80 ns and autocorrelation length = 3.4 mm, and using echoes from a flowing corn-starch/water mixture, we saw marked improvement in color Doppler visualization as well as an 11% increase in brightness, a 47% increase in contrast to speckle ratio (CSR), and a 17% increase in lesion contrast. Using a physical aberrator (plastic casting of a skull bone), RMS strength = 31 ns autocorrelation length = 3.3 mm, we saw a 5% increase in brightness, an 11% increase in CSR, and a 26% increase in lesion contrast. We believe that this technique will be useful in transcranial ultrasound with contrast agents, since it will allow us to use the strong echoes from the microbubbles for correction and since it will mediate the effects of reverberations due to the skull bone. We also include images from the first real-time 3D transcranial color Doppler ultrasound with contrast agents [C1151]

## "WLCp1-04: Exploring Maximum Doppler Diversity by Doppler Domain Multiplexing"

Doppler effect induced by temporal fading variation provides Doppler diversity, which can be exploited to combat the impairments caused by multipath fading. In this paper, a Doppler domain multiplexing (DDM) communication structure is presented to explore the potential Doppler diversity. Data streams in DDM system are encoded and multiplexed at different Doppler shifts to achieve both Doppler diversity and high spectral efficiency. Theoretical performances of both uncoded and coded DDM systems are analyzed. The analytical results show that DDM structure can effectively exploit the potential Doppler diversity inherent in time- varying fading. A sub-optimum decoder with Doppler domain equalization and soft maximum a posteriori decoding is employed to recover the data at the communication receiver. Simulation results show that significant performance gains can be achieved by DDM system over conventional time domain system. [C1152]

## "WLCp1-17: A SNR Independent Doppler Shift Estimator Based on Iterative Process in Mobile Communication Systems"

In this paper, we propose a Doppler shift estimator based on the autocorrelation function (ACF) of the time-varying channel. In order to eliminate the effect of additive noise, we analyze the conditions for the estimator independent of the signal- to-noise ratio (SNR) and implement the conditions with a simple iterative process named as adaptive lag. The proposed method achieves good SNR-independent performance in wide range of velocities and SNRs. [C1153]

## "Generalized Ambiguity Functions for Ultra Wide Band Random Waveforms"

The generalized ambiguity function of a random ultra wide waveform can be defined from the cross-correlation between the waveform and a time-scaled and delayed version of it, where the time scaling is related to the relative velocity of the target and the delay to the range. As a result of the randomness, the ambiguity function fluctuates between different realizations. A full characteerization includes its statistical distribution but often second orders staatistics are sufficient. The ambiguity function is then described as a sum of its average and a noise component defining a noise floor. The average value includes in the integrand a time-scaled version of the autocorrelation function of the random waveform, while the variance of the ambiguity function defines the noise floor of the side lobes. Particularly useful in characterizing the ambiguity function of a random waveform is the second moment statistics describing the sum of the squared aveerage and the variance. Formulations are developed analytically for Gaussian waveforms, phase-modulation by continuous Gaussian noise and randomized step frequency radar. [C1154]

## "Ka-band Noise Waveform Intrusion Detector on the Basis of Aoutodyne Effect in Chaotic Signal Generator"

A new method for design of a intrusion detector is suggested. The method is based upon the property of noise self-oscillator to produce Doppler signal only in case an object is moving within its coherence (correlation) range. The latter is defined by the width of power spectral density of the generated random signal. Preliminary results of design and investigation of noise waveform Ka-band Doppler sensor based on autodyne effect are preesented. The sensor suggested is very promising for design of various detectors because of their low false alarm rate, construction simplicity and high reliability [C1155]

## "Doppler frequency converter using a semiconductor plasma boundary moving at a relativistic speed"

Efficient and wide band frequency conversion using a finline with a silicon substrate has been discussed. Laser pulses move along the finline as generating an electron-hole plasma at the surface of silicon in the fins. The plasma acts as a rf-short moving at a relativistic speed, reflecting an incident wave and up-shifting its frequency through the double Doppler effect. The theoretical results have shown that a high frequency conversion ratio of 7.5 could be achieved with a power conversion efficiency of more than 50 % at W-band. [C1156]

## "The remote HF-Doppler detection of the sunrise effect"

The information about the ionospheric change is of great significance for the research of geophysical phenomenon and the communication guidance. In this paper, according to the year-round data of the HF-Doppler detection of the ionosphere, we induced and generalized the curves of Doppler frequency shift during the sunrise and analyzed the basic characteristic and the rule of the daily and seasonal variation of the Doppler detection of the sunrise effect. [C1157]

## "Influence of the Doppler Effect in Communication Link Between ESMO and ESEO Satellites and Usage of the Doppler Radar in ESMO Mission"

This paper shows the technical issues relating to the simulations of the communication microwave link between the ESMO (European Student Moon Orbiter) or the ESEO (European Student Earth Orbiter) minispacecraft to Earth. The paper presents the application of the Doppler pulse radar onboard the ESMO for the precise navigation above the Moon surface. [C1158]

## "Nonlinear ring formation via self-phase modulation in hot atomic vapor"

We have observed high-contrast nonlinear optical ring formation in hot atomic vapor. The standard Kerr model fails to predict important qualitative features of these optical patterns, but a Doppler-broadened two-level model is extremely successful. [C1159]

## "Numerical Evaluation of Ambiguity Function for Stepped Non-Linear FM Radar Waveform"

The numerical evaluation of a non-linear frequency modulation (NLFM) based on MATLAB code is presented. The results of the numerical evaluation are depicted in two-(autocorrelation function) or thee-dimensional plots (ambiguity function). The program makes a numerical approach in order to design a NLFM pulse based on the stepped frequency characteristic. The program could be used to optimize results of empirical search for other nonlinear frequency characteristics based on relations between LFM and NLFM frequency sweep. [C1160]

## "Stationary scatterer filtering in spectral domain optical Doppler tomography"

We report a method for improving the accuracy in determining blood flow rate and small vessel size by implementing a delay line filter when processing real-time spectral domain optical coherence tomography images of flow. [C1161]

## "Sub-Doppler and subnatural narrowing of an absorption line"

An experimental evidence of electromagnetically induce narrowing of an absorption line is presented. The width of this resonance is sub-Doppler and subnatural and it is confined between two closely spaced electromagnetically induced transparency windows. [C1162]

## "Very Low Frequency Modulation in Renal Autoregulation"

This study aims to examine the presence of a possible third renal autoregulatory mechanism in the very low frequency (VLF) band (~10 mHz) using a high-resolution time- frequency spectral method. Blood pressure and renal blood flow data were measured from conscious and anesthetized Sprague-Dawley and spontaneously hypertensive rats, at the level of the whole kidney (via ultrasound flow probe) and local cortical tissue of a kidney (via laser Doppler flow probe). In addition, N-nitro-L-arginine (LNAME) was used in order to assess the effect of nitric oxide on the third mechanism. Using a complex demodulation method with high time and frequency resolution, a VLF band was often observed, as well as amplitude modulation at the VLF of the two other autoregulation mechanisms. The presence of amplitude modulation is an indication of a particular form of nonlinear interaction between the autoregulatory mechanisms. Physically, such interactions may arise from the fact that all three mechanisms share a common effector, the afferent arteriole. In addition, the magnitude of amplitude modulation of the VLF on the other autoregulatory mechanisms was enhanced by the addition of LNAME, suggesting an important role of nitric oxide in the autoregulatory process [C1163]

## "Partial Aperture Effect-Free Doppler Centroid Estimation Method for Airborne Side-looking SAR Based on Range-Doppler Domain Contrast Minimization"

First Page of the Article [C1164]

## "Effect of Disk Waviness on Slider Dynamics"

The investigation reported in this paper studies the motion of a typical pico type slider as a function of disk waviness. Laser Doppler vibrometry (LDV) is used to study the motion of a slider on three disks with different waviness. In addition, numerical analysis is applied to determine stiffness and damping of the slider motion as a function of disk waviness. Defining the ratio of slider motion over disk impact motion as the gain of the slider, we find that in the low frequency range the gain of the slider is independent of disk waviness. However, in the high frequency range the gain of the slider is a function of disk waviness. [C1165]

## "Adaptive Baseband Compensation for I/Q Imbalance and Time-Varying Channel in OFDM System"

This paper proposes adaptive baseband compensation method for the OFDM system in the presence of I/Q imbalance of receiver front-end, and Doppler effect of time-varying channel. A paired-tones model is built up for the applications of two adaptive equalizers-the RLS and NLMS. Special scattered pilot tones in V-pattern are used in conjunction with the adaptive algorithms. The impact of Doppler frequency on the receiver performance is studied through computer simulation [C1166]

## "Semiconductor Millimeterwave Spectroscopy"

A new semiconductor high-resolution microwave room-temperature spectrometer has been developed in the Prague during 2004-2005. This simple mm-spectrometer makes possible Doppler limited as well as sub-Doppler resolutions. Accuracies of well developed lines are better then 109. The scientific program of the Prague laboratory is focused to atmospherically important species with a significant hyperfine structure of rotational levels. [C1167]

## "The Motion Analysis of a Moving Object in Sea by Analyzing Doppler Effects of Sound with Genetic Algorithms"

We have researched for the applicability of the genetic algorithms (GA) to problems such as multi objective optimization, time series prediction, the analysis from observed noisy data and the solution of implicit functions. Concerning these problems, we reported that GA is effective for the tracking of the moving ships and for the tracking of the objects orbiting the earth from observed time series bearing and distance data or only from sound

signals radiated by of unknown moving object. In this paper, we report on the analysis for the movement characteristics (distance, bearing, velocity, course) and sound source frequency by elimination Doppler effect from sounds radiated by the propulsion system of an unknown object in sea. To analyze those data, we applied two kinds of GA. One of them analyzes harmonic frequencies and their phases of the Doppler effected sound signals. The other GA analyzes the movement characteristics and sound source frequency based on the output of the former GA. We could prove the applicability of GA to this analysis through a computer simulation. [C1168]

## "A New CPFSK Telemetry Digital Polarization Diversity Receiver"

A new continuous phase frequency-shifted keyed (CPFSK) telemetry digital polarization diversity receiver is studied. With compared to conventional telemetry analog polarization diversity receiver, the realization of it is simpler and it can provide more system flexibility, and stability. Polarization diversity structure of telemetry receiver proposed is given. A new method of removing Doppler frequency and carrier frequency deviation is provided and analyzed. Its performance is investigated over additive white Gaussian noise (AWGN). The simulation results show that the Doppler frequency shift and carrier frequency deviation can be removed by the method proposed in this paper [C1169]

## "Simple Sea Clutter Canceller for Noise Radar"

In the last decade the noise radar technology is intensively investigated. The low transmitting power and nonspecific waveform makes that the noise radar has very god LPI properties. The simultaneous emission and reception of signals in such kind of radars make them sensitive to near-far problem. Strong echoes, originated from ground clutter can completely mask the weak target return. In case, when the radar is placed on a vessel, except of zero-Doppler ground returns the dominant part of return power consists of Doppler-spread sea cutter echoes. The papers present a simple adaptive sea clutter canceller, which can be used to mitigate near-far problem "on the sea". [C1170]

## "Combined Effect Analysis of Wiener Phase Noise and Doppler Spread in OFDM Communication System"

We derive an exact closed-form expression for the SNR degradation due to the combined effect of Wiener phase noise and Doppler spread in the OFDM system corrupted by shadowed multipath effect. The derivation depends on the continuous time signal model analysis assuming the subcarrier data symbols are constants. A simple approximate SNR degradation formula is obtained for slow fading channel, small phase noise effect and small phase noise linewidth-to-maximum Doppler frequency ratio. This approximate formula shows that the degradation factor in dB is the summation of the degradation factor in dB due to the phase noise effect only and the degradation factor in dB due to the Doppler spread only [C1171]

## "Research on the Method of Demodulation for PCM/FM Signal Based on Instantaneous Frequency Measurement"

Based on the theory of instantaneous frequency measurement, a method of demodulation for PCM/FM signal with Doppler frequency offset is presented. Firstly, through estimating Doppler frequency offset by instantaneous frequency measurement, the method corrects the frequency offset of PCM/FM signal and improves the precision of bit synchronization. Then, according to the relation between two adjacent points of bit synchronization, it realizes demodulation. The paper discusses the basic principle and the implementation of the method, analyses some factors that can affect the precision of instantaneous frequency measurement and the effect of Doppler frequency offset on demodulation, and proposes methods to improve the precision of instantaneous frequency measurement and the performance of demodulation. The results of computer simulation show that the method with a bright future for application is good at anti-jamming, better than other methods of demodulation and convenient to be realized by software and DSP [C1172]

## "Cooperative Network Communications in Dynamic Channel Environments"

Coded space-time cooperation is a powerful approach to deliver information over a distributed network. Multiple transmit and receive nodes form a distributed multiple-input-multiple-output (MIMO) system, thus provide the capability of high data rate transmission with the support of high diversity gains. However, unlike co-located MIMO systems, it is impractical for distributed MIMO networks to maintain a perfect synchronization between different transmit terminals. It has been shown that, in the presence of synchronization error between different relaying nodes of even a fractional symbol, coded cooperation using space-time block codes may experience severe inter- symbol interference (ISI) and, subsequently, significant performance degradation. It becomes even more challenging when Doppler effect exists as the result of moving transmit and/or receive nodes. In this paper,

we propose the use of BLAST-type of data transmission combined with effective channel coding. The relative independence between the information transmitted from different nodes allows individualized compensation of the time delay and Doppler shift, whereas the channel coding of the information across different transmit nodes assures high spatial diversity. As the result, the proposed scheme is capable in maintaining a high data rate in a dynamical channel environment. It provides robust and reliable communication quality by taking advantages of spatial information multiplexing and spatial diversity. [C1173]

## "Spatial-Temporal-Frequency Diversity in Radar Sensor Networks"

In this paper, the spatial-temporal-frequency diversity to improve the detection performance of Radar Sensor Networks (RSN) in the presence of certain types of interference (clutter, jamming, noise and interference between radar sensors) is studied. In order to reduce the interference between radar sensors and maximize the signal-to-interference-plus-noise ratio (SINR), we propose a method using the orthogonality criterion to design waveforms for radar sensors in the network. Besides the interference between radar sensors, performance of the network depends largely on other interference, especially clutter, which is extended in both angle and range, and is spread in Doppler frequency. By using the spatial-temporal diversity, we can suppress effects of these interference. In this paper, we also propose a receiver for diversity combining in RSN. As an application example, we apply the spatial-temporal-frequency diversity scheme to improve the detection performance or reduce the missdetection probability at a low false alarm probability. Simulation results for both non-fluctuating targets and fluctuating targets show that the performance of our proposed scheme is superior to that of the single radar with the spatial-temporal diversity only. [C1174]

## "Estimation and Equalization of Rapidly Varying Sparse Acoustic Communication Channels"

A method for estimating rapidly time-varying and sparse channels is presented. The impact of estimation performance on equalization of phase coherent communication signals is investigated. To address both the rapid channel fluctuations and the channel sparse structure, the delay-Doppler-spread function representation of the channel is adopted. The delay-Doppler-spread function may be considered as a first-order approximation to the rapidly varying channel in which each channel component is associated with Dopplers that are assumed constant or slowly varying over a certain averaging time. The sparse structure of the delay-Doppler-spread function is then exploited by sequentially choosing the dominant components that minimizes a least squares error. Comparison is made between nonsparse RLS channel estimation, sparse channel impulse response estimation and estimation using the proposed approach. The performance of channel estimation as well as the subsequent equalization based on those channel estimates are demonstrated for highly dynamic channels using experimental data [C1175]

## "Iterative Reception for Acoustic Underwater MIMO Communications"

This paper presents a soft input/soft output linear equalizer for Alamouti encoded MIMO signals. The derived structure allows for simultaneous equalization of MIMO channels and decoding of Alamouti coded signals. The equalizer/decoder is here used within the turbo equalization framework to exploit the complex and rich characteristics of the acoustic underwater channel. Such schemes can operate ate very low signal-to-noise ratio (SNR) levels enabling high transmission rates over long distances. We investigate the viability of the technique by using a simulation example and by studying its behavior for a real scenario, using data collected in the Baltic Sea [C1176]

## "Effects of Estimation Errors on the Noncoherent Capacity Over Time-Varying Channels"

We investigate the channel capacity of noncoherent communications over fiat fading channels. The lower bound of the noncoherent channel capacity as well as the upper bound of the capacity penalty using noncoherent communications are characterized and contrasted with the coherent capacity. Analytical results show that the coherent channel capacity is achievable via noncoherent communications under certain signal to noise ratios (SNRs) and Doppler frequency shifts. The thresholds of SNRs and Doppler frequency shifts are provided, under which noncoherent communications can perform virtually at no capacity penalty. [C1177]

## "Distributed Power and Scheduling Management for Mobile Ad Hoc Networks with Delay Constraints"

In this paper, we propose a cross-layer distributed power control and scheduling protocol for delay-constrained applications over mobile CDMA-based ad hoc wireless networks. Herein, we propose a novel scheme where power control is employed to combat delay occurring on multi-hop wireless ad hoc networks via cross-layer information exchange. Based on that, a distributed power control and scheduling protocol is proposed to control the incurred delay, as well as the multiple access interference (MAI). Unlike many previous works on power

control and scheduling, we also investigate the impacts of Doppler spread and noisy channel estimates upon the system performance, and provide a robust system which employs a combination of power control and coding/interleaving to combat the effects of Doppler spread by exploiting the time diversity when the Doppler spread gets large. Hence, our proposed approach can function appropriately over a wide range of channel conditions [C1178]

## "Receiver Design for Mobile OFDM with Application to DVB-H"

In mobile reception, orthogonal frequency division multiplexing (OFDM) may experience significant inter-carrier interference (ICI) which introduces an error floor proportional to the normalized Doppler frequency. To mitigate the effect of ICI, many schemes have been proposed but they are computationally complex for systems using large OFDM symbol length such as digital video broadcasting system for handheld (DVB-H). In this paper, we propose a low-complexity ICI suppression and channel estimation scheme for DVB-H systems. The proposed scheme is applied to a typical DVB-H system. Simulation results demonstrate that the proposed scheme is robust to mobility and can be employed efficiently in a DVB-H system. Comparison of DVB-H system with OFDM modulation and single carrier modulation (SC) employing frequency domain equalization (FDE) is investigated. Simulation results show the superiority of the SC to OFDM modulation for DVB-H systems and for the simulated scenarios. [C1179]

## "Transmit Diversity and Multiplexing Methods for 3G-LTE Downlink Control Channels"

In order to provide a smooth migration toward 4G, studies on 3G long-term Evolution (3G-LTE) have been announced recently in third generation partnership project (3GPP) [1] and standardization work is under way. This paper investigates multiplexing method combined with transmit antenna diversity for the downlink control channels in 3G- LTE. Four schemes, such as FDM-STBC, CDM-STBC, FDM- SFBC and CDM-SFBC, are investigated for the downlink control channels, in particular, for one bit type control channels. Through computer simulation, the receiver performance of these candidate schemes are analyzed under multi-path fading channel environments. The effects of channel estimation, Doppler shift and the number of users on the performance are investigated. It is shown that the CDM-SFBC outperforms other schemes. We believe that results will provide beneficial information to design the 3G-LTE downlink control channels. [C1180]

## "A study of the navigation for a spacecraft by using Modified Orbit estimator"

The error budget analysis is presented which quantifies the effects of different error sources in the Earth-based orbit determination process when the orbit estimation filter is used to reduce radio metric data. The estimator strategy differs from more traditional filtering methods in the nearly all of the principal ground system calibration errors affecting the data are represented as filter parameters. Error budget computations were performed for a Venus mission interplanetary cruise scenario for cases in which only X-band Doppler data were used to determine the spacecraft's orbit, X-band ranging data were used exclusively, and combined set in which the ranging data were used in addition to the Doppler data. Random nongravitational accelerations were found to the largest source of error contributing to the individual error budgets [C1181]

## "ANovel Method for Binary Chirp-Rate Modulation and Demodulation"

Chirp-rate modulation (CRM) is a kind of technique of spread spectrum which has the ability of anti-multipath and anti-interception. Meanwhile as a modulation method, CRM can be combined with other spread spectrum methods to compose a hybrid-spread-spectrum scheme and increase the system capability. In this paper, the method for binary CRM based on the fractional Fourier transform is investigated, and a convenient noncoherent demodulation method is presented. The peak of the output of the demodulator is derived. And the effect of Doppler shift is analyzed, which shows the inherent immunity against Doppler shift. Finally, simulation results show that the performance of this proposed method is worse than optimal matched demodulation by about 3 dB, but without needing of rigorous phase synchronization [C1182]

## "Doppler frequency shift estimation for rician channel in high-speed mobile communications"

In high-speed mobile wireless communication system, the side-effect of Doppler frequency shift is obvious. In order to get rid of it, the estimation of Doppler frequency shift is necessary. This paper proposes a new way to estimate the Doppler frequency shift with a new Rician channel model. The simulation results show that the estimate of Doppler frequency shift is more accurate with the proposed estimation method [C1183]

## "Signal Processing System for Seismic Exploration Based on Laser Doppler Effect"

In order to improve the resolution of seismic acquisition, a new signal processing system for seismic exploration

based on laser Doppler effect is proposed with an optimized differential optical configuration. The frequency bandwidth is properly determined by analyzing the frequency of the Doppler signal. The velocity, displacement, acceleration and frequency to be measured can be real-time obtained by frequency/voltage (F/V) converting the FM Doppler signal. A 100 dB dynamic range and the linear frequency range of 1.0 to 1000 Hz are realized. It is proved by experiments that the measurement accuracy of amplitude and frequency respectively are 0.6% and 1.0%. Obviously, the technological parameters are satisfactory, and the signal processing system for seismic exploration based on laser Doppler effect can be employed to explore in physical geography [C1184]

## "Radar Target Recognition Based on Micro-Doppler Effect"

Micro-Doppler effect is of great potential for radar target recognition since the micro-dynamics of structures on the target can be detected with it. The recognition process includes time-frequency analysis of the returned radar signal, feature extraction from time-frequency distribution images, and classification according to the feature set. In this paper, the time-frequency distribution images of four different types of micro-dynamics, which are vibration, rotation, coning and tumbling, are given and analyzed first. Then a method is proposed for feature extraction from time-frequency distribution images of micro-Doppler dynamics. Simulated experimental results have shown that high classification performances for different classifiers have been achieved [C1185]

## "Impact of the Estimation Errors and Doppler Effect on the Modulation Diversity Technique"

The performance of wireless communications systems can be significantly improved using the modulation diversity technique, which is basically based on the combination of a suitable choice of the reference angle of an MPSK constellation with independent interleaving of the symbol components. This technique presents good performance assuming the absence of estimation errors for channels characterized by flat fading. In this paper, the performance of this technique is analyzed taking into account the effects of channel estimation errors. It is shown, by simulation, that the efficiency of this technique is maintained even under this assumption. Additionally, the impact of the Doppler effect on the system performance is treated and a tradeoff between the interleaving depth and the error probability is achieved. [C1186]

## "Low-Complex ICI Cancellation for Improving Doppler Performance in OFDM Systems"

A combination of receiver windowing and inter-carrier interference (ICI) canceling is proposed for improving the Doppler performance of orthogonal frequency division multiplex (OFDM) systems. The windowing reduces the ICI, and also reduces the required number of canceled bins. The effect of windowing is analytically derived, and bounds are given on the possible gain that can be obtained. Since successful ICI cancellation relies on that the channel can be accurately estimated, the paper also give examples for how different one-dimensional and two-dimensional channel estimators can be expected to work for various Doppler spread and delay spread of the channel. To verify that the proposed approach for ICI canceling works, as well as studying the impact of channel estimation errors, simulations are performed using the key parameters of DVB-H. As a result it is found that with proper channel estimation, windowing but no ICI cancellation can increase the allowed Doppler by 20%, ICI cancellation but no windowing can also increase the allowed Doppler by 20%, and if both windowing and ICI cancellation are used, the allowed Doppler can increase by more than 40%. [C1187]

## "Partial Aperture Effect-Free Doppler Centroid Estimation Method for Airborne Side-looking SAR Based on Range-Doppler Domain Contrast Minimization"

Based on the statistical property of the range migration (RM) in the synthetic aperture radar (SAR) range compressed range-Doppler (RD) domain, a Doppler centroid estimation method for SAR is proposed. The method can mitigate the partial aperture effect (PAE) which seriously degrades the estimation accuracy of the traditional Doppler estimators for high contrast scenes. Experimental results with real data of airborne high resolution SAR support the application of the proposed method to practical SAR processing. [C1188]

## "Performance of Interleaved OFDMA Uplink with ICI Self-Canceling Over Doubly Dispersive Channels"

In the interleaved orthogonal frequency-division multiple access (OFDMA) uplink, the received signal from a user is corrupted by the intercarrier interferences (ICI) which result from both his own signal and other users' signals due to Doppler spreads. Furthermore, different received signal powers and Doppler spreads between users may increase the effect of the ICI. Among the schemes which have been proposed to reduce the ICI in OFDM, the ICI self-canceling scheme is easily applicable to the interleaved OFDMA uplink. In this paper, we investigate the performance of the interleaved OFDMA uplink with and without ICI self-canceling over doubly dispersive channels. We analyzed the signal-to-intercarrier-interference-plus-noise ratio (SINR) improvement and we

examined the symbol error rates and the error floors through simulation. [C1189]

## "The Effects of Driving Waveform of Piezoelectric Industrial Inkjet Head for Fine Patterns"

This paper presents the effect of driving waveform for piezoelectric bend mode inkjet printhead with optimized mechanical design. Experimental and theoretical studies on the applied driving waveform versus jetting characteristics were performed. The inkjet head has been designed to maximize the droplet velocity, minimize voltage response of the actuator and optimize the firing frequency to eject ink droplet. The head design was carried out by using mechanical simulation. The printhead has been fabricated with Si(100) and SOI wafers by MEMS process and silicon direct bonding method. To investigate how performance of the piezoelectric ceramic actuator influences on droplet diameter and droplet velocity, the method of stroboscopy was used. Also we observed the movement characteristics of PZT actuator with LDV(laser doppler vibrometer) system, oscilloscope and dynamic signal analyzer. Missing nozzles caused by bubbles in chamber were monitored by their resonance frequency. Using the water based ink of viscosity of 4.8 cps and surface tension of 0.025N/m, it is possible to eject stable droplets up to 20kHz, 4.4m/s and above 8pL at the different applied driving waveforms. [C1190]

## "Target multi-dimensional rotations effects on ISAR imaging"

The effects of target multi-dimensional rotations on inverse synthetic aperture radar (ISAR) imaging are analyzed from the point of view of Doppler history. In airborne ISAR, the geometry relationship between radar and moving targets is very complicate. And the relationship between Doppler change and target multi-dimensional rotations is not clearly. In this paper, a novel analytical geometry model is presented. Based on this model, we draw a simple conclusion and find an easy way to understand the Doppler frequency variation due to the multi-dimensional rotations of target [C1191]

## "Burst Mode Imaging with ENVISAT-1 ASAR Alternating Polarisation Data"

ENVISAT-1 ASAR (alternating polarisation) AP burst data segments frequency-time energy in Doppler histories according to the position of target relative to the burst timeline, at the same time, the energy that a scatterer contributes to the received echo ensemble depends on the relative scatterer position following the azimuth antenna pattern, hence the focused image exhibits the radiometric modulation, an effect known as scalloping. This paper investigates the applicability of the band-limited RD algorithm to process ENVISAT-1 ASAR AP burst-mode data, and shows its ability to remove the influence of the azimuth antenna pattern and to preserve phase information. Then the paper illustrates a strategy of filtering the power detected image to suppress the periodic modulation of the impulse response. Finally, the band-limited RD algorithm and the method of filtering in image power domain are verified by processing the ENVISAT-1 ASAR AP mode burst data [C1192]

## "Frame-overlapped Zoom-FFT Optimization in PD Radar Application"

This paper addresses a frame-overlapped zoom-FFT method applied to pulse Doppler (PD) radar echo spectrum analysis. The method can achieve high resolution of local spectrum, and improve the gain of coherent integration, so it can enhance the detection probability and the precision of parameter estimation for poor echo signal. Firstly this paper introduces the principal of frame-overlapped zoom-FFT. Then it addresses the parameter design criterions in high pulse repeat frequency (HPRF) PD radar application. Furthermore based on analyzing the effects on incoherent integration and target detection due to frame overlap, it illustrates the parameter design process by an example of PD radar spectrum analysis application and gives the comparison of overlap processing and no-overlap processing. Finally, a real-time spectrum analysis system implementation adopting the frame-overlapped zoom-FFT method is proposed [C1193]

## "Effects of geometry on clutter characteristics of hybrid bistatic space based radar"

For hybrid bistatic space based radar (HB-SBR) which is composed of a transmitter on a satellite and a receiver on an airplane, clutter is a serious problem for detecting slow moving target. The authors discuss the effects of geometry on clutter characteristics, such as Doppler-angle traces, isorange and isodoppler contours, Doppler ambiguities and so on, of HB-SBR which applies space-time adaptive processing (STAP) in this paper. It is shown that some unique clutter properties appear due to the great differences of platform speeds and heights between the transmitter and receiver in the hybrid mode. Some suggestions about bistatic geometry design are also made to improve he performance of moving target indication (MTI) [C1194]

## "Chaff Jamming Eject to Radar and Math Model Building"

Chaff jamming refers to the influence of Radar's compressing coefficient, spreading radar's spectrum, and the attenuation effect to incidence wave. After analyzing chaff's jamming effect to radar, mathematical models of

chaff jamming RCS, RCS statistical feature, and polarization feature are established, as a mathematical basis for simulation jamming evaluation of chaff jamming [C1195]

## "PNPM-LFM Combined Radar Signal Analysis"

A new combined radar signal-pseudo-random binary-phase code phase modulation and LFM combined radar signal is proposed, and the frequency spectrum function, the ambiguity function and the range correlation function are deduced. The working principle of combined radar is illustrated in detail and the formula of signals in each stage is deduced and the Doppler signal and it's effect on the correlation output of radar system is analyzed. Finally, the resolution, ambiguity characteristics and the range cut-off characteristic are studied. Research shows that the new combined radar system is feasible and has advantageous performance [C1196]

## "A Fast Method for Time Delay, Doppler Shift and Doppler Rate Estimation"

For realizing the rapid estimation of time delay, Doppler shift and Doppler rate of moving targets in passive radar, we present a cross ambiguity function algorithm based on higher order ambiguity function (CAF-HAF). In this algorithm, higher order ambiguity function transforms the nonlinear harmonious signal's estimation to the linear harmonious signal's estimation, then zoom-FFT is used for estimating the frequency portion which the authors are interested about. Therefore, the CAF-HAF algorithm realizes the accurate estimation of the time delay, Doppler shift and Doppler rate of moving target with less computational cost Then the computation cost and the accuracy of the CAF-HAF algorithm are compared with the cross ambiguity function method based on the fractional Fourier transform (CAF-FRFT), showing higher efficiency and being more adaptive for real time signal processing [C1197]

## "Method of Resolving the Range Ambiguity for High PRF Stepped-Frequency Radar"

High PRF stepped-frequency radar can achieve simultaneously the advantages of pulse Doppler (PD) and high range resolution (HRR) radar, but it's difficult to resolve the range ambiguity brought about by high PRF. In this paper, a novel method based on the phase difference out of the FFT between two adjacent range cells is proposed to solve the problem. This method firstly solves the range/Doppler coupling in the FFT by iterative reckoning between the range and the Doppler of a target and the accuracy of both reach 5 high resolution bins respectively. Secondly, it eliminates the effects of the target motion to the phase difference, consequently the accuracy of resolving the range ambiguity is reasonably high. Simulation verifies its validity [C1198]

## "Technique of Doppler compensation for phase-coded signal pulse compression"

Codes used in phase-coded pulse compression waveforms suffer from Doppler mismatch. Based on an analysis of the effects of Doppler mismatch on quasiphase-coded waveforms and the performance results, a new technique of Doppler compensation is proposed. This technique solves the problem of the sensitivity of phase-coded signal to Doppler. It is proved that pulse compression performance is quite well by using this technique, and it meets the project's requirement very well [C1199]

## "A novel channel estimation method for SC-FDE over fast fading channels"

Single carrier frequency domain equalization (SC-FDE) is an attractive technique for broadband wireless communications because it does not have the problems of OFDM systems such as large peak-to-average power ratio and the sensitivity to carrier frequency offsets. However, channel variations within an SC-FDE block destroy orthogonality in frequency domain, resulting in interference, which increases an error floor in proportional to normalized Doppler frequency. To mitigate the effects of channel variations, this paper first provides an interference analysis in both time- and frequency-domain. With this analysis, an interpolation and unique word (UW) based scheme for estimating the time varying channel parameters at each sampling time is proposed. Theoretical analysis and simulation results show that the proposed interference suppression method and channel estimation scheme have low computational complexity and good performance dealing with changes in channel characteristics. [C1200]

## "Modeling of Multiple path Fading and Analysis of Signal Spectral Properties in Digital Signal Transmission"

In this work formulations are developed to determine fast fading in digital signal transmission along a cluttered service area. Other fading effects such as frequency fading, time-dependent fading, doppler spread and depolarisation are taken into account. Computed results from the developed formulations, for a specific case, are used to show that the total received signal is a superposition of multipath ray signals to the receiver [C1201]

## "A Study of Information Fusion Based on Federated Kalman Filtering"

Traditionally the popular navigating modes in UAV navigation system are RP (radio positioning) and GPS (Global Positioning System). But these two kinds of method have their own inherent flaw respectively. The RP (radio positioning) system must rely on grand control station, at the same time, it will be disturbed easily and its navigation precise is not good when flying distance is far. The updating rate of GPS is low and the position precise of GPS will descend in shelter area such as foothill and mountainous area. Actually, according to the practical needs and possibility people usually combine many kinds of navigation system so that we can utilize their merit. In this paper, we design a new kind of integrated navigation system combined many kinds of navigation system, such as DNS (Doppler navigation system), TAN (terrain aided navigation) and SMN (scene matching navigation) based on SAR (synthetic aperture radar). This integrated navigation system is based on federal Kalman filtering. The simulation results show that this method can provide satisfactory navigation precise for UAV autonomous fly [C1202]

## "A Real-Time Digital Baseband Channel Emulation System for OFDM Communications"

This paper presents the design and implementation of a digital baseband channel emulator. The proposed emulator consists of several wireless channel effects and RF front-end impairments. The channel effects include an additive white Gaussian noise source and a multi-path fading channel with up to 12 faders that can have programmable delays, magnitude, and a Doppler spectrum or a flat spectrum. Other RF electronics effects such as power amplifier non-linearity, carrier frequency offset, oscillator pulling, phase noise, I/Q imbalance, DC offset, and sampling clock offset are also modeled and designed in digital logic. The whole emulator is implemented on FPGA and can run up to 40 MHz, making it suitable for most OFDM wireless systems [C1203]

## "Detection of Ultra-High Speed Moving Target Based on Matched Fourier Transform"

Ultra-high speed moving target is a new case falls across in modern radar target detection. The echo model of the ultra-fast moving target is founded in this paper, and its effect on pulse Doppler processing is analyzed. Then we propose a new algorithm of pulse Doppler processing based on matched Fourier transform (MFT). According to the characteristic of the echo, we propose an algorithm to realize MFT-based target detection which has light computation load, clear physical meaning and strong searching range pertinence. The simulation results show the validity of the algorithm [C1204]

## "Polyphase Coded signal Design for Netted Radar Systems"

A modified simulated annealing algorithm (MSAA) is proposed as a statistical technique to design polyphase coded signals for orthogonal netted radar systems (ONRS) which have good autocorrelation and cross correlation properties. This algorithm is a combination of simulated annealing and Hamming scan algorithms. Some of the synthesized results are presented, and their properties are better than other known in the literature. The effect of Doppler frequency shift on the performance of these signals is investigated and found "thumbtack ambiguity function". The synthesized polyphase sequence sets are promising for practical application ONRS/multiple radar. The convergence rate of the algorithm is also good [C1205]

## "Phase Cancellation for Synthesizing Range Profile of Target with Micro-motion"

Micro-motion, such as nonuniform motion, induces complex range-Doppler coupling effect, which results in distortion in synthesizing range profile. To eliminate or suppress the distortion of the synthetic range profile (SRP), conventional technology such as motion compensation requires velocity estimation. Unfortunately, for a high-speed moving target with micro-motion, it is difficult to achieve real-time accurate estimation of the velocity of the target Based on phase cancellation; a new technology is proposed to achieve range profile of a target with micro-motion via stepped-frequency waveform (SFW). The emulation result confirms the effect of the new technology [C1206]

## "Simulation Models for MIMO Mobile-to-Mobile Channels"

Two new sum-of-sinusoids (SoS) based simulation models for multi-input multi-output (MIMO) mobile-to-mobile (M-to-M) Rayleigh fading channels are proposed. First, an ergodic statistical (deterministic) SoS simulation model is proposed, and its statistical properties are derived and verified by simulations. The deterministic model is shown to well approximate the reference model and, compared to existing simulation models, requires smaller number of scatterers. By allowing all three parameter sets (amplitudes, phases, and Doppler frequencies) to be random variables, the deterministic model is modified to yield a statistical simulation model. Compared to the deterministic and existing simulation models, the statistical model better matches the reference model over a wider range of normalized time delays while using a smaller number of scatterers [C1207]

## "Frequency offset acquisition based on subcarrier differential detection for OFDM communications on doubly-selective fading channels"

An effective frequency offset acquisition technique based on differential detection for wireless orthogonal frequency-division multiplexing (OFDM) communication is investigated in this paper. By taking advantage of differentially coherent detection, data-aided frequency acquisition assisted by frequency-domain pseudo-noise (PN) matched filters (MF's) can achieve lower probabilities of false alarm and miss over a propagation channel with a wide enough coherence bandwidth than its noncoherent counterpart can. Furthermore, the proposed technique can also function very well over a severely frequency-selective fading channel while the subcarrier-level differential detection is exploited. Extensive computer simulations verified the superiority of the proposed technique. [C1208]

## "Application of a digital deconvolution technique to brain temperature measurement and its correlation with other physiological parameters"

The underlying reason for the local hyperthermia changes produced after a stimulus is not very well known and the relationship between local temperature changes and other physiological parameters has never been established. Current local temperature measurements are not completely accurate over time due to the physical constraints of the sensor, such as heat accumulation and dissipation. To clarify this issue, simultaneous in vivo measurements of local temperature, local blood-flow by laser Doppler flowmetry and neurotransmitter extracellular release using in vivo amperometry were performed with the aim of establishing their interrelationship. Local brain temperature measurements are usually obtained using thermocouples and thermistors, generally because of their small size and high level of accuracy. However, due to heat accumulation and dissipation effects on the sensor, the transient temperature measurement is not as accurate. In this paper, a simple method to obtain actual temperature fluctuations from measured values is proposed using classical digital signal processing techniques; the sensor was modeled via its transfer function. Deconvolution provides a method for obtaining actual temperature changes, enabling further comparative kinetic studies of all those physiological parameters, and helps to clarify the probable mechanism that underlies neurovascular coupling. [C1209]

## "Chebyshev approximation of baseband Volterra series for wideband RF power amplifiers"

The Volterra series represents a very powerful mathematical tool for system-level analysis to describe the input-output behavior of nonlinear devices such as RF power amplifiers, which generally incorporate memory effects. Starting from the most general complex baseband representation of a nonlinear RF power amplifier, an equivalent nonlinear system with lower complexity is developed. The complexity reduction is obtained by a bandwidth dependent approximation of the multi-dimensional Volterra kernels with orthogonal polynomials in the frequency-domain. The resulting nonlinear time-domain model consists of a cascade of complex linear pre-filters and a memoryless polynomial with complex parameters. If the input signal bandwidth becomes sufficiently small, we obtain a special well known system from the most general approximation which can be represented in the baseband region by purely static nonlinearities (AM/AM- and AM/PM-conversion). We show for a 3rd-order nonlinear system with typically smooth kernels that the number of free parameters can be reduced while maintaining the required modeling accuracy. [C1210]

## "Performance of finite-depth interleaved convolutional codes in a Rayleigh fading channel with noisy channel estimates"

We derive the pairwise error probability of convolutional codes in a time-varying Rayleigh fading channel with finite interleaving depth and noisy channel estimates. The analysis quantifies the estimation-diversity tradeoff, which results from the opposite effects of the Doppler spread on the channel estimation accuracy and the channel diversity. It is also shown that when the channel estimates are correct, this analysis gives the same result as an existing perfect channel estimation analysis. [C1211]

## "Exact BER analysis of a pi/4-DQPSK OFDM system in the presence of carrier frequency offset over frequency selective fast Rayleigh fading channels"

An exact closed-form bit error rate expression is derived for an orthogonal frequency-division multiplexing system, each subcarrier modulated by pi/4-shifted differentially encoded quadrature phase shift keying, in the presence of carrier frequency offset over frequency-selective fast Rayleigh fading channels. Both single channel reception and diversity reception with maximal ratio combining are considered. The closed-form expression allows us to investigate the effect of several channel parameters, including mean delay spread and maximum Doppler shift, on the system bit error rate performance. Particularly, the effect of carrier frequency offset on the

system performance can be studied for a more realistic wireless channel environment model. Small carrier frequency offsets have slight influences on the system performance. Compared with the same amount of Doppler shift, carrier frequency offset usually leads to a greater degree of performance degradation. Systems with fewer subcarriers are more sensitive to the channel mean delay spread. By using the exact closed-form bit error rate expression, an optimum number of subcarriers can be found, and the allowable carrier frequency offset, Doppler shift, and mean delay spread for given operating conditions can be determined. [C1212]

## "Analysis of Power Performance of a Muzzle Velocity Radar"

Measurement of a muzzle missile velocity usually represent Doppler radars. The rating of a muzzle velocity is shaped on the basis of measurement of a missile velocity on various sections of its trajectory. Thus from the point of view of design of a meter and the exact choice of its parameters the rating of a radar maximum operation range has an essential value. The range of action determines an amount of cycles of measurement which can be implemented for one shot so, essentially influences magnitude of an aggregate error of muzzle velocity estimation. In the given type of meters on a maximum operation range except for classical radar factors: transmitted powers, performances of antennas, noise nesses of the receiver, etc., essential effect render geometrical factors, the bound with a mechanical trajectory of shell, and factors, the bound with a breadth of the shell backscattering diagram. As shown in the given paper, the joint registration of all these factors results in appearance of essential limitations on a maximum operation range which are necessary for taking into account at system design of a meter [C1213]

## "A velocity-adaptive channel estimation scheme using the simple zero-forcing technique in the frequency domain"

We propose a velocity-adaptive channel estimation scheme using a simple zero-forcing technique in the frequency domain. The proposed scheme is derived by approximating the frequency response of the Wiener filter as a rectangular shape. Channel estimation is performed by removing frequency components that are higher than the maximum Doppler frequency in the received signal. Simulation results show that the proposed scheme outperforms conventional schemes for a wide range of mobile velocities (3-300 km/h). [C1214]

## "Low-complexity pilot-aided channel estimation for OFDM systems over doubly-selective channels"

In this paper, we investigate channel estimation (CE) and data detection for OFDM systems over doubly-selective channels. We derive an oversampling basis expansion model (BEM) for doubly-selective channels and its statistical properties. The time diversity in the Doppler-induced inter-carrier-interference (ICI) and its relationship to the carrier frequency offset (CFO) induced ICI are illustrated using the BEM. We derive two low complexity linear minimum mean-square-error (LMMSE) channel estimators using the BEM. The sphere decoder (SD) is modified to equalize the ICI channel. A low-complexity iterative equalizer without matrix inversion is also proposed. Our proposed channel estimators have low complexity and achieve good performance. Furthermore, the low-complexity iterative equalizer performs close to SD. [C1215]

## "Analysis and modelling of experimental doubly-spread shallow-water acoustic channels"

This paper investigates the characteristics of the shallow water acoustic channel as a medium for digital communications. Experimental measurements are presented for such channels exhibiting depths of up to 50 m and ranges between to 500 m and 10 km. Results include measured impulse responses extracted via channel soundings using chirp-based pilot signals. Time dispersion and frequency selectivity measures such as the rms delay spread and the coherence bandwidth of the multipath channel are used to characterize the channels under investigation. Additionally, analysis of the temporal variability using the Doppler spectrum of the distinct spectral components present in the received signal is presented. Furthermore, a simulator for a stochastic channel model is proposed based on autoregressive type filters for capturing the temporal dynamics of the channel. Results demonstrate that the proposed simulator may be utilized effectively in simulations of shallow-water channels. [C1216]

## "On the fluctuations of the ambiguity function in radar and sonar"

The ambiguity function is useful for describing the behavior of a radar or a sonar signal. This function was introduced to radar theory by Woodward, it appears to be a good tool to select good signals for the range and Doppler estimation. In this context, the signal of interest is supposed to be a deterministic function corrupted by an additive Gaussian white noise. Extensions to stochastic narrow band signals exist. The object of this paper is not to discuss about each estimator's accuracy, but simply to show the effect of a colored noise and a fluctuating target on the ambiguity function in one hand, and to present a process which will limit their influence. The statistical behavior of the ambiguity function is studied, and we show how the ambiguity function can be

separated into two quantities: a deterministic one, and a stochastic one. Then, a process to minimize the stochastic part is proposed. Finally, an application to a moving target localisation is presented. [C1217]

## "STARE, a sonar data post-processing and visualisation software package"

This paper presents STARE, a sonar-data post-processing and visualisation tool developed by TNO and written in Matlab 6.5. The software takes into account all available acoustic and nonacoustic data (GPS, radar, source/receiver position, time latencies, etc.). The latter can be used to get optimal position information for the identified sonar contacts, or to correlate with the acoustic data (e.g. for a first visual classification). For this, detailed effects are taken into account, e.g. ship displacement during ping, time-Doppler coupling. STARE allows to show monostatic, bistatic as well as multistatic data in different kinds of displays (bearing, range), (x,y), geographical. [C1218]

## "NARCISSUS-2005: a global model of fading channel for application to acoustic communication in marine environment"

We present the latest version of an operational numerical model of acoustic impulse response in a random sea-channel, with application primarily to communication in the marine environment. Phenomena taken into account are: random scattering from surface and bottom irregularity; fading from surface waves or swells, and movements of source and receivers relatively to boundaries; Doppler and distortions due to source and receiver movements. Statistics for the sound-fields are evaluated; from these statistics are extracted various scales (Rice number, delay spread, fading rate, etc.) and pseudo-random Monte Carlo simulations of transmitted signals. This model was tried, as a whole, against experimental data collected at sea within various European MAST projects at the end of the 1990s: very shallow coastal waters (North Sea) for project SWAN, continental shelf environment (Mediterranean Sea) for project PROSIM. The validation procedures included investigations of several statistical properties of fading: the "Rice factor" (ratio of the energy of the mean coherent part of the response to the mean energy of the random scattered part of the response), the spectral broadening, the delay spread, the normality of the random part of the response, the shape of the mean and random part of the response (decay as function of delay). Involved signals included frequency modulations and pseudo-random sequences, with frequency ranges from 400 Hz to 6.5 kHz. Source-to-receiver ranges were 500 m, 1.5 km, 5 km and 15 km. The model NARCISSUS, tested as a whole, seems to quite successfully compare with observations. [C1219]

## "Development of broadcast technologies for mobile TV"

This presentation discussed the issues, technologies, and spectrum implications of broadcast technologies for mobile TV. The presentation aims to address such broadcasting dilemmas as limited battery capacity, limited processing power, and competing demands for antenna/silicon space. It also gives the advantages and disadvantages of the following technologies: DVB-H, DMB, and FLO. [C1220]

## ""Analytic" approximation of Doppler ultrasound blood flow signals"

Spectral resolution may be enhanced by complex signal representation ("analytic" signal) of the signals processed. This paper addresses the impact on statistical and computational performance of the autoregressive modified covariance spectral estimator on a clinical scenario, while using, or not, discrete "analytic" signals. The statistical performance results prove that an "analytic" signal representation should be obtained prior to the estimation process. A novel algorithm to compute the complex modified covariance matrix is used to achieve increased computational performance. This approach reduces the estimation error and the execution time by 1% and 30% respectively [C1221]

## "Field measurement based performance analysis of digital audio broadcasting (DAB) reception in mobile channels"

This paper analyzes the reception of terrestrial digital audio broadcasting (T-DAB) signals at L-band in mobile channels, where multipath fading, Doppler spread and noise effects degrade the received signal. Receiver power levels and DAB base-band parameters have been recorded in order to study real performance of DAB signals in mobile propagation channels, with different vehicle speeds and with different multipath levels, considering environment types with different degrees of building density. The degradation of the received signal is presented in curve showing relationships between the pseudo-channel BER and the carrier to noise ratio. Threshold values for these two parameters are presented, considering different channel conditions (vehicle speed and environment type). The results presented in this paper contribute to a detailed characterization of the DAB signal degradation and the required C/N threshold values in mobile channels. [C1222]

## "MOBMAC-an energy efficient and low latency MAC for mobile wireless sensor networks"

Numerous MAC protocols have been proposed for stationary wireless sensor networks (WSNs). However, there have been very few approaches proposed to make the MAC layer in WSNs suitable for mobile scenarios. We propose a new MAC layer protocol called MOBMAC to support mobility in WSNs. MOBMAC uses an adaptive frame size approach to overcome the effect of frame losses caused by the Doppler shifts in mobile scenarios. An extended Kalman filter (EKF) is used to predict the frame size for each transmission, which enhances the energy efficiency of the system and minimizes latencies. Our study shows that under mobile scenarios, the MOBMAC reduces energy consumption by 60% and shows decrease of 25% in latency in comparison with the well known base protocol $SMAC. Our study also includes the contribution of a more realistic physical layer implementation model in ns-2, which processes the received frame based not only on the fading characteristics of the signal but also on the SNR and relative velocity between the communicating sensor nodes. [C1223]

## "Rotation effects of an axicon ultrasonic transducer when measuring a blood flow rate"

This paper investigates the rotation effect of an axicon ultrasonic transducer when measuring the blood flow rate (Q) in a coronary artery bypass. Results show that, using a system in vitro, for a transducer placed at 90 degrees from the direction of the blood flow, there is not a significant influence in the parameters of the signal due to the effect of rotating the transducer. [C1224]

## "Improving frequency synchronization by means of new correlation criteria for fine time synchronization in MIMO system"

{no data available} [C1225]

## "Parameters computation of the extended mobile fading channel of type II"

In mobile wireless communication systems, the multipath propagation in addition to the movement of the receiver and/or the transmitter leads to drastic and random fluctuations of the received signal. For flat fading channels, the extended Suzuki process of type II has been proposed as a stochastic model of such received signal fluctuations. In this paper we discuss this stochastic model and an appropriate deterministic model, and subsequently present and analyze simulation results based on these models. [C1226]

## "Studies on a High-Compression Technique for Weather Radar Reflectivity Data"

Studies are carried out on a contour-based method for highly compressing voluminous weather radar reflectivity data to optimize the compression and reconstruction parameters. In particular, the effects of the choice of thresholds and the degree of smoothing at encoding and retrieval ends are studied with respect to achievable compression ratios, root-mean-square error of the retrieved contours, and the visual fidelity of the reconstructed reflectivity images. Results are presented for multiple actual Doppler weather radar reflectivity data sets [C1227]

## "Analysis of passive targets detection using CDMA signal"

The use of a non-cooperative code division multiple access (CDMA) transmitter as the illuminator for a bi-static radar system is investigated. A signal-processing scheme is developed to detect moving targets. This scheme uses the Doppler shift of targets echoes to estimate the targets' speed and time delay. The system contains two separate but collocated receivers where Doppler and cross-correlation processing is applied to the direct path and target signal path. We implement the cross-correlation processing using fast Fourier transform (FFT) instead of direct integration. [C1228]

## "A cross-correlation model for non-isotropic scattering with non-omnidirectional antennas in MIMO propagation channels"

We present a cross-correlation model for multiple-input multiple-output (MIMO) Rayleigh fading channels in a two-dimensional (2D) multipath random media when energy is non-uniformly received/transmitted to/from the receiver/transmitter along propagation directions. We investigate the impact of non-omnidirectional propagation pattern of antennas along with the impact of non-uniform distribution of the scatterers in the propagation environment which introduces non-isotropic wave propagation, at both transmitter and receiver ends. The non-isotropic propagation is described by non-uniform probability density functions (pdf) for the direction-of-departure (DOD) and the direction-of-arrival (DOA) of the outgoing/incoming propagating waves from/to stations. The propagation patterns of antenna elements (and the effect of mutual coupling between them) are also described by the Fourier series expansion of antenna propagation patterns. The expression of the cross-correlation function (CCF) turns out to be a linear expansion of a number of Bessel functions of the first kind. The coefficients of this

expansion are given by linear convolution of the Fourier series coefficients (FSC) of the corresponding antenna patterns and the FSCs of the corresponding pdf of the non-isotropic propagation directions. The Fourier analysis on the CCF shows impacts of non-isotropic environment and non-omnidirectional antennas on the spectrum of the received channel process while the maximum Doppler frequency shift remains invariant with variations of beam-patterns and the pdf of propagating waves. [C1229]

## "Field comparison tests of a bottom-mounted Aanderaa RDCP600 with an RDI Workhorse 600 ADCP, and a moored string of Aanderaa RCM9 MKII current meters"

Detailed field testing of a bottom-mounted Aanderaa RDCP600 Doppler profiler was conducted at a protected coastal embayment. The RDCP600 was compared for 30 days to a string of seven moored Aanderaa RCM9 MKII in situ Doppler current meters, and an RDI 600 kHz workhorse ADCP. The test buoy was equipped with outriggers to allow measurements very close to the surface and to examine the acoustic and wake effects of the buoy on the performance of the RCM9 standard. The two 600 kHz Doppler profilers were deployed on the same bottom frame in order to ensure the same tilt and distance (approximately 50 m) from the moored RCM9 current meters. The Doppler profilers were programmed to sample during alternating time windows within a 20-minute sampling interval in order to avoid acoustic cross talk and interference. A common time base was achieved via post-deployment linear interpolation. Results of vector correlations and difference statistics show excellent agreement between all of the current measurement devices. Mean differences were generally less than 0.005 m s' and the RMS differences were on the order of 0.02 m s-1. [C1230]

## "Postprocessing waveform selection in broadband active sonar"

We discuss a technique for estimating the impulse response for an underwater acoustic signal from active sonar returns for antisubmarine warfare. This is used to study the effects of substituting one waveform for another while reducing the need for extensive at-sea data collection. This work may also form the basis for an optimization scheme whereby waveform selection is performed at the signal processing stage to maximize the signal-to-noise ratio while minimizing nonRayleigh clutter and target splitting due to over-resolution. This method is valid in the reverberation-limited regime under the assumption that there are no strong, high Doppler scatterers (clutter and targets). Our approach uses the complex matched filter time series to deconvolve a known waveform from the combined propagation and signal processing impulse response. This is done using either an analytic expression for the signal Fourier transform or a numerical, fast Fourier transform of a digitally sampled replica. Using the extracted impulse response, we may then simulate the response of an arbitrary waveform contained within the same frequency band. To validate our method, we consider band-separated, mid-frequency hull sonar data using hyperbolic frequency modulated waveforms. [C1231]

## "Joint frequency offset and channel estimation in the OFDMA uplink: Cramer-Rao bounds and training sequence design"

In this paper, we address the data-aided joint estimation of frequency offsets and channel coefficients in the uplink of an OFDMA scheme. For large training sequence sizes, a compact and informative expression of the Cramer-Rao bound (CRB) is derived. In particular, we show that asymptotic performance bounds for the parameters of a given user do not depend on the number of users. Moreover, it is shown that orthogonal and non-orthogonal carrier assignment schemes (CAS) both lead to the same asymptotic CRB. Finally, we bring to the fore the training sequences that are likely to lead to accurate estimates. Due to the above results, the design of the training sequence of a given user can be achieved independently from other users. Simulation results sustain our claims. [C1232]

## "Semi-blind channel estimation for OFDM systems via an EM-MAP algorithm"

In the OFDM communication context, semi-blind algorithms allow to cope with Doppler effect due to the mobility of wireless systems. For slowly varying channels, the estimation process can be performed on a block of symbols assuming that the channel is constant over the block. This algorithm enhances the performance in terms of channel estimation with the additional advantage of a linear arithmetical complexity. In this paper, we propose an EM-MAP algorithm which takes into account a channel correlation model between the coefficients of the block structure. Simulations results presented in the context of 5 GHz WLANs show that this new algorithm performs better than the EM-block algorithm in the mobile environment. [C1233]

## "Predictive equalizer design for DVB-T system"

We propose several new channel predictive equalizers designed for ETSI DVB-T systems. In conventional DVB-T equalizer designs, the storage of 3 symbols is needed in order to do interpolation of the CFR (channel

frequency response) in the time axis. This huge amount of storage can be eliminated in our proposed predictive equalizers. We present 3 kinds of predictive equalizers to predict the trend of the CFR and the Doppler effect. After simulation and comparison among these 3 kinds of predictive equalizers and a conventional 2D linear interpolated equalizer, we can choose the 1storder predictive equalizer with acceptable performance for a low cost solution for DVB-T system equalizer design. [C1234]

## "Performance studies of a VSF-OFCDM system using a symbol relocated scheme during retransmission"

In this paper, a symbol relocated (SR) scheme has been proposed for variable spreading factor orthogonal frequency code division multiplexing (VSF-OFCDM) systems to achieve frequency diversity during retransmission. The performance has been evaluated for two combining schemes of hybrid auto repeat request (ARQ) namely chase combining and incremental redundancy. The results show that the proposed SR scheme achieves significant improvement in terms of system throughput over the conventional schemes. This effect is more significant for chase combining because the rotated mechanism is more effective when the same packet is transmitted during the retransmission. It is also found that SR scheme is not sensitive to Doppler frequency variation, which makes SR scheme an attractive candidate for fast fading channels. Further investigations also suggest the suitability of the SR scheme for smaller spreading factors (in frequency domain) and larger coding rates. [C1235]

## "Cerebral Hemodynamics Assessed by means of Transcranial Doppler and Near-Infrared Spectroscopy in Healthy Smokers and non-Smokers"

The assessment of cerebral vasomotor reactivity (VMR) is a valuable tool for the early detection of risk condition in healthy subjects and for the non-invasive bedside evaluation of patients. Typically, cerebral hemodynamics assessment is performed in correspondence of CO2reactivity. We studied the VMR of a population of young healthy non-smokers (n=10, age 27 plusmn 4.1) and healthy smokers (n=4, age 28 plusmn 4.5) using a joint approach based on transcranial Doppler ultrasonography and near-infrared spectroscopy, to monitor cerebral blood flow velocity (CBFV) and concentrations of oxygenated (O2Hb) and reduced (CO2Hb) haemoglobin. VMR was induced by means of voluntary breath-holding (BH). We quantified VMR using the breath-holding index (BHI). Smokers BH duration was significantly lower than that of non-smokers ($p < 10-4$; their BHI did not significantly differ from that of non-smokers in terms of CBFV, but differed in terms of O2Hb and CO2Hb concentrations changes. Specifically, with respect to non-smokers, smokers presented a delayed VMR that took place only around 60% of the apnoea phase. This delayed response could reveal an impaired autoregulatory mechanism and could be a risk condition when the subjects need to compensate an abrupt change in the cerebral blood flow [C1236]

## "Efficient wideband sonar parameter estimation using a single slice of Radon-ambiguity transform"

A novel efficient technique, based on a Radon-ambiguity transform (RAT), for time delay and Doppler stretch estimation is presented. The proposed approach combines the narrowband ambiguity function (NAF), the wideband ambiguity function (WAF), and the Radon transform (RT) to estimate multiple targets in noisy environments. The main ridges of NAF represent straight lines whose slopes depend on the Doppler rates of the moving targets. These lines could be effectively detected by computing the RT of the NAF for all possible angles. However, the computation of RT for all possible angles is computationally exhaustive. It is shown that, without calculating the entire RAT, it is possible to estimate target parameters using only a single slice of RAT, i.e., using an appropriate projection of the NAF. The resolution issue and the effect of the integration length of RAT in complex white Gaussian noise are also discussed. It is demonstrated that the proposed method can successfully separate overlapping targets. [C1237]

## "Combined effect of phase and RGPO delay quantization on jamming signal spectrum"

This paper deals with the analysis of jamming signals emitted by ECCM systems after phase quantization, performed by radio frequency digital memory (DRFM) devices, and after introduction of increasing time delay. The analysis presented here shows first the exact solution to the problem of calculating the spectrum of a phase-quantized jamming signal when the quantization levels are equally spaced. The spectrum of the signal presents a primary term, which is simply an attenuated version of the signal received by the ECCM system, and false terms whose amplitude and location depend on the number of quantization bits. Afterward, the effect of time delay quantization introduced by range gate pull-off devices is analytically evaluated, combined to the phase quantization. Results show that this second distortion can be generally neglected with respect to the spurious terms due to the phase quantization. [C1238]

## "Experimental studies of the 2.4-GHz ISM wireless indoor channel"

Experimental results from indoor measurements of the 2.4-GHz wireless channel are presented. These measurements include both quasi-static and time-varying channel conditions in a number of indoor environments. Four channel propagation characteristics of interest are evaluated. For the time-varying environment, the Doppler spread of the wireless channel is measured. For the quasi-static environment, mean excess delay, rms delay spread, and coherence bandwidth of the channel are determined. The effect each of these propagation characteristics has on multiple antenna wireless systems and their suitability for indoor use is discussed. [C1239]

## "Aerouter™-a graphical simulation tool for routing in aeronautical systems"

The enormous growth and demand for in-flight Internet access has driven the need for producing effective simulation tools in order to identify effectively the best resources, such as satellites and gateways, for routing in these large-scale systems. We introduce a simple simulation tool called Aerouter, which can assist in identifying the best satellites and gateways for routing in aeronautical applications. The proposed simulation tool includes new routing techniques and also takes Doppler and atmospheric attenuations into account in its automatic calculations. Preliminary results illustrate the effectiveness and usefulness of Aerouter for future in-flight Internet access networks. [C1240]

## "Blind source separation in the presence of Doppler frequency shifts"

We address the problem of blind separation of sources, mixed subject to possible Doppler frequency-shifts, differing between sources and between sensors. This situation is likely to occur, e.g. in scenarios involving mobile sensors and/or sources, but so far the multiple sources case does not seem to have been addressed (at least not in open literature, to our knowledge). We propose a batch-type iterative procedure for the estimation of the (static) mixing parameters and the frequency-shifts, followed by application of the inverse system to reconstruct the sources. The estimation procedure can be regarded as parameterized joint diagonalization of a bulk of rank-one matrices. Somewhat surprisingly, correlation matrices at zero lag are generally sufficient for separation, and consequently, the separation of white Gaussian sources is generally possible in this framework-unlike the situation in classical static mixing-as we demonstrate in simulation. [C1241]

## "Time-frequency channel modeling and estimation of multi-carrier spread spectrum communication systems"

In wireless communications, the channel is typically modeled as a random linear time-varying system that spreads the transmitted signal in both time and frequency due to multipath and Doppler effects. In this paper, we show how time-frequency analysis can be used to model and estimate the channel of a multi-carrier spread spectrum (MC-SS) system with a complex quadratic spreading sequence. We show that in this case the effects of time delays and Doppler frequency shifts can be characterized effectively as time-shifts. Using the discrete evolutionary transform (DET) we are able to estimate these effective time shifts via a spreading function and use them to equalize the channel. To illustrate the performance of the proposed method we perform several simulations with different levels of channel noise, jamming and Doppler frequency shifts. [C1242]

## "MIMO transmission subspace tracking with low rate feedback"

The paper describes a low rate feedback algorithm for conveying partial channel state information-specifically, the dominant row subspace of the channel matrix-from the receiver to the transmitter in a continuously time-varying multiple-antenna environment. Since subspaces are points on a complex Grassmann manifold, variations in subspaces are treated as a piecewise geodesic process on the manifold. The receiver feeds back one bit to indicate the preferred sign of a random velocity matrix of the geodesic. Numerical results show that the performance of the proposed algorithm is better than the Grassmannian subspace packing approach at low-to-medium Doppler frequency and always better than the previously proposed gradient sign feedback scheme. [C1243]

## "Scale-lag diversity reception in mobile wideband channels"

We consider the effect of mobility on a wideband direct sequence spread spectrum (DSSS) communication system, and study a scale-lag Rake receiver capable of leveraging the diversity that results from mobility. A wideband signal has a large bandwidth-to-center frequency ratio, such that the typical narrowband Doppler spread assumptions do not apply to mobile channels. Instead, we assume a more general temporal scaling phenomenon, i.e., a dilation of the transmitted signal's time support. Such analysis applies, for example, to ultra-wideband (UWB) radio frequency channels and underwater wideband acoustic channels. [C1244]

## "Bit error rate performance of decision feedback detection for space-time block coded systems over time-selective fading channels"

In wireless channels, time-selective fading effects arise mainly due to Doppler shift and carrier frequency offset. In time-selective fading channels, the Alamouti-based decoding scheme has an error floor caused by interference due to time-selectivity. This paper proposes decision feedback detector for the Alamouti scheme to mitigate the effects of a time-selective fading channel. Moreover, we present an evaluation of the average bit error rate (BER) performance of the proposed scheme over time-selective fading channels. [C1245]

## "Multi-modal sensor localization using a mobile access point"

We consider the problem of sensor node localization in a randomly deployed sensor network, using a mobile access point (AP). The mobile AP can be used to localize many sensors simultaneously in a broadcast mode, without a preestablished sensor network. We consider a multi-modal approach, combining radio and acoustics. The radio broadcasts timing, location information, and acoustic signal parameters. The acoustic emission may be used at the sensor to measure Doppler stretch, time delay, and angle of arrival. These measurements are individually sufficient to localize a sensor node, or they may be advantageously combined. We focus on the cases of Doppler and time delay. Sensor localization algorithms are developed, and performance analysis includes acoustic propagation effects caused by the turbulent atmosphere. [C1246]

## "TFARMA models: order estimation and stabilization"

The time-frequency ARMA (TFARMA) model is introduced as a time-varying ARMA model for nonstationary random processes that is formulated in terms of time shifts and frequency (Doppler) shifts. We present Akaike and minimum description length information criteria for the practically important task of selecting the TFARMA model orders. Because the estimated inverse filter used by the resulting order selection procedures is not guaranteed to be stable, we propose an iterative stabilization algorithm that is based on the concepts of instantaneous roots and root reflection/shrinkage. The performance of the proposed order selection and stabilization techniques is assessed through simulation. [C1247]

## "Adaptive pulse compression repair processing"

It is well known that the standard matched filter used in radar pulse compression generates range sidelobes in the vicinity of large targets which can result in the masking of smaller nearby targets. Recently, pulse compression repair (PCR) was proposed as a means of suppressing the range sidelobes after matched filtering has taken place. This is especially applicable to in-service radar systems, where one may not have access to the received signal prior to standard pulse compression or where it may not be feasible to replace the current pulse-compression system. The PCR algorithm adaptively operates on the output of the standard matched filter, thereby treating the autocorrelation of the received waveform as if it were the transmitted waveform. This paper examines the effects of the Doppler mismatch on the PCR algorithm in which the resulting correlation between the transmitted waveform and the Doppler-shifted received waveform is mismatched to the waveform autocorrelation. It is shown that PCR degrades gracefully as Doppler mismatch increases, even in dense target scenarios. [C1248]

## "Performance comparison of three recent STAP methods"

In this paper, we present a comparison of target detection performance for normalized adaptive matched filter (NAMF), normalized parametric adaptive matched filter (NPAMF), and normalized low-rank adaptive matched filter (LRNAMF) for space-time adaptive processing. Test statistics for these algorithms as functions of range bins and filter outputs as functions of Doppler beam position (DBF) and azimuth angle (AZ) are computed for the KASSPER L-band datacube, which is simulated for the airborne linear phased array radar application. First, we illustrate that when the signal-to-noise ratio is used as a target-detection parameter, LRNAMF outperforms NAMF and NPAMF under weak conditions of training data contamination. Next, we demonstrate the target cancellation effect when the training data are contaminated by competing targets (outliers). Finally, we present a scenario for target detection in heterogeneous radar clutter when there is spatio-temporal steering vector uncertainty. In this scenario, we show that there is substantial broadening in the filter outputs as functions of DBP and AZ for these algorithms. [C1249]

## "Measurement and analysis of ambiguity functions of passive radar transmissions"

Passive coherent location (PCL) radar systems make use of broadcast or communications 'illuminators of opportunity' in a bistatic configuration. In order to understand the performance limitations of this type of radar it is

necessary to know the ambiguity properties of these waveforms, and how they vary with the form of modulation and with the bistatic geometry. This paper presents and analyses the ambiguity functions of a set of off-air measurements of signals that might be used for PCL systems. We find that the ambiguity behavior of analog modulation formats, such as FM radio or analog television, depend significantly on the instantaneous program content, and can be very poor, for example during pauses in speech. Digital modulation formats, in contrast, are much more favorable and much more constant with time. This suggests that the choice of signals to be used for PCL may be made on a dynamic basis, according to the modulation and bistatic geometry. [C1250]

## "Integrated power control and rate allocation for radio resource management in uplink wideband CDMA systems"

Power control and rate allocation are two radio resource management functions that can be used to enhance system utilization. In a time-varying environment, these functions need to be made adaptive. We consider certain implementation restrictions which cause deviations from ideal conditions in adaptive processing. An integrated power control and rate allocation approach to enhance system throughput is proposed. Simulation results show that by using closed-loop power control in conjunction with rate allocation in the presence of the Doppler effect and delay in feeding back channel state information (CSI), significant throughput and BER performance improvement over rate adaptation alone is obtained. [C1251]

## "A generalized algorithm for the generation of correlated Rayleigh fading envelopes"

Although the generation of correlated Rayleigh fading envelopes has been intensively considered in the literature, all conventional methods have their own particular shortcomings, which seriously impedes their applicability. A very general, straightforward algorithm is proposed for the generation of an arbitrary number of Rayleigh envelopes with any desired, equal or unequal power in wireless channels, either with or without Doppler frequency shifts. The proposed algorithm can be applied in the case of spatial correlation, such as with antenna arrays in multiple input multiple output (MIMO) systems, or spectral correlation between random processes, as in orthogonal frequency division multiplexing (OFDM) systems. It can also be used for generating correlated Rayleigh fading envelopes in either discrete-time instants or a real-time scenario. Besides being more generalized, our proposed algorithm is more precise, while overcoming all the shortcomings of conventional methods. [C1252]

## "Frequency exchanger from electronic telemetering equipment of movement features"

The community of authors are concerned for a long time the evaluation in distance of movements at low speed in fluid environments. This work presents the concept of frequency exchanger as essential of electronic equipment from Doppler system of telemetry of movement features in the air with low speed and low execution costs of this study. It is presented the main scheme, the motivation of this choice, the function of blocks and it is insisted upon FPGA-FLEX 10K-ALTERA implementation for the concrete realization of frequency switcher [C1253]

## "An analysis of phase array radar system on a moving platform"

In this paper, we derive a time-varying model for the steering vector of a phased array pulse Doppler radar system installed on a moving platform. Six oscillating motions are included in the derived model as well as the forward motion of the platform. We also present the sensitivity analysis of the derived model and analyze the effect of the perturbation between the true and measured array manifold on the accuracy of the motion compensation algorithm. From the simulation, it can be shown that the platform motions have no prominent effects on the target's power spectrum in moderate sea states (up to 3). However the barge's forward motion is a problem if the targets fall in the spreading spectral region of the sea clutter. [C1254]

## "Aspects of multistatic adaptive pulse compression"

It is well known that two or more radars operating in close proximity, at the same time, and in the same spectrum can severely interfere with one another despite the use of low cross-correlation waveforms. Recently, an approach was proposed called multistatic adaptive pulse compression (MAPC) based on a minimum mean-square error (MMSE) formulation which has been shown to suppress both range sidelobes and cross-correlation ambiguities to the level of the noise. This paper examines the performance of the MAPC approach under the effects of Doppler mismatch. It is demonstrated that for relatively high Doppler the MAPC approach experiences some Doppler-induced sidelobes around large targets yet is still substantially superior to the standard matched filter. [C1255]

## "Comparison of bistatic clutter mitigation algorithms for varying geometries"

Airborne bistatic radar systems require effective techniques to mitigate the impact of ground clutter returns on detection performance. Bistatic clutter generally appears more severe than in monostatic systems owing to increased two-way antenna gain over a broad set of angles and greater clutter spectral variation over range. Adaptive filtering seems like a natural response to combat both of these effects. However, the consequent clutter non-stationarity-variation of clutter angle-Doppler response with range presents difficulty when implementing the adaptive filter, since such an effect leads to errors in the require site clutter covariance matrix estimate. Approaches for coping with clutter non-stationarity are central to effective bistatic space-time adaptive processing (STAP) techniques. In this paper we consider the impact of sensor geometry on the performance of several recently proposed bistatic STAP techniques. Our findings suggest best performance for those methods providing pre-STAP compensation of the data in both angle and Doppler. [C1256]

## "Effects of antenna rotation on STAP performance in forward applications"

The effects of platform rotation, and in particular antenna rotation, on the performance of space-time adaptive processing (STAP) in clutter limited, forward looking airborne radar applications are considered. The change of shape of the clutter surface in angle-Doppler space as the antenna rotates is critical to the performance of STAP. Theoretical considerations and simulation results show that STAP is likely to be more resilient to roll than yaw, although the problems of yaw can be alleviated by the application of motion compensated phase delay steering. [C1257]

## "Refined method for terrain scattered interference mitigation"

Terrain scattered interference mitigation methods for airborne radar have been described in previous papers and deconvolution methods for interference suppression have been proposed. This paper describes a refined method for terrain scattered interference mitigation and investigates performance for different conditions and limitations. An important part of the method is a threshold function to enable least squares estimation of the multipath impulse response. Least squares estimation can be applied if the impulse response is time limited or if a limited number of impulse response coefficients are required for sufficient interference suppression. The impulse response estimation can be performed either before or within the coherent processing interval. It is assumed that the direct path signal can be accurately estimated without strong multipath errors. Small relative Doppler shift errors are required between the direct path and the terrain scattered paths. Several strong jamming signal sources cannot be resolved and suppressed. Receiver blocking gives errors in the impulse response estimate and jamming signal residues in the main beam signal. Clutter signals might have to be suppressed to get accurate impulse response estimates. Bandwidth effects must be considered to get numerical stability in the inverse filtering and deconvolution operations. The refined method can suppress interference down to the receiver noise level in simple terrain scattering scenarios. [C1258]

## "Target classification based on micro-Doppler signatures"

In this paper, we propose a Gabor filtering method to extract localized micro-Doppler signatures represented in the time-frequency domain. The dimensionality of the extracted Gabor features is further reduced by using the principal component analysis (PCA) method. Therefore, a suitable classifier can be used for target classification based on their different motion dynamics. In our study, we use simulated radar data. Three different classifiers (Bayes linear, k-nearest neighbor, and support vector machine) are compared and tested. Our experiments show that Gabor features are robust in discriminating micro-Doppler effects of different types of micro-motions, and SVM classifier provides the best performance. [C1259]

## "Effect of Earth's rotation and range foldover on space based performance"

A space based radar (SBR) by virtue of its motion generates a Doppler frequency component to the clutter return from any point on the Earth as a function of the SBR-Earth geometry. The effect of Earth's rotation around its own axis also adds an additional component to this Doppler frequency. The overall effect of the Earth's rotation on the Doppler turns out to be two correction factors in terms of a crab angle affecting the azimuth angle, and a crab magnitude scaling the Doppler magnitude of the clutter patch, interestingly both factors depend only on the SBR orbit inclination and its latitude and not on the specific location of the clutter patch of interest. Further, it is shown that the crab angle has maximum effect for an SBR on a polar orbit that is above the equator. The crab magnitude on the other hand peaks for an SBR on an equatorial orbit. It is also shown that Earth's rotation together with range foldover phenomenon significantly degrade the clutter suppression performance of adaptive processing algorithms. Detailed derivations of these results are presented in this paper. [C1260]

## "Network signaling compression for bit loading"

Link adaptation technology has been introduced in new generation transmission systems such as 3-G or 4-G optimizing both their throughput and their power consumption. The adaptation of radio configuration requires information about the radio link quality. The information most be exchanged between the access point and the mobile terminal, leading to an associated dealing load, whose amount may decrease the system transmission efficiency. A mechanism for reducing the amount of dealing information has to be designed for increasing the overall system capacity (more users, more available bandwidth). This paper addresses multi-carrier systems whose link adaptation is called out by means of bit load tag algorithms. However, the associated signaling load increases quickly with the number of sub-curriers, modulation schemes and users. These bit-loading vectors are considered a-priori known at the receiver, and almost no literature concerning transmission of such information is available. In realistic transmission systems, correlation exists in time due to Doppler effect, and in frequency due to multi-path delay spread. We intend to exploit this two fold redundancy to decrease the signaling information load related to the power vector data for bit loading. A compression system for both bit allocation and power allocation of the bit loading is proposed. The performance of such compression system is then evaluated. [C1261]

## "A new adaptive equalization technology in time-varying multipath channel"

In wireless communication system, with the increase of the maximum Doppler frequency shift, constant module algorithm (CMA), least mean squares (LMS) and recursive least squares (RLS) algorithms could not track the varying channel, which decrease the effect of equalization Kalman filter is the optimal one in tracking time-varying channel, but it needs training sequences, which restricts its application. This paper combines the three kinds of adaptive equalization algorithms and Kalman filter algorithm respectively for better effect and simulations show that our methods are effective [C1262]

## "Application of DRFM in high frequency ground wave radar"

Compared with the traditional analog delay, to conveniently control the time delay of responder of high frequency ground wave radar and obtain duplicate signal with better coherence, the digital radio frequency memory (DRFM) which consists of FIFO is designed to sample the received signal of radar at high speed continuously and simulate the target at any distance. This design is proved to meet the demand of responder of radar well [C1263]

## "Performance analysis of digital watermarking through OFDM channels"

Different most used image watermarking scheme performances while transmitted over OFDM multi-path channels both with Doppler shift and without Doppler shift have been evaluated. Simulation results have shown that the system suffers from the Doppler shift and the watermarking performances are also decreased while the Doppler shift increasing. [C1264]

## "Advanced Line-Shape Calculations and their Use in the Determination of "Isotropic" Magnetic Fields in Pulsed Plasmas"

Summary form only given. Measurements of magnetic fields are central in many studies of equilibrium and transient laboratory plasmas. Known diagnostic methods are based on detecting an anisotropy in either the emitted radiation (the Zeeman/Paschen-Back effect) or the dispersion properties of the medium (the Faraday rotation). Consequently, these techniques can not be used in situations where the magnetic field has various directions in the region viewed by the diagnostic system or if its direction varies during the time of observation, as is often the case in e.g. laser-produced or pinch plasmas. Moreover, magnetic fields with amplitudes that vary in time or in space pose additional problems in the applicability of the traditional methods. In order to overcome these difficulties, a new spectroscopic approach for measurements of magnetic fields with such configurations in plasmas has been proposed and experimentally verified. The technique is based on the spectroscopic analysis of line-shapes of different fine-structure components of the same atomic multiplet that undergo different splitting under the magnetic field. Furthermore, this technique allows for accurate magnetic field detection in the presence of other rather dominating broadening mechanisms in plasma (the Stark and the Doppler effects). In order to obtain accurate results, especially in the case of Stark-dominated spectra, this technique requires detailed line-shape analysis. To this end, use is made of a new method for the calculation of the spectral line broadening in plasma. The idea of the method is to numerically simulate the motion of the interacting plasma particles (both ions and electrons) and use the resulting time-dependent field to obtain the evolution of the emitter system. This approach allows for addition of external electric and/or magnetic fields in a fully consistent manner, thus providing a powerful tool for investigating spectral line profiles in plasma under the simultaneous influence- of magnetic and electric fields. [C1265]

## "A mobility based link layer approach for mobile wireless sensor networks"

Several MAC protocols have been proposed for wireless sensor networks (WSNs). These include T-MAC, D-MAC and the more commonly utilized SMAC. In this paper, we propose a new MAC layer approach to support mobility in WSNs. The proposed technique utilizes an adaptive frame size approach to overcome the effect of frame losses caused by the Doppler shifts under mobile scenarios. An extended Kalman filter is used to predict the frame size for each transmission, which also directly enhances the energy efficiency of the system. Our results show that based on the adaptive frame size predictor and its comparison with the SMAC protocol, the proposed technique can improve overall system performance and deliver enhanced energy efficiency of 24% under mobility. The current implementation of ns-2 does not take into consideration the packet error rate. As another contribution of our work, we have developed a physical layer model for ns-2, which processes the received frame based not only on the fading characteristics of the signal but also the SNR and relative velocity between the nodes. To characterize a more accurate wireless sensor networks' physical layer, we have modeled the Mica-2 sensors in MATLAB and implemented the model in ns-2 for simulations [C1266]

## "Doppler diversity receiver for broadband wireless OFDM system under high-speed mobile environments"

A novel, simplified time-domain Doppler diversity receiver for OFDM system is proposed. In high-speed railway applications, when the train moves at the speed of 250-500 km/h, the Doppler spread of channel is obvious. With the proposed Doppler diversity receiver, OFDM system performance can be better. And the amount of multiplications and additions of the proposed Doppler diversity receiver can also be reduced. Simulation results show that adequate equalization is necessary for OFDM system under high-speed mobile environments. [C1267]

## "Quadrature Doppler Ultrasound Signal Senoising Based on Adaptive Representations"

The spectrogram of Doppler ultrasound signal has been widely used in the clinical diagnosis. The additional frequency component arising from noise will produce an adverse effect on the subjective analysis of the spectrogram and its quantitative analysis. Two approaches based on the adaptive representations including the adapted local cosine transform (CPD) and the wavelet packet (WPD), combined with the garrote thresholding, and is proposed to denoising quadrature Doppler ultrasound signal. At first, to avoid the phase distortion induced by denoising the complex Doppler ultrasound signal directly, the directional information is extracted from the quadrature signal. And then the denoising methods based on the adaptive representations are performed on the forward and reverse flow signals, respectively. At last, the estimated signal is reconstructed from the denoised signals using Hilbert transform. The simulation results have shown that these approaches are superior to ones based on the wavelet transform, especially under low SNR circumstances, and moreover, the denoising method using the CPD has achieved the best performance [C1268]

## "Imaging performance of the Si/Ge hybrid Compton imager"

The point spread function (PSF) of a fully-instrumented silicon/germanium Compton telescope has been measured as a function of energy and angle. Overall, the resolution was 3deg to 4deg FWHM over most of the energy range and field of view. The various contributions to the resolution have been quantified. These contributions include the energy and position uncertainty of the detector; source energy; Doppler broadening; and the 1/r broadening characteristic of Compton back-projection. Furthermore, a distortion of the PSF is observed for sources imaged off-axis from the detector. These contributions are discussed and compared to theory and simulations [C1269]

## "Differential Geometry Measures of Nonlinearity for Ground Moving Target Indicator (GMTI) Filtering"

The ground moving target indicator (GMTI) radar is widely used to detect, geolocate, track, and classify ground-moving targets in all weather, day-night, and cluttered conditions. The measurements of a GMTI radar are slant range, azimuth, and range-rate or Doppler. These measurements are nonlinear functions of the target state. Until recently, a quantitative measure of the degree of nonlinearity (DoN) for nonlinear filtering problems was lacking. Recently, the DoN of a filtering problem with a nonlinear measurement model has been quantified using the differential geometry based measures of nonlinearity such as the parameter-effects curvature and intrinsic curvature. We calculate three types of parameter-effects curvature and intrinsic curvature for the nonlinear GMTI filtering problem for a variety of scenarios. We vary the distance between the target and the GMTI sensor in these scenarios using simulated data. We demonstrate that the state estimation mean square error (MSE) increases with increase in the DoN [C1270]

## "Signal sampling method for power measurements in mobile UHF environments"

This paper depict. a measurement method that was developed to consistently characterize a mobile environment on the UHF band in terms of path loss. An automated data acquisition method is presented which consists of setting the sampling rate based on: a Rayleigh statistical distribution of the radio channel, the sounding instruments limitations and the intended mobile top speed. The Doppler effect is also taken into account when the resolution bandwidth is set. The paper also covers the acquired data processing technique that leads to the separation of the long and short term fading components using a moving mean filter. [C1271]

## "Adaptive Waveform Distortion Compensation"

Radar receivers use low sidelobe matched filtering techniques to separate closely spaced targets. Ideally, low sidelobes can be achieved through either waveform selection or through spectral weighting of the matched filter. In practice, however, the minimum achievable sidelobe levels are determined by the presence of waveform distortion. Such distortion can be unintentional (e.g., as the result of hardware errors in the radar's transmitter or receiver) or intentional. This paper presents several non-iterative adaptive processing techniques for canceling coherent waveform distortion. Moreover, these techniques also potentially super-resolve closely spaced targets [C1272]

## "Velocity sensitivity mapping in tissue Doppler images"

{no data available} [C1273]

## "A novel doppler based ultrasonic surface roughness measurement"

{no data available} [C1274]

## "Mobile Multiuser Access with Approximately MAI-free PMU-OFDM Transceiver Design"

{no data available} [C1275]

## "Low complexity channel estimation scheme for OFDM systems with the aid of dynamic pilots"

This paper presents a low complexity channel estimation scheme for OFDM systems in multipath fading channels. The proposed scheme is designed based on the pilots, which are arranged at different locations for different OFDM symbols. In slow and moderate time-varying fading channels, the channel frequency response could be estimated accurately with simple linear interpolation. On the other hand, the number of embedded pilots is reduced using the proposed scheme. Ultimately, the channel frequency response of the current OFDM symbol is estimated from the current and neighboring pilots and no further calculation is required. The effects of the Doppler frequency on the proposed scheme are also considered in this paper. Computer simulations are conducted to evaluate the performance of the proposed scheme. It is shown that the performance of the proposed scheme is close to maximum likelihood (ML) algorithm in the time-varying fading channels [C1276]

## "Effects of cyclic prefix on OFDM systems over time-varying channels"

In this paper, effects of cyclic prefix (CP) are investigated for orthogonal frequency division multiplexing (OFDM) systems over time-varying channels. Although employing a CP as the guard interval is a simple way to combat the inter-symbol interference (ISI) and the inter-carrier interference (ICI), it reduces the transmission efficiency of the system, especially for channels with long channel-impulse response (CIR), such as hilly terrain channels. On the other hand, the time-varying channel also gives rise to ICI. We show that to achieve a signal-to-interference ratio of 20 dB, for slow fading channels, half the length of CIR is enough for CP. For fast fading channels, the Doppler frequency become domination factor to affect OFDM systems [C1277]

## "Empirical Models and Parameters for Rural and Indoor Wideband Radio Channels At 2.45 and 5.25 GHZ"

The modeling results from wideband radio channel measurements are presented for two environments: rural and indoor. The paper focuses on the average and instantaneous characteristics of received power including: path loss, shadow fading, power delay profiles, and rms delay spreads. Furthermore, the cross correlation between shadowing of the path loss and the delay spread is investigated and found to be large. Doppler measurement campaigns were conducted in both environments, at 2.45 GHz and 5.25 GHz along the same measurement routes, with 100 MHz bandwidth. In this paper it is shown that we may apply 2.45 GHz band small scale models into 5.25 GHz band. It can be also seen, as for the measured scenarios, on average, the difference in terms of

path loss between 2.45 GHz and 5.25 GHz in line-of-sight indoor environment, where waveguide effect is encountered, is c.a. 8 dB, instead in rural outdoor the mentioned difference is c.a. 6 dB [C1278]

## "SNR-independent maximum Doppler frequency estimators with bandwidth adjustment technique"

Information of the maximum Doppler frequency enable to optimize many channel-adaptive techniques and radio resource management methods for mobile radio communication systems. In this paper, we propose four maximum Doppler frequency estimators which are based on the level crossing rate (LCR), the zero crossing rate (ZCR), the covariance function (COV) and the autocorrelation function (ACF). To eliminate the influence of additive noise, we analyze the conditions for the estimators independent of the signal-to-noise ratio (SNR) and implement the conditions with a downsampling process in the time domain. The proposed methods achieve good SNR-independent performance in the Rayleigh fading channels [C1279]

## "Anomalous Resistivity in Plasma Focusing Cells for Intense Electron Beams"

The efficient focusing of electron beams generated from a pulsed-power-driven diode can produce a bright spot on a high atomic number bremsstrahlung converter for radiography. Pulsed-power diodes can reliably produce high doses with < 1-cm spot sizes. Because of its simplicity, gas cell focusing has been the method of choice for several decades. The electron beam enters the cell through a thin foil that separates the gas from the vacuum diode region. Ideally, the relativistic electron beam drives a gas breakdown that produces a highly conductive plasma. If the beam enters the cell with the correct focusing angle and the beam self fields are largely neutralized, the beam focuses ballistically onto a radiation converter (target). Plasma focusing cells (density approaching 1016cm-3) have a potential advantage over that of a neutral gas due to the large initial conductivity. The influence of micro instabilities and turbulence can degrade the classical resistivity of these cells for some parameters. Using the simulation code LSP, we have observed the onset of anomalous resistivity for low plasma densities and large embedded magnetic fields. The resistivity results from oscillations due to the Bernstein mode instability in the current-carrying plasma. Due to the Doppler effect, the frequency of the electron mode in the ion rest frame can be made sufficiently low to interact with the ions. The resulting oscillations have a growth rate that scales with the relative drift speed between the electrons and ions. Here we discuss the scaling of the instability derived from simulation and theory and its impact on the operation of a plasma focusing cell for radiography. [C1280]

## "Magnetic Field Diagnostics in Transient Plasmas"

Summary form only given: Measurements of magnetic fields are a key issue in numerous studies of plasmas carrying high-current pulses. However, the traditional techniques, based on Zeeman splitting or Faraday rotation, can not be used in situations where the magnetic field has no definite direction during the time of observation, and/or at the region viewed by the diagnostic system, as commonly occurs in laser-produced or pinch plasmas. This problem is also manifested for magnetic fields with amplitudes that vary in time or space. We present a new spectroscopic diagnostics that allows for determining the magnetic field straight even in situations where the field direction and amplitude vary in space and during the time of observation. Furthermore, it is demonstrated that this technique allows for accurate B-field detection in the presence of other broadening mechanisms in the plasma (Stark and Doppler effects). The technique is based on the spectroscopic analysis of line-shapes of different fine-structure components of the same atomic multiplet that undergo different splitting under the B-field. The approach allows for distinguishing between different mechanisms influencing the line-shapes. Here we report on the experimental verification of the proposed method for the B-field measurements using laser-produced plasma injected into the A-K gap of a vacuum transmission line carrying a 160 kA, 100 ns current. The magnetic field generated in the inter-electrode gap produces line splitting of the plasma emission lines, that is unambiguously inferred from the emission line shape in spite of the dominance of the line shape by the Stark broadening. [C1281]

## "Experiments on the Bonding Interface Vibration of Thermosonic Flip Chip"

The vibrations of chip and tool tip during thermosonic flip chip bonding were studied. By measure the vibration of the chip and tool tip with a Doppler laser vibration measure system, the "suddenly velocity decrease" of chip was elucited. It is noticed that this means the bonding strength formed in the bonding interface. By analyzing the vibration displacement and frequency of the chip and comparing with the vibration displacement of the tool tip, it is noticed that the chip vibrates in a "stick-slip" state after the "suddenly velocity decrease", and the continued ultrasonic vibration may effect the formed bonding area, and suggest about the ultrasonic power supply pattern was obtained [C1282]

## "Nonlinear Thomson Scattering for Plasmaand Laser Characterization"

Summary form only given. One of the most powerful methods of diagnosing plasma is detecting the scattering of electromagnetic radiation from the plasma. The process is described by the Thomson scattering (TS) in which the electron radiates with the same frequency of the incident field. The radiation signal is proportional to the number of the electrons but the electron motion shifts the frequency by Doppler effects. Thomson scattering then yields detailed information of both the electron density and speed distribution (temperature). TS typically has a very small cross-section, therefore it is advantageous to use more intense lasers. It is known for years that the electron acquires an additional energy in the high fields, known as the ponderomotive energy. Recent discussion shows that the electron also acquires a counterpart ponderomotive momentum. The ponderomotive momentum causes the electrons to drift along the laser propagation, which results in additional spectral shift. The effect is known as the nonlinear Thomson scattering. Since the drift velocity is proportional to the laser intensity, a spread of the laser intensity results in spectral broadening. We have calculated detailed spectra of the Thomson scattering from intense laser fields by solving the electron motion inside the intense laser field nonperturbatively and subsequently calculating the radiation spectra from electrodynamics theory. The spectral shift and broadening correlate with the laser properties and can exceed the Doppler shifts introduced by the electron speed, which suggests that deconvolution is necessary to remove the intensity effects from the laser and recover the true electron properties for the high intensity Thomson scattering. Concurrently, this basic interaction between the plasma and high intensity laser opens up the possibility of using the nonlinear Thomson scattering to characterize the laser fields, e.g. measure the absolute laser intensities in-situ and optically. The role of- the electron in this case is thus changed from being a target to functioning as a probe [C1283]

## "A Kalman filter for the navigation of remotely operated vehicles"

A Kalman based asynchronous data fusion algorithm for the navigation of a tethered remotely operated underwater vehicle is presented. Using a non-linear dynamic simulation of the tethered ROV system, the performance of the Kalman filter is measured for various motion sensor combinations. The sensor suite tested includes a Doppler velocity log, fiber-optic gyrocompass, depth sensor and an ultra-short baseline position system. Provided the gyrocompass functions properly, the study shows that an extended Kalman filter which uses a complete model of the ROV, including, drag, tether and thruster effects, does outperform a constant velocity model in instances of sensor drop out. The positioning error is reduced by 20% in these instances. It is found that the ultra-short baseline system is the driving factor in the smoothness of the results. [C1284]

## "An eigenpath underwater acoustic communication channel simulation"

One of the less reliable communication channels is the underwater acoustic channel. This is due to its reverberant properties produced by the surface and the bottom of the sea and Doppler spreading caused by the transmitter and the receiver movements. To foresee some characteristics it is important to develop a reliable model. An accurate model allows to evaluate the channel behavior and it brings the possibility to compare the performance of different systems under the same condition. In this work, we present the simulation of a modified Rayleigh fading communication channel model, which takes into account the boundary reflections and Doppler shift effects. The model describes the underwater channel with several distinct paths (eigenpaths) over which a signal can propagate from the transmitter to the receiver (eigenpath signals). Each eigenpath signal contains a dominant and stable component and many smaller and randomly scattered components (sub-eigenpath components). The envelope of the eigenpath signal can therefore be described using a Rice fading model. [C1285]

## "Evolution of Plasma Flow Shear and Stability in the ZaP Flow Z-Pinch"

Summary form only given. The ZaP flow Z-pinch experiment at the University of Washington investigates the concept of using sheared flows to stabilize an otherwise unstable plasma configuration. The stabilizing effect of a sheared axial flow on the m=1 kink instability in Z-pinches has been studied using linearized, ideal MHD theory to reveal that a sheared axial flow stabilizes the kink mode when the shear exceeds a threshold. The ZaP experiment generates a Z-pinch plasma that is 1 m long with a 1 cm radius with an embedded axial flow. Time-resolved Doppler shifts of plasma impurity lines are measured along 20 chords to determine the plasma axial velocity profiles. An azimuthal array of magnetic probes measures the fluctuation levels of the azimuthal modes m=1, 2, and 3. After pinch assembly a quiescent period is found where the mode activity is significantly reduced. The plasma axial velocity evolves from a uniform to a sheared and back to a uniform flow profile. The sheared flow profile is coincident with a plasma quiescent period where magnetic mode fluctuations are low. The value of the velocity shear satisfies the theoretical threshold for stability during the quiescent period and does not satisfy the threshold during high mode activity. Evolution of the plasma parameters including ion temperature and axial velocity will be presented [C1286]

## "A comparison of two measurement systems designed to provide real-time current information in

## support of navigation"

Freeport LNG Development, LP is designing and constructing an LNG receiving terminal in Freeport, Texas. The Port of Freeport wants to install a near real-time current monitoring system near the port entrance to assist pilots navigating the waterway. Knowledge of currents at the approach to the Freeport Entrance Channel is critical for the safety of the approaching vessels. Longshore currents are redirected around these jetties, creating intensified longshore (cross channel) currents just offshore of the jetties which makes alignment of vessels difficult. Having current data available in near real-time will allow the pilots to make information-based decisions, thus helping ensure safe navigation and improving the efficiency of the port by maximizing tonnage throughput. This paper presents the results of a comparison trial conducted jointly by Fugro GEOS and NOAA CO-OPS. This cooperative effort came about when Fugro GEOS contacted NOAA after being contracted by Freeport LNG Development, LP to perform an oceanographic survey at the Freeport Entrance Channel. Data from a Nortek Aquadopp mounted in NOAA's new clamparatus system on Navigation Buoy 6 at the Freeport Entrance Channel are compared with those from an RDI Workhorse acoustic Doppler current profiler mounted in a seabed frame nearby. Seven clamparatus systems have been deployed in the Chesapeake Bay as an enhancement to the PORTS® there, and this was the first system installed in Texas. The clamparatus system provides a more cost-effective solution for obtaining current profile information in real-time and provides data within the navigation channel which is of most interest to the professional mariner. However, the data require full verification. Errors can be introduced by the magnetic effect of the steel structure of the buoy and its movement. A brief review of the two sets of instrumentation, mounting and measurement techniques is given. A thorough comparison of the direction data collected from both systems is presented. The mean of the absolute value of the difference in directions at 6.5m below the surface is 13.8° (standard deviation = 19.4°) when all data are included. The difference decreases to 8.7° (standard deviation = 7°) when only points with speeds- greater than 0.15 m/s are considered. Recommendations are made for future trials and system improvements. [C1287]

## "Use of a video and laser system to quantify transect area for remotely operated vehicle (ROV) rockfish and abalone surveys"

In situ surveys by remotely operated vehicle (ROV) and submersibles are important sampling tools for making fish and invertebrate population estimates. A major challenge associated with these methods is the measurement of the search and/or transect area due to variation in the field of view (FOV) throughout a dive. In addition, to effectively survey complex habitats it is often desirable to adjust the camera angle, which results in significant differences in the FOV in the recorded images and subsequent spatially variant image magnification. This paper describes a method for obtaining accurate surveyed area estimates using FOV measurements derived from image analysis and from the speed of the vehicle measured by a Doppler velocity logger (DVL). The image analysis software considers camera tilt angle, roll and pitch of the ROV, distance from the bottom, and the location of the reference lasers in the imagery to calculate the field of view. The DVL continuously logs forward/aft and port/starboard speeds for a representation of the vehicles movement over the bottom, and in effect, distance traveled. The development of these methods has led to a highly accurate estimate of transect area that will be used to calculate densities of commercially important rockfishes and endangered white abalone in the Southern California Bight. [C1288]

## "TRIAXYS™ Acoustic Doppler Current Profiler Comparison Study"

A field trial was conducted during the summer months of 2004, off the West Coast of Vancouver Island comparing ADCP measurements from a buoy-based platform and two bottom based installations in about 45m depth. The buoy-based instrument was a Nortek 600KHz Aquadopp™ Acoustic Current Profiler (ACP) downward looking unit, integrated into the hull of a 1m diameter TRIAXYS™ Directional Wave Buoy. The two bottom mounted units were a Nortek 600KHz ADCP and an RDI 300KHz ADCP™ . Post recovery data analysis compared both bin averaged depths (10-15m and 20-25m) with no tidal correction and a set of corrected bin alignments for tidal height effects from which direct comparison of data was completed. The TRIAXYS™ mounted ACP data agreed with the bottom mounted units typically to within 4-5 cm/s for velocity and to within 3-5 degrees for direction for depths down to 30m. For the trial period, maximum wave heights to 2.5m were measured, with no significant effect on ACP measurements. [C1289]

## "Towards bathymetry-optimized Doppler re-navigation for AUVs"

This paper describes a terrain-aided re-navigation algorithm for autonomous underwater vehicles (AUVs) built around optimizing bottom-lock Doppler velocity log (DVL) track lines relative to a ship derived bathymetric map. The goal of this work is to improve the precision of AUV DVL-based navigation for near-seafloor science by removing the low-frequency "drift" associated with a dead-reckoned (DR) Doppler navigation methodology. To do this, we use the discrepancy between vehicle-derived vs. ship-derived acoustic bathymetry as a corrective error measure in a standard nonlinear optimization framework. The advantage of this re-navigation methodology

is that it exploits existing ship-derived bathymetric maps to improve vehicle navigation without requiring additional infrastructure. We demonstrate our technique for a recent AUV survey of large-scale gas blowout features located along the U.S. Atlantic margin [C1290]

## "Broadband Doppler compensation for rational wavelet-based UWA communication systems"

This paper proposes a broadband Doppler compensation structure based on rational orthogonal wavelet signaling and perfect reconstruction wavelet filter banks. A transmultiplexer system model is presented to characterise wavelet signalling, channel transmission and Doppler compensation processes. Because the underwater acoustic (UWA) Doppler scales are rational numbers very close to 1, a special class of wavelets, the rational orthogonal wavelets with a scale dilation factor of aj: j isin Z, 1 < a < 2, are introduced in this application. These rational wavelets are well adapted with the proposed Doppler compensation structure and achieve good system performance. By effectively resolving the multiscale nature of the UWA channels for wideband signal propagation, this class of wavelets forms optimal shaping pulses with unique robustness against Doppler dispersion and has a potential for further development towards a new class of rational wavelet based UWA systems [C1291]

## "Channel estimation of uplink for MC-CDMA systems"

Multi-carrier code division multiple access system (MC-CDMA) is a flexible and adaptable radio interface to provide dynamically changing bit rates and a variety of services on radio channels. An accurate channel estimate allows the use of multi-user detection and power loading to improve system performance. In this paper, we propose a novel channel estimation method of uplink for MC-CDMA systems. In MC-CDMA systems, code-multiplexed pilot symbols are transmitted consecutively in both time and frequency domains. In the proposed method, weighted pilot symbols in both domains are coherently added to improve signal to noise ratio of pilot symbols in channel estimation. We propose a method to select the weighting factor for pilot symbols according to the changes of propagation by measuring the maximum Doppler shift and the maximum delay time. Also the channel estimation algorithm is simplified. The method is evaluated in the end. The results show that the method is simple and effective. [C1292]

## "Interference cancellation based receive scheme to combat ICI for OFDM systems"

In his paper, we analyses and proposes a new receiver structure to mitigate the effect of interchannel interference (ICI) on the reception of OFDM signals. The system operates in a frequency selective Rayleigh fading channel. Interchannel interference is caused by the time variations in channel gain within OFDM symbol and leads to an error floor, which is a function of Doppler frequency. In this study, it was found that by performing parallel interference cancellation at the receiver, we were able to significantly reduce the error floor. [C1293]

## "A State-Space Approach to Semi-Blind Adaptive Multiuser Detection in Time-Varying Environment"

Autoregressive (AR) model derived from Jakes' Doppler Spectrum is used for signature sequence estimation in direct sequence code division multiple access (DS-CDMA) system. A decision directed algorithm is proposed to work on iterative basis during the course of data transmission in a rapidly time-varying environment. The algorithm is based on state-space approach which uses Kalman filter for signature sequence estimation in the presence of multipath and time varying channel. The proposed algorithm successfully works in tracking rapid changes of the channel whereas gradient-based algorithm like LMS almost fails in doing so. A linear minimum mean squared error (MMSE) detector is used to detect the symbols, which are then used in updating the received signature waveforms, distorted by the time-varying channel. Simulation results are presented which show that the performance of a linear adaptive receiver can be improved significantly with signature tracking on high Doppler spreads in DS-CDMA system [C1294]

## "Orthogonal pulsing schemes for improved target detection in space based radar"

Two phenomena that degrade the performance of ground moving target detection (GMTI) capabilities of space based radars (SBR) are (i) range foldover effects associated with multiple data points originating from different range bins due to the radar pulse stream and (ii) Earth's rotational effect on clutter Doppler frequency. The degradation in performance due to these phenomena is quantified in this paper and methods to minimize their effect are discussed. In this context, transmit pulsing schemes involving waveform diversity is proposed for improved target detection capabilities [C1295]

## "Outdoor radio channel measurements at 2.35 GHz for WiBro systems"

{no data available} [C1296]

## "Frequency-time codes for OFDMA uplink applications"

Orthogonal frequency division multiplexing (OFDM) is a multi-carrier block modulation scheme primarily used in high bit rate systems to mitigate inter-symbol interference (ISI) experienced in multipath wireless channels. The annoying effect of ISI is almost all removed by the insertion of a cyclic prefix (or postfix) extension. However, during the transmission, ISI may also provides a multipath diversity advantage if the path gains fade independently on the different OFDM subcarriers. In this case, diversity translates in frequency diversity when discrete Fourier transform (DFT) is performed at the receiver. The Doppler shift of each subcarrier frequency caused by relative motion of the receiver and transmitter also yields to frequency diversity due to independent frequency shifts on each subcarrier. In an uplink multi-access scenario, subcarriers used by different users inevitably exhibits frequency diversity due to their different locations and speeds. In this paper, we introduce a new frequency diversity scheme called frequency time Trellis code (FTTC) that exploit the channel diversity. The performance of the FTTC transmit diversity is analyzed by simulation on slow Rayleigh fading channels. The results show that the FTTC scheme SER performances are better than the uncoded version [C1297]

## "Modeling of OFDM-based systems with frequency offsets and frequency selective fading channels"

We derive vector transmission models for OFDM-based systems: pure OFDM, multiuser OFDM (OFDMA), CDM-OFDMA and MC-CDMA. Two kinds of OFDMA systems, conventional OFDMA and interleaved OFDMA are studied and the effects of frequency offset and multipath propagation are investigated. For each system both downlink and uplink transmission models are described. The models allow multiuser detection as a means to cope with carrier frequency offsets, which is especially useful for the uplink. The possibility of frequency offset estimation is discussed briefly. [C1298]

## "Measurement of river surface currents using rough surface scattering"

Simple Bragg scattering is often the type of rough surface scattering applicable to rivers. Thus the center frequency of the Doppler spectrum provides information on the velocity of the surface of the river. We have developed a simple continuous wave microwave system called Riverscat to take advantage of this effect to measure river surface currents. Measurements with this velocity sensor show that surface velocity is well related to the depth of the river. Therefore on unstable streams where the bottom changes either at the measurement site or downstream of it, Riverscat offers the potential for improved monitoring of stream discharge. [C1299]

## "Delta modulation for channel feedback in transmit diversity systems"

In a wireless communication system with multiple transmit antennas, knowledge of the channel at the transmitter can be used to increase link and system capacity. In a frequency division duplex system, the channel may be estimated by the receiver and communicated back to the transmitter for use in future transmissions. Efficient schemes that achieve channel feedback in this manner are of interest. We present a channel feedback scheme that uses delta modulation to encode channel information efficiently by exploiting the temporal correlation of the wireless channel. A system with multiple transmit antennas and a single receive antenna is used to evaluate the performance of the channel feedback scheme. The effect of feedback channel errors on system performance is shown. The presented method is found to be advantageous for channels with low to moderate Doppler frequencies. [C1300]

## "Photoassociation Spectroscopy of Cold Alkaline Earth Atoms near the Intercombination Line"

The properties of photoassociation spectra near the intercombination line of group II atoms are theoretically investigated. Unlike in most current photoassociation spectroscopy the Doppler effect can significantly affect the shape of the investigated lines [C1301]

## "Effects of Earth rotation on clutter spectrum for space-based radar"

In space-based radar (SBR), the Earth rotation results in an external Doppler component of the clutter patch. It in turn affects the clutter spectrum through transforming the shapes of the clutter ridges in both angle-Doppler and range-Doppler domain. The relationship between the shapes and nadir point latitude of the platform as well as the system parameters, such as orbit altitude, incline, operation wavelength and pulse repetition frequency (PRF) are discussed in this paper and Earth rotation effects are evaluated in different SBR systems. [C1302]

## "Quasisolitons formation and frequency modulation under conditions of non-stationary double resonance in common-upper-level scheme with great inhomogeneous broadening of quantum transition lines"

Transient regime of common-upper-level scheme double resonance is studied numerically. It was shown that in the presence of resonance detunings in channels of interaction and with taking into account of inhomogeneous broadening of resonant transition lines the process of stationary gained signal pulse forming is accompanied with signal carrier frequency pulling to the value that is corresponding some condition. This relates frequency detunings with transition central frequencies and differs from such conditions for Raman scattering. In some cases. Satisfaction of this condition provides the effective conversion of pump pulse energy into signal one. Depends on frequency detuning values one- or two-pulse structure will arise in signal channel. To vary these detunings it is possible to manipulate of signal pulse magnitudes and of time shift between them [C1303]

## "An intelligent sensor for ETC ad hoc networks"

This paper introduces an intelligent K-band speedometer sensor (KBSS) for ETC (electronic toll collection) system, that is applicable to ad-hoc networks. New and high-precision speedometer sensors have been installed in mobile nodes (vehicles) and on ETC terminals network using K-band Doppler and K-band FMCW (frequency modulated continuous wave) technology, respectively. The ETC network and mobile nodes are organized in an ad hoc manner. The new speedometer sensor is small, inexpensive and low-power device based on the Doppler effects phenomenon to obtain a speed of the vehicle more precisely. The ETC system is capable to locate the position of the vehicles within a long distance from ETC area and without the vehicles even having to slow down during they approach to the ETC gates. The experimental design, data collection and data evaluations are discussed, and the features of the new system have been appraised and compared with a conventional speedometer. The results show that our new speedometer development exhibits a phenomenal performance gains with low cost design, light weight and its performance provides a pragmatic element for emerging ITS infrastructure. [C1304]

## "5 GHz RLAN interference on active meteorological radars"

This paper examines the effects of wireless access systems on meteorological radars operating in the band 5600-5650 MHz. It analyses data collected during field experiments involving IEEE 802.11a signals and the CWSR98 weather radar located in Franktown, Ontario, Canada. Results show levels of degradation on the gif, moment data, and ascope products of the radar due to RLAN interference. The work concludes with a maximum aggregate RLAN power level, input to the radar antenna that causes minimum degradation in the radar imagery. [C1305]

## "Characterization and reduction of number dependent sensitivity in multi-pole linear ion trap standards"

The multipole linear ion trap standard developed at the Jet propulsion laboratory has demonstrated excellent short and long-term stability and improved immunity from two of its remaining systematic effects, the second order Doppler shift and second order Zeeman shift. The technology has also demonstrated long-term operation in the field. In this paper, we discuss the LITS systematic effects and present the characterization and reduction of the primary shifts and their dependence on ion number [C1306]

## "Nonlinear equalization for frame-differential IR-UWB receivers"

This paper shows equalization approaches for high-data-rate transmitted-reference (TR) IR-UWB systems employing an autocorrelation receiver front-end. Using a maximum likelihood sequence detector (MLSD) with decision feedback (in the back-end of the TR-receiver), a significant improvement of the receiver performance is possible. To avoid the high complexity of the MLSD detector, alternative equalizer structures are evaluated. If the parameters of the channel are not known a priori, an equalizer has to be adapted during the transmission of training data. Such an adaptive equalizer is presented as a reference. Furthermore, we study the design of minimum mean square error (MMSE) equalizers assuming knowledge of the channel. A linear MMSE equalizer is designed using the linear and nonlinear channel coefficients. Then the concept of the linear equalizer is extended to a nonlinear Volterra equalizer which further improves the performance of the IR-UWB receiver structure. All proposed methods are discussed and the effects are shown with computer simulations. [C1307]

## "High performance channel model hardware emulator for 802.11n"

In this paper, the design and implementation of a new high performance hardware channel emulator is

presented. The purpose of the developed emulator is to efficiently reproduce in a laboratory environment the accurate behaviour of several effects of the radio channel over a multiple antennas wireless communication system, including AWGN (additive white Gaussian noise), multipath, attenuation and Doppler shift. The main application target is the test and the performance evaluation of a new 802.11n transceiver. The prototype has been implemented on a board including both an ARM processor and a field programmable gate array (FPGA), and it supports the simulation of a 40 MHz radio frequency bandwidth. [C1308]

## "Variable guard interval orthogonal frequency division multiplexing in presence of carrier frequency offset"

The goal of this paper is to highlight the benefits of using variable guard interval (VGI) in orthogonal frequency division multiplexing (OFDM) based wireless local area network (WLAN) systems. An algorithm is derived and its performance merit for implementing VGI in the presence of carrier frequency offset is provided. OFDM system needs to maintain orthogonality among sub carriers, which may be lost due insufficient guard interval and carrier frequency offset (due to local oscillator mismatch and Doppler effects). Static guard interval is usually kept large enough to tolerate worst case channel delay spread conditions, which in turn causes loss in efficiency of the system. The use of variable guard interval is expected to improve the system throughput. Since insufficient guard interval and carrier offset together cause orthogonality loss among sub carriers, the dynamic selection of guard interval in the presence of carrier frequency offset is considered in this work. Results are presented to analyze achievable gains. It has been shown that significant improvement in throughput is achievable by this scheme [C1309]

## "Network signalling compression for bit loading"

Link adaptation technology has been introduced in new generation transmission systems such as 3-G or 4-G, optimizing both their throughput and their power consumption. The adaptation of radio configuration requires information about the radio link quality. The information must be exchanged between the access point and the mobile terminal, leading to an associated signaling load, whose amount may decrease the system transmission efficiency. A mechanism for reducing the amount of signaling information has to be designed for increasing the overall system capacity (more users, more available bandwidth). This paper addresses multi-carrier systems whose link adaptation is carried out by means of bit loading algorithms. However, the associated signaling load increases quickly with the number of sub-carriers, modulation schemes and users. These bit loading vectors are considered a-priori known at the receiver, and almost no literature concerning transmission of such information is available. In realistic transmission systems, correlation exists in time due to Doppler effect, and in frequency due to multi-path delay spread. We intend to exploit this two-fold redundancy to decrease the signaling information load related to the power vector data for bit loading. A compression system for both bit allocation and power allocation of the bit loading is proposed. The performance of such compression system is then evaluated. [C1310]

## "Adaptive resource allocation for multiuser MIMO/OFDM networks based on partial channel state information"

MIMO/OFDM has recently been the subject of much interest because of its potential for meeting the stringent requirements of the next-generation broadband wireless communication systems. In this paper, a multiuser resource allocation and management approach which combines adaptive sub-carrier allocation as well as a power and bit distribution based on partial channel state information is proposed to significantly improve the performance of a multiuser MIMO/OFDM system. It is shown that the proposed methodology, which relies on the combination of beamforming and orthogonal space-time block coding, guarantees all the users with a quality of service required for a minimum targeted BER. It can also optimize the power efficiency as well as the sub-carriers allocation in order to maximize the data rate while ensuring fairness among all the users. In particular, it is shown that by taken advantage of the channel side information obtained through both, mean and covariance feedback, the proposed methodology exhibits resistance to the Doppler effects due to correlated channel variations while achieving good system performance [C1311]

## "Optimal MMSE finite parameter model for doubly-selective channels"

Multipath propagation and mobility-induced Doppler effects contribute to the time- and frequency-selectivity (doubly-selectivity) in channels. To describe the doubly-selective channel, we propose a finite parameter model composed of kernels expressed as a function of the channel correlation based on Karhunen-Loeve (KL) expansion. The proposed model is optimal in the MMSE sense, provided that the instantaneous channel correlation is matched. It can also adapt to changes in the velocity of the terminal. Even when the channel correlation is unavailable and can only be assumed from Jakes' model, the channel estimation mean square

error (MSE) of our proposed model is shown to be comparable or outperforms the oversampled basis expansion model (OBEM), polynomial model (PM) and Slepian model as validated by Monte-Carlo simulations on Rayleigh fading channels. In the application in an OFDM system, the proposed model confers significant BER performance gain over OBEM and PM [C1312]

## "Optical Intersatellite System Based on DPSK Modulation"

The use of optical carrier for intersatellite link (ISLs) can lead the whole system at higher data rates performing low probability of jamming, lower interference, lower power requirements and smaller antenna size. The choice of 1550 nm wavelength technology gives rise to some problems, such as higher antenna size, but offers important benefits: less Doppler shift, less complexity in tracking and acquisition procedure. The main constraint affecting the system performance concerns on the Doppler effect suffered by the signal due to the relative movement between satellites. An analysis of the optical transmitter/receiver performance, operating at 1550 nm will be developed. The communication system is based on a DPSK modulator with direct detection receiver, in order to improve system sensitivity with respect to conventional intensity modulation-direct detection (IM-DD) systems [C1313]

## "Nanocell spectroscopy interpreted in the frame of the Bloch vector model"

The elementary Bloch vector model, that describes in a simple geometrical model the behaviour of a closed 2-level atom, reveals appropriate to understand the absorption behaviour, with its coherent Dicke narrowing occurring for a λ/2 thickness and with revival at (2n+1)λ/2, and the fluorescence behaviour, unsensitive to this periodical Dicke-type narrowing. This report discusses on how to understand the wash out of the sharpest features of the coherent Dicke narrowing, when relaxation or saturation are taken into account. [C1314]

## "Coherent light emission by self-induced spatial longitudinal patterns in a Rb85 molasses"

This experiment investigates coherent light emission by self-induced spatial longitudinal patterns in an optically cooled Rb85molasses. This work adapts the CARL model to include a ring cavity while taking into account the specific nature of the interaction with the Doppler beams (noise included). Taking advantage of the very different natural time scales present in the experiment, the dimensionality of the problem has been reduced. The resulting, strongly reduced model, consists of a Fokker-Planck equation for the probability distribution of atomic positions and momenta, coupled to two ordinary differential equations describing the evolution of the counter propagating fields in the resonator. [C1315]

## "Large frequency offset carrier synchronization in segmented matched filter DS/BPSK receiver"

This paper investigates the effects of significant frequency offset on the performance of a digital segmented matched filter (SMF) DS/BPSK receiver. A new carrier frequency discriminator for carrier acquisition in this structure of high dynamic DS/BPSK receiver is presented. The proposed algorithms employs segmented correlator and whole length correlator outputs to form a frequency discriminator (CFD) which has a tracking range of the symbol rate, and the tracking range is independent of the spreading code length. A frequency synchronization scheme is also explored, which extending the range of frequency acquisition and shorting the time of acquisition. At mean time the paper presents the best discriminator selection between CFD and four-quadrant frequency discriminator(FQFD) during the process of acquisition. [C1316]

## "Probing collision effects in the confined environment of a nanocell"

The collisional effects in nanocell spectroscopy are investigated. Experiments performed on the well-resolved Cs D1line (894 nm), have enabled a simultaneous comparison of λ/2 and λ/4 thickness for various densities. Because nanocell spectroscopy, when performed under normal incidence irradiation, allows a sub-Doppler resolution owing to the velocity-selection operated by the transient regime of optical interaction, the pressure behaviour of the various hyperfine components can be studied individually. Considerable differences are found to occur for the pressure-induced shift, as already observed through selective reflection (SR) spectroscopy on the Cs D2line. [C1317]

## "A snake-like swimming robot using IPMC actuator and verification of doping effect"

Ionic polymer metal composite (IPMC) is one of the most promising EAF actuators for applications, and slave good property of response and durability. The characteristics of IPMC materials depend on a type of counter ion. In applying to mechanical systems such as a robot, there exist possibilities to change the properties of the dynamics by changing the counter ions according to environment or purpose adequately. In this paper, we consider swimming of a snake-like robot with IPMC actuator, and demonstrate a smooth swimming motion.

Then, we also verify the doping effects by experiments. [C1318]

## "A new spreading code for multi-carrier spread spectrum systems"

{no data available} [C1319]

## "Influence of modulation frequency on the shape of nonlinear resonances in methane"

Investigations at the 6-5, 7-6 and 8-7 transition of resolved hyperfine structure of the F2(2)P(7)?3methane line with the use of a He-Ne laser with a telescopic intracavity light beam expander at a wavelength of 3.39 μm are performed. [C1320]

## "An investigation into channel prediction algorithms for a switched-beam smart antenna system"

In a switched-beam smart antenna system, predicting the message signal during the interval of signal fading or beam changing is required. In this paper, a channel prediction algorithm that is capable of estimating a future block of fading coefficients is studied. Jakes channel model is used to represent the wireless communication channel. It is shown that the algorithm is able to predict the fading coefficients quite well. The effects of observation interval length, number of scatterer signals in the channel model and the Doppler frequency on the estimation algorithm are investigated. [C1321]

## "Atom interferometric method for eliminating Doppler effects in precision measurements"

We present a method to reduce the residual Doppler effect by almost two orders of magnitude in our optical frequency standard. The approach combines atom interferometry and launching of microkelvin neutral atoms. [C1322]

## "Doppler RAKE detection in fast-fading environment"

The conventional RAKE detection of the code division multiple access (CDMA) system exploits multi-path diversity, but is only optimal in slow- fading scenarios. For fast-fading environments, where Doppler effect has a significantly detrimental impact on detection, the Doppler-RAKE receiver, which jointly exploits time and frequency diversity, is being researched as one possible solution. We further develop the system in several aspects to ameliorate its performance, while considering the trade-offs between its improved effects and the increased complexity of the algorithms. [C1323]

## "Compression of bit loading power vectors for adaptive multi-carrier systems"

Link adaptation technology has been introduced in new generation transmission systems such as 3-G or 4-G, optimizing both their throughput and their power consumption. The adaptation of radio configuration requires information about the radio link quality. The information must be exchanged between the access point and the mobile terminal, leading to an associated signaling load, whose amount may decrease the system transmission efficiency. A mechanism for reducing the amount of signaling information has to be designed for increasing the overall system capacity (more users, more available bandwidth). This paper addresses multi-carrier systems whose link adaptation is carried out by means of bit loading algorithms. However, the associated signaling load increases quickly with the number of sub-carriers, modulation schemes and users. These bit loading vectors are considered a-priori known at the receiver, and almost no literature concerning transmission of such information is available. In realistic transmission systems, correlation exists in time due to Doppler effect, and in frequency due to multi-path delay spread. We intend to exploit this twofold redundancy to decrease the signaling information load related to the power vector data for bit loading. A compression system for the power vector data of the bit loading is proposed. The performance of such compression system is then evaluated on real power vector data. [C1324]

## "Performance degradation of OFDM system over time-varying fading channel"

The paper considers the performance degradation of an orthogonal frequency division multiplexing (OFDM) system over frequency-selective time-varying fading channels. The time variations of the channel during one OFDM frame destroy the orthogonality of the different subcarriers and generate power leakage among the subcarriers, known as intercarrier interference (ICI). A novel and suitable channel model for OFDM is introduced and serves as the basis for the derivation of the ICI. The bivariate probability density function (PDF) of the ICI is shown to be a weighted Gaussian mixture. A two-dimensional Gram-Charlier representation for the bivariate probability density of the ICI is established; it is shown that its truncated version, of order 4,6, provides a very good approximation. Finally, the degradation in the performance of OFDM resulting from Doppler effects caused

by a time-varying, frequency selective Rayleigh fading channel is obtained by averaging the approximated ICI statistics over the fading channel statistics. [C1325]

## "Intercarrier interference cancellation scheme for OFDM communication systems"

The paper studies an efficient ICI cancellation method termed segment equalization scheme. According to the time-variant nature of the mobile channel, the received OFDM signal and channel impulse response (CIR) are divided into many segments before FFT, then all the segments are equalized in the frequency-domain, the results are summed to demodulate the OFDM signal. Simulations and performance analysis show that an OFDM system using the proposed segment equalization can effectively reduce the ICI caused by the frequency offset and large Doppler frequencies in mobile radio channels. [C1326]

## "Analysis of envelope detector loss using arbitrary order Gram-Charlier series"

The analysis of envelope detector performance is a fundamental and difficult problem in receiver design. In this paper, from the point of view of detector loss, the method of analyzing envelope detector performance with arbitrary order Gram-Charlier series is derived which is more accurate than the usual method-Barton empirical formula. Based on this, the effects on detector loss of three factors-video integration number, detection threshold and the input SNR of envelope detector-are analyzed and the accuracy of Barton empirical formula is also discussed. By choosing the proper order of Gram-Charlier series expansion and the validation of Monte Carlo simulation, the accuracy and fidelity of Gram-Charlier series expansion method is guaranteed. The methods can be used widely in receiver design. [C1327]

## "Kalman filtering for channel estimation in space-time coded systems"

The paper considers channel estimation, in the context of space-time coding. Kalman filtering (KF), in its prediction form, is employed to track the fading channel in a multiple-antenna system, using orthogonal space-time codes and three different decoders. The system's performance is evaluated through computer simulations. The effect of the Doppler rate on the channel estimation and decoding scheme is investigated. The results show that the performance degrades as the Doppler frequency increases. Furthermore, the effect of channel estimation on the decoders' performance is examined. It is shown that when channel estimation errors cannot be kept sufficiently small, then a simple symbol by symbol decoder provides the same performance as a joint decoder. [C1328]

## "Optimisation of the spatial attitude of the bistatic and multistatic synthetic aperture radar"

In this paper the advantages of the multiposition synthetic aperture radar (SAR) system are discussed. Usage of SAR requires careful positioning of receivers and transmitters. This positioning as well as the transmitted signal determines the quality of the estimation through the space ambiguity functions which strongly depend on relative positions of the transmitter and receiver. Bistatic and multistatic synthetic aperture radar system has advantages over the single position remote sensing system. Special regard must be paid to the fact that spatial resolution as well as intervals of the ambiguous measurements strongly depend on spatial attitude of the receiver and transmitter in the bistatic and multistatic SAR. Spatial attitude optimisation therefore must be made with the following scheme: analysis of the equal distance lines and its gradients. Then spatial attitude optimisation must also be made for analysis of the equal Doppler frequency lines. Each bistatic pair is modelled for the side looking and forward side looking SAR with the same space attitude and velocity. [C1329]

## "Simplified calculation of mobile location using scatter information"

Scatter information can be used to overcome the problem of mobile localization in non-line-of-sight conditions. Since many redundant parameters, such as scatterer locations and Doppler parameters are involved in the nonlinear localization equations, it is difficult to obtain the solution to mobile position. We reduce the numbers of measurements and redundant parameters in the nonlinear localization equations by taking advantage of an inherent symmetric Doppler property of a special set of measurements. Incorporating this property with time-delay and direction measurements corresponding to multipath signals with the same Doppler-shifted frequency, a novel closed-form solution to mobile location is proposed. Numerical results are provided to show that it is less insensitive to the scatter environment than ordinary localization methods. [C1330]

## "An adaptive clutter rejection filter in ultrasound color flow imaging systems"

In ultrasound color flow imaging systems, the imaging quality is highly influenced by the clutter originating from the vascular wall, stationary and slowly moving tissue. Moreover, in practice, relative motion between the probe held by doctor and the blood flow also induce the clutter along with blood flow. If there is not clutter rejection,

the estimation value of low velocity blood flow will be inaccurate, and the CFM imaging quality will be poor. In this paper a new adaptive filtering scheme is introduced. In this scheme statistical theory is used to calculate the mean frequency and variance of clutter signal. The mean frequency is used to mix down the Doppler signal, and the variance determines the filter's cut-off frequency. So it achieves the adaptability of the clutter rejection filter and improves the accuracy and flexibility of the ultrasound devices. [C1331]

## "Compensation of timing mismatches in time-interleaved analog-to-digital converters through transfer characteristics tuning"

We analyze transfer characteristic mismatches of sample-and-hold circuits in time-interleaved analog-to-digital converters and show their intrinsic connection to aperture delay mismatches. Both cause linear-phase mismatches, i.e., timing mismatches, which significantly degrade the signal-to-noise ratio. Based on our analysis, we introduce a novel power-saving method to correct timing mismatches among the channels by tuning the transfer characteristics of the sample-and-holds. Simulation results confirm the prospects of the presented method. [C1332]

## "Noise reduction for Doppler ultrasound signal based on cycle-spinning and thresholding methods"

The spectrogram of Doppler ultrasound signal has been widely used in the clinical diagnosis. The additional frequency component arising from noise will produce an adverse effect on the subjective analysis of the spectrogram and its quantitative analysis. The methods combining cycle-spinning with thresholding methods using orthogonal wavelet transform and cosine packet decomposition are proposed to remove noise from Doppler ultrasound signal. At first, a specified transform method is performed on the signal of interest. Then the soft or hard thresholding method is used to shrink the coefficients, from which the denoised signal is reconstructed. In the simulation study, the improvements of the mean frequency waveform and the SNR before and after denoising are studied. Simulation results have shown that the methods incorporating with cycle-spinning are superior to those traditional denoising methods. In view of computational complexity and performance improvements, the orthogonal wavelet transform combined with cycle-spinning is a practical approach for denoising Doppler ultrasound signal. [C1333]

## "Joint estimation of time delays, Doppler shifts and DOAs of multipath signals"

The paper presents a new approach for jointly estimating the time delays, DOAs, and Doppler shifts of multipath reflections of a signal. Based on the repetitive characteristic of the transmitted signal, a signal model is developed, which has the rotational invariance property. The PRO-ESPRIT algorithm is applied to the model. The respective Doppler shifts, time delays and DOAs can then be estimated from the rotational invariance factors and corresponding eigenvectors. The efficiency of the proposed approach is validated by computer simulations. [C1334]

## "Performance analysis of acceleration resolution for the LFMCW radar"

Aiming at the influence of high acceleration modulation of the linear FMCW (LFMCW) radar echo signal in the short range and high resolution applications on missiles, satellites, and planes, we derive the expression of acceleration resolution for the LFMCW signal. It is concluded that the acceleration resolution is inversely proportional to the square of the effective time width. We also analyze the influence on the Doppler resolution and time delay caused by the unknown acceleration. It is concluded that the increase of time width does not necessarily enhance the Doppler resolution, because of the existence of acceleration, delay resolution decreases with the increase of unknown acceleration. Computer simulations justified these conclusions. [C1335]

## "Geometric distortion correction in the subaperture processing for high squint airborne SAR imaging"

Basic subaperture processing for synthetic aperture radar (SAR) imaging consists of generating a set of low-resolution images and adding them coherently to form the final high resolution image. For an airborne high squint imaging mode SAR, the coherent addition processing suffers from the geometric distortion in the subaperture images caused by range-Doppler interaction and the irregularities in aircraft motion. This paper presents a method to compensate these effects based on the geographical coordinate transform, which is used as a middle processing prior to the coherent summation of the subaperture images. It mainly involves coordinates calculations between the focus target plane and the image display plane under the flat-Earth model, and then a 2D interpolation is carried out in the image domain. A quantitative evaluation using point-target simulations of the coherent subaperture imaging algorithm for a squint single of 60deg is also provided. Its performance successfully demonstrates the validity of the proposed method. The further advantage of implementing this

approach is that the crucial step of compensating the spatially-variant residual phase error can be done at the same time, and the resultant images with constant sample spacing are ready to be mosaiced to produce the full-strip image [C1336]

## "SAR automatic range-migration correction"

A new idea is presented to correct range migration in SAR imaging. In the range-Doppler domain, all the samples at a given Doppler frequency constitute a Doppler slice. Different Doppler slices are found to have similar envelopes. According to this similarity, the Doppler slices are shifted in range to correct range migration. This technique applies even without the prior information about the relative motion between the radar and the target [C1337]

## "Radar radial velocity variance measurements to decipher mountain-influenced Kelvin-Helmholtz waves, slope flows, and rotors"

The variance of the radial velocity in a cloud radar's signature is an underused parameter. The parameter represents a combination of the effects of convective turbulence and mechanical mixing from wind shear. It's usefulness in deciphering laminar, sheared, and turbulent mountain-influenced airflows within clouds is demonstrated in this paper [C1338]

## "C- and Ku-band ocean backscatter measurements under extreme wind conditions"

During the 2002 and 2003 ONR CBLAST Hurricane Program Field (HPF) and the NOAA/NESDIS Hurricane Ocean Winds and Rain Experiment, the University of Massachusetts (UMass) installed IWRAP, a conically scanning dual-band (C- and Ku-band), dual-polarized pencil-beam airborne Doppler radar that profiles the volume backscatter and Doppler velocity from rain and the backscatter from the ocean surface simultaneously at four incidence angles covering incidence angles from 25 to 55 degrees. From the measurements acquired during missions flown through hurricanes Gustav, Isadore, and Lili (2002) and Fabian and Isabel (2003), high wind regime Geophysical Model Functions have been derived at both frequencies and polarizations. Concrete saturation effects in the NRCS are presented, and sensitivity in the wind direction at high wind speed is discussed through the analysis of the second harmonic of the NRCS. [C1339]

## "Correlation time analysis of delay-Doppler waveforms generated from ocean-scattered GPS signals"

The ocean-scattered Global Positioning System (GPS) signal can be used, in a bistatic radar configuration, for estimating the ocean surface roughness. This requires fitting a scattering model to the distribution of reflected power in delay and Doppler. The delay-Doppler map, or waveform, is generated through the cross-correlation of a local copy of the pseudorandom noise (PRN) code assigned to each GPS satellite with the reflected signal over increments in Doppler frequency equal to the pre-detection bandwidth. The correlation time of the reflected signal voltage sets an upper limit on the pre-detection integration time. Correlation time was estimated from experimental data through fitting a model Gaussian function to the magnitude of the complex autocorrelation of the time series of the waveform. Range bins were taken 1.1 chips prior to the averaged waveform peak in the leading edge and 2.5 chips after the averaged waveform peak in the trailing edge. Doppler bins were set at -500, 0, and +500 Hz relative to the Doppler frequency of the corresponding direct GPS signal. The direct GPS signal was tracked using a frequency locked loop (FLL). Results showed that maximum correlation time occurs approximately 0.72 code chips prior to the averaged waveform peak. The correlation time was found to vary with the elevation angle of the satellite, with lower elevation satellites showing longer correlation time. Some experimental results were compared with model predictions. A good comparison was usually found for delay bins near the specular point and both the model and experiment showed a decrease in the correlation time for longer delays. In the higher range bins the model tended to predict longer correlation times than those observed in the experimental data [C1340]

## "Laboratory measurements of wave-turbulence interaction for scatterometry application"

Measurements of the space-time structure of short gravity-capillary waves in the presence of turbulence in a laboratory wave channel are presented. This study was stimulated by the need to investigate the influence of turbulence on the scattering surface, which contributes to a microwave scattering at grazing and moderate incidence. Mechanically generated periodic (4 to 10 Hz) waves and multijet manifold were used as sources of surface waves and subsurface turbulence. A laser slope gauge (LSG) and an imaging slope gauge (ISG) were used to measure short waves of length 2-10 cm and frequencies up to 150 Hz. A dual polarized (VV, HH) coherent CW X-band scatterometer was used to obtain Doppler spectra of the scattered signals for grazing

angles from 30 to 60 degrees. Simultaneous time series of wave slopes and microwave scattering and their frequency spectra permitted a comparison of these parameters both with and without turbulence. Both scattering and decaying of the surface waves by turbulence were observed. A presence of turbulence had a pronounced distortion effect on the short waves due to scattering by submerged turbulence. Interaction with turbulence caused decrease of the energy of short waves and broadened the directional spectra of their propagation. Measurements of the Doppler frequency shift and amplitude of the scattered microwave signal are consistent with this changing in the wave field and reveal Bragg scattering by the short waves [C1341]

## "Equalization and channel estimation for OFDM systems in time-varying multipath channels"

In this paper, we consider orthogonal frequency division multiplexing (OFDM) systems with severe Doppler effect. In the frequency domain, this effect destroys the orthogonality between subcarriers and introduces interchannel interference (ICI). In the time domain, fast time-varying channels make channel estimation difficult and degrade the estimation accuracy. Thus ICI-mitigating and improved estimation techniques are desired. We proposed a new equalization technique to suppress ICI in linear minimum mean square error (LMMSE) sense and complexity can be greatly reduced. A novel channel estimation technique with low complexity and free of training symbol design is also proposed to estimate time-varying channels. Numerical results show that our proposal has significant performance improvement over traditional estimation and equalization techniques. [C1342]

## "Reduction of Doppler-induced ICI by interference prediction"

Although wireless OFDM systems are robust against frequency-selective fading and ISI effects, their relatively long symbol lengths are vulnerable to time-selective fading and ICI (intercarrier interference) effects in mobile environments due to Doppler spread. However, commonly, a time-selective fading channel is linearly time-varying from symbol to symbol for existing wireless communication systems and vehicle speed limits. The linear property greatly reduces channel parameters. Based on this condition, we propose an ICI-reduction method. The ICI-reduction method first solves the linear channel parameters of each path, and then combines with a decision-feedback method to predict the ICI values from the estimated channel information, followed by the subtraction of the ICI components. Further, the proposed algorithm adopts an iterative ICI refinement technique to enhance the ICI prediction accuracy. The simulation results show that the new method can effectively reduce the ICI and error floor of the symbol error rate. The proposed algorithm is further simplified. The simplified version still maintains almost the same performance as before, with a much reduced complexity. [C1343]

## "Robust multi-carrier modulation in the presence of frequency offsets"

Applications of orthogonal frequency division multiplexing (OFDM) techniques to wireless communications are highly sensitive to time and frequency offsets between the transmitter and the receiver. These can be the effects of Doppler shifts due to relative motion and/or synchronisation errors. We propose an algorithm based on the Bartlett window, which greatly improves the robustness of this class of algorithms and the overall performance in uncertain channels. A simulated example of a mobile wireless communication system with relatively long channel response shows the effectiveness of this approach. [C1344]

## "InSAR coherence estimation"

For interferometric SAR processing (InSAR), the quality of the interferogram is affected by many factors such as Doppler centroid difference, baseline, atmospheric effect. It can be measured by the estimation of the coherence of the data. It has been shown that the coherence image can be used to do the classification in the area such as water, soil, plants, city or something else. But the coherence estimation is always biased somehow. To find an asymptotically unbiased coherence estimation method is therefore challenging and important for InSAR processing. In this paper, several different coherence estimators are introduced. An accurate coherence computation method using an existing DEM is proposed and illustrated [C1345]

## "Range and velocity ambiguity mitigation techniques for the WSR-88D weather radar"

Several mechanisms are currently provided to alleviate effects of range overlaid echoes and velocity aliasing in the Weather Surveillance Radar-1988 Doppler (WSR-88D). However, due to limitations in these techniques, observation of severe weather phenomena is significantly impaired. This paper presents results from a multi-year study at the National Severe Storms Laboratory dealing with methods to mitigate the effects of range and velocity ambiguities in the WSR-88D [C1346]

## "Towards homogeneously broadened spectroscopy of bogoliubov excitations in bose condensates"

This study proposes and demonstrates experimentally a momentum space echo method using two and four-photon Bragg pulses, in order to overcome Doppler broadening and inhomogeneous density effects. This method involves of an excitation scheme which results to populations in momentum space. This scheme is demonstrated experimentally by using a four-photon echo pulse to reflect the initially populated excitations. The spectroscopic response of the echo pulse is narrower than that of a regular Bragg pulse. This study also determines the high resolution Bragg spectrum of a BEC in a harmonic trap. Results show that the Bragg spectrum contains radial modes due to the inhomogeneity and finite size of the BEC in the radial dimension. Here, steeper external trapping potentials in the radial dimension is considered, and a suppression of the number of excited radial modes is calculated, as compared to harmonic trapping, using the quasi-particle projection method. In the limit of a box potential, a single excited mode is found. For linear excitations beyond the phonon regime, an effective potential representation of the problem is presented, which limits the number of excited modes by calculating the number of trapped states of this potential. By making the trap steeper, modes are driven out of the trapped state region, and eventually are left with only one mode which is excited significantly [C1347]

## "Capacity studies of MIMO channel models based on the geometrical one-ring scattering model"

Simulation results for the capacity of multiple-input multiple-output (MIMO) mobile radio channels are presented in this paper. Our MIMO channel simulation model is based on the so-called one-ring scattering model with two antennas at both the base station (BS) and the mobile station (MS) side. For the capacity study, we have investigated the influence of various model parameters, such as the angle spread at the MS, the mean angle of arrival (AOA), and the orientation of the antenna elements. The Doppler effect is also taken into account. Nonisotropic scattering around the MS is modelled by the von Mises distribution. The presented simulation results show an excellent correspondence between the statistical and the time average of the capacity. Furthermore, it turned out that a large distance between the antenna elements is not a guarantee for high capacity. Simulation results are also provided for the level crossing rate (LCR) and the average duration of fades (ADF) of the MIMO channel capacity. [C1348]

## "Direct observation of the double structure in a parametrically-driven MOT"

The double structure potential predicted in the atomic cloud of a magneto-optical trap by one (Doppler part) and two photon process (sub-Doppler part) are experimentally observed and studied through the modulation of cooling laser intensities [C1349]

## "A novel low complexity channel estimator with frequency offset resistance for CDMA [C3G wireless applications]"

A new channel estimator that does not require a separate frequency offset estimator is proposed. The new algorithm has low complexity and low latency compared to the weighted multi-slot averaging algorithm. The simulation results demonstrate the improved resistance to high Doppler frequency and high frequency offset. [C1350]

## "A system for PF flow rate monitoring"

This work presents measuring methods for coal dust monitoring and the new APF system from KWANT company which allows for on-line monitoring. Out of the methods based on processes accompanying propagation of electromagnetic waves, for measuring the coal dust concentration, particular care is to be taken to those based on the following: Doppler effect measurement and measurement of the wave's limit frequency. The APF system monitors the pulverized flow (PF) velocity, PF concentration, and the flow rate of PF. [C1351]

## "Joint timing and pilot symbol channel estimation for diversity receivers in Rayleigh fading channels"

An effective method for joint timing and channel estimation for receive diversity systems in a frequency-flat Rayleigh fading environment is presented. We implement nonsynchronous timing recovery using Gardner's timing error detector, whose insensitivity to phase errors allows for timing recovery prior to pilot symbol based channel estimation. By employing a polyphase filter bank in the timing loop, we are able to simultaneously carry out matched filtering and data interpolation, thus eliminating the need for a separate interpolation filter. In addition, selection diversity combining is used to select the input to the timing loop, thus improving the reliability of the signal used for timing recovery. Pilot assisted channel estimation is performed on the recovered data strobes. For normalized Doppler frequency of 0.01 the system's bit error rate (BER) performance is within 1 dB from the ideal timing and channel estimation error bound, with an additional drop of 1.5 dB for a nonoptimum channel interpolator. In deep fades, the receiver timing is held fixed. We show that the receiver maintains timing lock

over such fades up to a normalized timing bandwidth of 1Ч10-4for normalized Doppler frequency up to 0.05. [C1352]

## "Estimation of snowfall over the sea of Japan using AMSR-E passive microwave remote sensing observation"

Snowfall is an important geophysical parameter and the observation of the spatial and temporal distribution of snowfall can provide valuable information for a wide range of applications including climate change studies and atmospheric modelling. This paper investigates the feasibility to estimates the amount of solid precipitation and the cloud liquid water content over the ocean using AMSR-E passive microwave brightness temperature observations. The parameters are retrieved by minimizing the difference between the observed and modeled brightness temperature. The radiative transfer in the atmosphere is solved using the discrete ordinate method (4 streams) and the Henyey-Greenstein phase function. The scattering effect of the snow particles is calculated using Mie theory and the liquid-equivalent size of the ice particle. Except for the snowfall and the cloud liquid water content, most parameters, which influence the observation are derived from other data sources. The Newton-Raphson method is used to solve the iteration process using observed brightness temperatures at 89 GHz vertical polarization and 36.5 GHz horizontal polarization. The algorithm was applied using data from the Wakasa Bay Experiment 2003 in Japan and the results are compared to snowfall observation derived using a Z-R relationship and data from the Mikuni Doppler radar. Good agreement was achieved for different atmospheric conditions [C1353]

## "Ku-band backscatter from the Cowlitz River: Bragg scattering with and without rain"

Ku-band backscatter from the Cowlitz River in southwestern Washington State was measured for incidence angles from 0° to 80°. The measurements were made for light-wind conditions with and without rain. In rain-free conditions, Bragg scattering was the dominant scattering mechanism for both HH and VV polarizations out to 75°, beyond which the signal-noise-ratio dropped very low at HH. When a light rain was falling on the river, the cross section increased substantially at moderate incidence angles. Doppler spectra taken during rain showed that VV polarized backscatter is primarily from Bragg scattering from ring waves while HH polarization scatters from both ring waves and stationary splash products, depending on the incidence angle. Finally, the effect of hail on the magnitude and spectral properties of backscatter was observed. [C1354]

## "Impact of ocean currents on scatterometer winds in the tropical Pacific Ocean"

The SeaWinds scatterometer on QuikSCAT has been measuring wind vectors globally since mid-July, 1999. The scatterometer signal is generated by backscatter from centimeter-scale wind-generated waves. When the wind blows against (with) the surface currents, the scatterometer will measure higher (lower) winds than the absolute wind measured by an anemometer at a buoy. We estimate time-varying surface currents by differencing the scatterometer and buoy winds from the Tropical Atmosphere-Ocean array. We compare the wind differences with climatological and actual currents derived from drifters at 15-m depth, acoustic Doppler current profiles (ADCP) at 25-m depth and the TOPEX/Poseidon altimeter. We find the zonal wind differences in good agreement with the zonal currents, particularly with the geostrophic zonal currents from the altimeter. Climatological current estimators that include an annual and semiannual component as well as a linear dependence on the Southern Oscillation Index (SOI) show good skill in predicting the zonal wind differences. The meridional wind differences have magnitudes as large as the zonal differences; however, the meridional wind differences are not well predicted by the estimators. Previous studies of the meridional currents also show less predictability in the meridional component than in the zonal component. The relative motion winds from the scatterometer are precisely what are needed in bulk algorithms for air-sea fluxes. Therefore, ignoring the effect of ocean currents will contribute to errors in the flux fields. Comparisons of flux fields derived using QuikSCAT winds with those derived using NCEP Reanalysis winds show that, while the current effect can be quite large, other NCEP model errors exceed those from currents [C1355]

## "QRM-MLD combined with MMSE-based multipath interference canceller for MIMO multiplexing in broadband DS-CDMA"

This paper proposes maximum likelihood detection with QR decomposition and the M-algorithm (QRM-MLD) sophisticatedly combined with the multipath interference canceller (MPIC) based on multipath interference (MPI) replica generation exploiting two-dimensional minimum mean squared error (MMSE) for multiple-input multiple-output (MIMO) multiplexing in broadband DS-CDMA. Simulation results clarify that the proposed QRM-MLD coupled with MPIC exhibits excellent signal separation capability by sufficient MPI suppression effect through a three-stage MPIC comprising two-dimensional MMSE, followed by QRM-MLD associated with soft-decision Turbo decoding. We also show that the throughput values of 200,250, and 300 Mbps (corresponding frequency

efficiency values are 5.0, 6.0, and 7.5 bits/sec/Hz, respectively) are achieved at the average received signal energy per bit-to-noise power spectrum density ratio (Eb/ N0) of approximately 6.0,9.5, and 13.0 dB by QPSK with the coding rate of R = 8/9, 8PSK with R = 3/4, and 8PSK with R = 8/9, respectively in 4-by-4 MIMO multiplexing, for broadband DS-CDMA assuming a 40-MHz bandwidth in a six-path Rayleigh fading channel with the maximum Doppler frequency of 20 Hz. [C1356]

## "Performance investigation of space-division OFDM over vector broadcast frequency selective fading channels"

Motivated by the high capacity of multiple-input multiple-output (MIMO) broadcast channels, this paper investigates the use of only linear signal processing (and hence conventional codec) at the transmitter and receivers to realize the rich diversity (or capacity) of the channel. In particular, we combine a recently developed orthogonal space division multiplexing (OSDM) scheme and orthogonal frequency division multiplexing (OFDM) to decompose per-subcarrier channel into many uncoupled single-user spatial modes. Issue like channel mismatches arising from pilot-aided channel estimation and Doppler spread is examined, and a method exploiting the frequency correlation of the channel to reduce processing complexity is proposed. Simulation results show that for HiperLAN II, the scheme can achieve good performance with four simultaneous downlink users at Doppler spread of 40 Hz (or speed of 8.5 km/h at 5 GHz). [C1357]

## "Simultaneous maximum likelihood estimation of time delay and time scaling"

First Page of the Article [C1358]

## "Per-tone equalization for OFDM over doubly-selective channels"

We propose a per-tone frequency-domain equalization approach for OFDM over doubly-selective channels. We consider the most general case, where the doubly-selective channel delay spread is larger than the cyclic prefix (CP), which results into inter-block interference (IBI). IBI in conjunction with the Doppler effect destroys the orthogonality between subcarriers and hence, results into severe intercarrier interference (ICI). In this paper, we propose a novel per-tone frequency-domain equalizer (PTFEQ) that is obtained through transferring a time-varying time-domain equalizer (TV-TEQ) to the frequency-domain. The purpose of the TV-TEQ is to restore orthogonality between subcarriers and eliminate ICI. We use the mean-square error criterion to design the PTFEQ. An efficient implementation of the proposed PTFEQ is also discussed. Finally, we show some simulation results of the proposed equalization technique. [C1359]

## "Optimal length of the training and data phase in continuous flat fading MIMO channels"

In this paper, we investigate the optimal length of the training and data phase for continuously time-varying channels that maximize the achievable information rate. It is shown that both lengths depend not only on the Doppler spread of the channel but also on the noise power and the number of transmit antennas whereas the number of receive antennas and the channel condition have only a small influence. It turns out that the optimal coherence interval depends strongly on the SNR, whereas the optimal ratio between training and data phase is nearly independent on the SNR. [C1360]

## "Frequency offset estimation by differentially coherent frequency error characterization for OFDM wireless communications"

A novel frequency offset estimation technique for OFDM wireless communications is proposed in this paper. By taking advantage of subcarrier-level differentially coherent detection, the proposed estimator based on frequency error characteristics can effectively overcome frequency-selective fading effects. Frequency error characterization is achieved by means of pseudo-noise (PN) matched filters (MF) on the subcarrier basis; thus, it inherently needs no assistance in the form of accurate timing information. In addition, the proposed technique can combat the rapid time-selectivity caused by a high Doppler spread because it requires channel stationarity within only short time duration due to the exploitation of a single training symbol. Furthermore, a linearized estimator is also proposed to reduce the computational complexity, resulting in some insignificant performance degradation. Extensive computer simulations have verified the superiority of the proposed technique. [C1361]

## "Timing synchronization in high mobility OFDM systems"

OFDM systems are sensitive to timing synchronization errors. Utilizing pilot-aided channel estimators in OFDM systems can further increase this sensitivity. This is shown in Y. Mostofi et al. (Oct. 2002) where authors have analyzed the-effect of such errors on a pilot-aided channel estimator in a fixed wireless environment. They proposed an algorithm that exploits this sensitivity to improve timing synchronization without additional training

overhead. The effect of these errors and design of suitable synchronization algorithms for high mobility applications, however, have not been studied before. In this paper we extend the analysis in Y. Mostofi et al. (Oct. 2002) to high mobility environments. Timing synchronization becomes more challenging for mobile applications since power-delay profile of the channel may change-rapidly due to the sporadic birth and death of the channel paths. We find analytical expressions for channel estimation error in the presence of timing synchronization errors and mobility. We show that the sensitivity of the channel estimator can still be exploited to improve timing synchronization in high mobility environments. Then we extend the algorithm proposed in Y. Mostofi et al. (Oct. 2002) to high mobility applications. Finally simulation results show the performance of the algorithm in high delay and Doppler spread environments. [C1362]

## "A novel iterative approach for Doppler spread estimation in LOS environment"

In this paper, a novel iterative algorithm for maximum Doppler frequency estimation is proposed. In line-of-sight (LOS) environments, it is known that the performance of the conventional maximum Doppler frequency estimator obtained by the Rayleigh fading assumption will degrade severely. Thus we propose an estimator that estimates the Rician K factor first, then iteratively estimate the Doppler spread and the angle of arrival (AOA) of the LOS component through the autocorrelation function. In addition, the Cramer-Rao bounds (CRB) for the K factor and maximum Doppler frequency estimations are also derived for comparison. Simulation results indicate that the proposed estimator is not only superior to the conventional estimator but also robust to the channel parameters variation. [C1363]

## "New algorithms for widefield SAR image formation"

The widefield polar format algorithm, the Stolt polar algorithm, and the differential Doppler algorithm use variations of a new along-track alignment and formatting system (ATAFS) to generate fine-resolution images from synthetic aperture radar (SAR) data. ATAFS introduces a spatially variant modification of the SAR phase history storage format to remove the formatting inaccuracies of the conventional polar format algorithm and enables full image quality over large scenes without range curvature distortion or image defocus. These new algorithms are well-suited for processing fine resolution spotlight and ultra-wideband SAR data. Their image quality performance is comparable to that of the range migration algorithm (RMA). Unlike RMA, the new algorithms operate on data stabilized to a fixed reference point to remove the azimuth chirp (the Doppler bandwidth of the reference point) before it compromises processor efficiency. [C1364]

## "Enhancement of backprojection SAR imagery using digital spotlighting preprocessing"

This paper examines signal processing methods for improving the fidelity of backprojection SAR imagery using a preprocessing method that suppresses Doppler aliasing as well as other side lobe artifacts that are introduced by the radar radiation pattern. The algorithm, known as digital spotlighting, imposes a filtering scheme on the azimuth-compressed SAR data, and manipulates the resultant spectral data to achieve a higher PRF to suppress the Doppler aliasing. The merits of the algorithm are studied using the ARL boom-SAR data. [C1365]

## "Effect of fast fading on hybrid detection in VSF-OFCDM systems"

This paper presents an analytical study on the variable spreading factor (VSF) orthogonal frequency and code division multiplexing (OFCDM) system over a fast fading channel. Hybrid multicode interference (MCI) cancellation and minimum mean square error (MMSE) detection is proposed in the system as an efficient way to eliminate MCI. It is shown that the optimum power ratio of pilot channel to one data channel is about 0.25 K, where K is the total number of data channels. When the Doppler frequency fDis less than 200 Hz, the effect of the Doppler on the system performance is negligible. However, increasing fDfrom 200 Hz degrades the system performance rapidly. Although the gap in BER between the hybrid and pure MMSE detection decreases as fDincreases, the gap is still large as long as fDis less than around 800 Hz. For a wide range of Doppler shift, a larger frequency domain spreading factor (NF) is expected, whereas a smaller time domain spreading factor (NT) provides better performance when fDincreases. [C1366]

## "The Earth rotation effect on a LEO L-band GMTI SBR and mitigation strategies"

Space based radars (SBR) have been used to accomplish a number of civilian and military missions. Most recently, SBR concepts have been considered to perform ground moving target indication (GMTI) radar modes. Unlike airborne surveillance platforms, SBR clutter returns are affected by the high satellite velocity and Earth rotation. The phenomenology of the Earth's rotation, and its impact on clutter Doppler returns, are discussed for a Low Earth Orbit (LEO) L-band radar concept. The USA Air Force's Research Laboratory Space Time Adaptive Processing Tool (RLSTAP) high fidelity radar modeling tool is used to provide simulated data in order to demonstrate the Earth rotation effects, and resulting clutter rejection impact on slow moving target detection.

[C1367]

## "Effect of Doppler frequency on pilot arrangements in wireless OFDM systems"

This paper describes in detail the effect of Doppler frequency on different pilot arrangements in wireless OFDM systems, under Rayleigh faded channel conditions. This paper also addresses the issue, of how to arrange the location of pilot tones, and a new pilot insertion scheme is proposed and compared. It is shown, that for lower Doppler frequencies the proposed scheme performs better than other existing pilot schemes. It is shown via simulations that over Rayleigh multipath faded channels it is more efficient to use fewer pilot tones in all symbols, instead of using all tones as pilot tones in some symbols. Another important observation from the simulation results is, that comb-type pilot estimation is less effected by Doppler frequency. The reason is the existence of inter carrier interference (ICI) caused by Doppisler shifts. [C1368]

## "Unaided acquisition of weak GPS signals using circular correlation or double-block zero padding"

Acquisition of very weak GPS signals requires long coherent and incoherent integration. Increasing the coherent, or predetection, integration time (PIT) improves sensitivity, but is limited because of the unknown data and bit edges. Incoherent integration is less sensitive, because of squaring loss. Two algorithms are developed to use a PIT which is a multiple of one data bit interval, without requiring assisting information. Both algorithms estimate the most likely data bit combination and use this to subsequently reverse the data signs over each PIT and synchronize the start of each PIT. The algorithms differ in the method of coherent integration. One uses circular correlation (FFT/IFFT), the other uses double block zero padding (DBZP). Circular correlation requires larger numbers of Doppler bins as the PIT is increased. In contrast, DBZP does not use Doppler bins, but suffers from loss because it does not account for the Doppler effect on the code duration. Consequently, the varying delay between the received signal and the replica will cause subsequent incoherent integrations to be added at the wrong delay. Solutions have been developed for each of these problems. In the case of circular correlation, a small PIT is used initially and after few steps the Doppler bins which have the lowest likelihood are eliminated. Thus, the PIT can be increased without increasing the total number of Doppler bins. In the case of DBZP, an approach is developed to compensate for the change in the code duration and relative delay, with only a small increase in the processing requirement. Simulations indicate that both of these algorithms can acquire signals below 15 dB-Hz. The problem of acquiring weak signals in presence of strong interfering signals is also addressed. [C1369]

## "Multipath effects on beacon performances"

Multipath effects may create serious problems in mobile communication channels, which are caused by scattering from environments. Obvious syndromes include additional time delay, frequency shift, and fading effects. In this work, we study the multipath effects and propose a solution for alleviation. [C1370]

## "Detailed OFDM modeling in network simulation of mobile ad hoc networks"

In mobile ad hoc network (MANET) studies, it is imperative to use highly detailed device models as they provide high layer protocols with good prediction of underlying wireless communication performance. However, such studies often utilize abstract models for execution speed and simplicity. This paper first shows that physical layer variables including path loss, shadowing, multipath, Doppler have significant effects on the predicted overall networking performance. It then proposes an approach to simulate details of wireless propagation and radio characteristics in networking studies while still maintaining a reasonable simulation execution time. Through our runtime performance studies with detailed OFDM Simulink/MATLAB models and QualNet network simulator, it is shown that the proposed approach can improve the simulation runtime performance by three to four orders of magnitudes without compromising the fidelity of simulation results. [C1371]

## "Two-dimensional signaling in Ricean fading with imperfect channel estimation"

The analytical framework reported in X. Dong et al. (May 2003) for calculating the symbol error rate (SER) of two-dimensional (2-D) signaling in Rayleigh fading with channel estimation errors is further developed to address the more general case of frequency-flat Ricean fading. We show that in the presence of channel estimation errors, the SER of arbitrary 2-D signaling with polygonal decision regions in Ricean fading can be expressed as a two-fold proper integral with finite integration limits, which is suitable for numerical evaluation. Moreover, this new analysis is general in the sense that it is applicable to any channel estimation scheme where the estimated and the actual channel gains are jointly complex-Gaussian. The effect of static channel estimation errors and dynamic channel estimation errors introduced by pilot symbol assisted modulation (PSAM) and minimum mean square error (MMSE) channel estimations are studied using the newly derived SER formula. The effect of Doppler frequency shift in the line-of-sight (LOS) component of the channel on the error performance is

investigated in our analysis. The analytical and numerical results presented in this work provide a useful tool on choosing suitable signaling formats and optimizing parameters in the communication system design. [C1372]

## "Performance analysis of rate adaptation in WCDMA communication systems"

The variability of the wireless channel requires adaptive techniques for efficient, radio resource service The throughput gains for ideal rate adaptation over nonadaptation in a wideband CDMA communication system is analyzed. The result is obtained by using the derived probability density functions of service ratio. We further investigate how performance degrades with adaptation restrictions, which include adaptation interval, Doppler effect, delays associated with channel state information feedback, and finite number of spreading factors. Our results show that rate adaptation with restrictions does not always bring gains over nonadaptation. [C1373]

## "Information rates of time varying Rayleigh fading channels"

In this paper, information rates of mobile radio channels without channel state information (CSI) at either the transmitter or the receiver are investigated. The channel is modeled as a time varying Rayleigh fading process whose dynamics are characterized by a Doppler spectrum with specified normalized fading rate. Results are presented in terms of the block length, the normalized fading rate, and the signal-to-noise ratio (SNR), for the Clarke's Doppler spectrum and uniform spectrum. [C1374]

## "Threshold of LDPC coded BICM for Rayleigh fading: density evolution and EXIT chart"

In this paper we focus on the threshold computation and convergence analysis of regular LDPC coded BICM for Rayleigh fading channels. We compute the decoding threshold using discretized density evolution with and without channel state information. The convergence properties of DE are analyzed using extrinsic information transfer (EXIT) chart. The key parameter, the power correlation coefficient is identified and threshold degradation is quantified when perfect CSI is not available at the receiver. The optimal energy allocation between pilots and coded symbols is found to be sensitive to the normalized Doppler spread of the channel, the interpolation filter, modulation schemes and the pilot selection. [C1375]

## "On the robustness of space-time coding for spatially and temporally correlated wireless channels"

The robustness of space-time coding techniques for wireless channels that exhibit both temporal and spatial correlation is investigated. A general space-time covariance model is developed and employed to evaluate the exact pairwise error probability for several space-time codes. A significant degradation in the performance of space-time coding techniques is observed for cases where the scatterers are located in close proximity to the mobile and the spacing between transmit antennas is a fraction of a wavelength. The conditions for which the commonly used assumption of independent transmission paths is valid are investigated as a function of the scattering radius and the spacing of the transmit and receive antennas. [C1376]

## "Doppler frequency extraction of foliage penetration radar based on the Hilbert-Huang transform technology"

The paper deals with Doppler frequency extraction in foliage penetrating radar (FPR). The strong echoes from dense foliage and the high attenuation of the radar microwaves often make it difficult for traditional time-frequency distributions to represent the Doppler frequency clearly and locally. A Hilbert-Huang transform (HHT) technology is proposed to extract the desired signal from interference and to give a new Doppler frequency Hilbert spectrum. Higher signal-to-clutter ratio (SCR) and higher resolution in the time-frequency distribution are obtained. [C1377]

## "Optimal training for MIMO fading channels with time- and frequency-selectivity"

Demand for high data rate leads to frequency-selective propagation effects, whereas carrier frequency-offsets and Doppler effects induced by mobility introduce time-selectivity in wireless links. These fading channels, once acquired, offer joint multipath-Doppler diversity gains. In addition, space-time multiplexing and/or coding offer attractive means of combating fading, and boosting capacity of multi-antenna communications. As the number of antennas increases, channel estimation becomes challenging because the number of unknowns increases, and the power is split at the transmitter. Optimal training sequences have so far been designed for flat-fading and frequency-selective multi-antenna systems. In this paper, we design a low complexity optimal training scheme for block transmissions over time-and frequency (a.k.a. doubly)- selective channels with multiple antennas. The optimality in designing our training schemes consists of maximizing a lower bound on the ergodic (average) capacity that is shown to be equivalent to minimizing the mean-square error of the linear channel estimator. Simulation results confirm our theoretical analysis which applies to both single- and multi-carrier transmissions.

[C1378]

## "Radar irregular sampling"

Irregular pulse repetition time (PRT) implies irregularly sampled signals in pulse radar. Irregular PRT is intentional because it improves the radar anti-jamming performance. This radar specific case involves not only standard analysis from irregular samples but also demands additional research. The frequencies above the sampling frequency should be sought, and unwanted signals (so-called clutter) should be suppressed. The state of the art, especially the applicability of the discrete Fourier transform (DFT) and frame decomposition, is investigated. Solving for the desired frequencies and filtering the clutter are treated as the most serious of all radar specific problems. [C1379]

## "Channel modeling for spread spectrum via evolutionary transform"

Given the importance of direct sequence spread spectrum (DSSS) communications, the modeling of its transmission channel is of great interest. Due to multipath and Doppler effects in the transmission channel, the transmitted signal is spread in both time and frequency. Transmission channels that spread the message in time and frequency are modeled as random, time-varying systems. It is shown that the estimation of the parameters of such models is possible by means of the spreading function which is related to the time-varying frequency response of the system and the associated evolutionary kernel of the DSSS signal. Applying the time-frequency or frequency-frequency discrete evolutionary transforms, we show how to compute the spreading function from the received DSSS signal. The procedure is efficiently implemented with the discrete evolutionary transform. Once the number of paths, delays, Doppler frequencies and gains characterizing the channel are found, we use this information to obtain an estimate of the pseudo-noise and a decision parameter to determine the bit sent. Our procedure is illustrated with simulations of the process, and the corresponding bit-error rate. [C1380]

## "Time-domain channel shortening and equalization of OFDM over doubly-selective channels"

We discuss time-domain equalization of OFDM over doubly-selective channels. We consider the most general case, where the channel delay spread is larger than the cyclic prefix (CP), which results in inter-block interference (IBI). IBI, in conjunction with the Doppler effect, destroys the orthogonality between subcarriers and, hence, results in intercarrier interference (ICI). The time-domain equalizer (TEQ) is assumed to be a time-varying finite impulse response (TV FIR). The purpose of the TEQ is to convert the doubly-selective channel into a purely frequency-selective channel whose delay spread fits within the CP. In other words, the purpose of the TEQ is to restore orthogonality between subcarriers in the OFDM system. [C1381]

## "A novel spread clutter suppression algorithm based on multiple-dimension matched field processing technique [Cover-the-horizon radar]"

High-frequency skywave over-the-horizon radar (OTHR) can provide a wide coverage over the horizon by means of the refraction within the ionosphere. However due to the complex propagation conditions of electromagnetic waves in the HF band, many disadvantageous effects, such as phase path contamination and multimode propagation, cause the target to be submerged by the neighboring spread clutter. In this paper, the spread effect of identical clutter, backscattered from the adjacent dwell illumination region (DIR), has been discussed. On the basis of the existing matched field processing (MFP) method developed for this problem, the multiple-dimension cross-relation method, using the multiple channel signals, has been proposed and used for the temporal data directly. Experimental simulations are given to demonstrate that the improved method is effective in suppressing the spread clutter. [C1382]

## "High-resolution spectroscopic X-ray diagnostics for studying the ion-kinetic energies at the stagnation of a Z-pinch plasma"

Summary form only given. Spectroscopic systems with toroidally bent crystals, giving resolving power of 7000 and time-gated (1 ns) spatially-imaged spectra with 0.1 mm resolution, are used to obtain the kinetic energies of [H] ions as a function of time throughout the stagnation phase in a neon-puff, 350 kA Z-pinch experiment. The spectrographs were so designed to allow for Rocking-Curve-limited spectral resolutions, verified by double-grating measurements. Optically thin lines (mainly satellites) are utilized in order to obtain the Doppler contribution to the line profiles. The data show that the mean ion kinetic energies drop drown to the electron thermal energy at the end of the radiation phase of the plasma. The data also yield the electron density from the satellite-intensity ratios, and the total ion densities from line-shape measurements and analysis of the opacity effects. This allows for the investigation of the ion-energy conversion at stagnation and comparisons to the radiated energy, using collisional-radiative and radiation-transport calculations. The variations observed in the

plasma structure and in the ion velocities along the pinch column allows for studying the relation between the ion-kinetic-energy history and the ionization processes in the plasma. In addition, the shapes of the resonance and intercombination lines of He-like ions are used to obtain the properties of the colder parts of the plasma. The energy balance in the plasma and inferences of temperature and density gradients will be discussed. [C1383]

## "Nonlinear laser synchrotron source experiment for tunable, monochromatic X-rays"

Summary form only given. The laser synchrotron source (LSS) experiment at the Naval Research Laboratory generates X-rays using Thomson scattering of laser photons from a relativistic electron beam. Previous experiments utilized a thermionic RF electron gun operating at 2.856 GHz to produce electron beams with an energy of 4.1 MeV and average currents of 300 mA over the 300-nsec macropulse. A Nd:Glass laser (5 J, 10 nsec, 1.053 m wavelength) was used in a 180-degree scattering geometry. Experimental results included the generation of 372 eV photons with 2% bandwidth and 2Ч107photons per pulse. A new experiment is underway to investigate nonlinear Thomson scattering using a new photocathode RF gun (BNL IV design) and the T3laser ( 1 J, 0.3 psec). When this laser is focused to a spot size of 10 μm the peak intensity reaches 6Ч1018W/cm2with a corresponding laser strength parameter a0=2.2. The quiver motion of an electron in such an intense field is relativistic, and the scattered radiation occurs at higher harmonics of the linear Doppler-upshifted frequency. The new experiment has two laser pulse compressors: one for the uv pulse which illuminates the photocathode and one for the main (scattering) laser pulse. This allows the electron beam and scattering beam pulse lengths to be varied independently. The nominal RF gun operating parameters are 4.5 MeV, 100 A peak current, [C1384]

## "Wave propagation and slowing the time-fluctuating MIMO channel"

It has been reported (Marzetta, T.L., Proc. 37th Annual Allerton Conf. on Commun., Control, and Computing, 1999) that the number of transmitters that can be used beneficially in a MIMO system is limited by the coherence time of the channel due to difficulties with channel estimation at the receiver. These impediments either reduce achievable capacity or impose an effective "speed limit" on the mobile, above which the effective throughput is reduced. We represent the signal incident at the mobile as a sum of plane waves. The channel transfer matrix is found to factor into time-dependent and time-independent parts. The preprocessing method proposed consists of beam forming, followed by Doppler compensation for the signals received on each beam. Beam forming effectively partitions the angular spectrum at the mobile, with each partition suffering a smaller Doppler spread, resulting in the channel fluctuation due to mobile motion being "slowed down". The coherence time of the preprocessed channel is found to increase by a factor of the order of the number of mobile receiving antennas. These results remove constraints imposed by training requirements on the number of transmit antennas and increase the allowed vehicle speeds. [C1385]

## "Joint Doppler and polarization characterization of moving targets"

In through-the-wall imaging radar systems, the synthesized images may not provide sufficient range and cross-range resolution for visual classification and identification of the targets. Target movement and target Doppler characteristics can be used to combat resolution limitations and improve object discrimination. However, slowly moving targets and targets moving perpendicular to the incident waves render target motion ineffective in high-resolution imaging. We utilize the target's polarization properties and introduce time-varying polarization signature estimation based on polarization time-frequency distribution. [C1386]

## "Space-time adaptive processing for forward looking arrays"

The paper applies space-time adaptive processing (STAP) to forward looking arrays. Traditionally, STAP research provides results for a side-looking array where a linear relationship exists between clutter Doppler and azimuth sine. This relationship does not hold in the forward looking case. Additionally, mainbeam clutter in the side-looking boresight case is range independent and, consequently, the clutter notch is always at zero hertz. In contrast, mainbeam clutter is range dependent in the forward looking case, resulting in multiple clutter notches for range ambiguous clutter. This range dependency corrupts the independent, identically distributed assumption required for the samples used in covariance estimation. The assumption can still be applied for a small data set, e.g., small range extent. Therefore, partially adaptive techniques with fewer degrees or freedom and correspondingly smaller sample support requirements must be used. Results are presented in the form of clutter power spectral density, signal-to-interference-plus-noise ratio, improvement factor, antenna patterns, and detection probability. [C1387]

## "Steering vector mismatch: analysis and reduction"

In adaptive radar systems, optimal processing for target detection is only possible when the target location in

angle and Doppler is used to build the processing filter. When this location is not exact, losses occur. These losses translate into a reduction in detection probability. After development of analytical expressions to quantify the effects of this mismatch, two techniques are examined for reducing these effects. These techniques are tested against losses due to Doppler mismatch. The first technique involves the use of temporal windows and reduces mismatch losses at the expense of reducing the overall signal-to-interference-plus-noise ratio (SINR) of the target. The second technique involves the use of additional filters, and achieves a reduction in mismatch losses without sacrificing maximum SINR. A brief overview of the problems associated with multidimensional (angle and Doppler) mismatch is also presented. [C1388]

## "Simultaneous use of multiple pseudo random noise codes in multistatic CW radar"

In multistatic continuous wave radar, the choice of codes and frequencies used for transmission has a strong influence on detection and ease of parameter extraction. The paper describes the various effects of using single and multiple codes in a number of separated transmitters, either with the same or separated carrier frequencies. To visualize some of the results, synthetic radar data have been generated and used in the processing. [C1389]

## "New implementation of the Billingsley clutter model for GMTI data cube generation"

Internal clutter motion (ICM) places significant limits on the effectiveness of STAP clutter suppression techniques, for example in achieving the smallest minimum detectable velocity in GMTI radar surveillance applications. To simulate this effect with maximum fidelity, the required correlation must be impressed on the returns from individual scatterers during the construction of the data cube. Doing so can represent a substantial computational burden on the simulation process when a clutter scene is characterized by many millions of individual pixels. Such numbers are typical when using high fidelity SAR maps as the basis of the clutter model. The paper reports on a fast computational technique for wind-blown clutter simulation that works within a flexible data-generation system employing real high-fidelity IFSAR maps with co-registered elevation data as ground truth. [C1390]

## "An analysis of the effects of windowing on selected STAP algorithms"

The paper analyzes the effects of common data windows on STAP algorithms and the non-adaptive signal match processor. The windows are applied both to temporal and spatial dimensions. With the exception of factored approaches, it is shown that STAP algorithm performance decreases when windows are applied. Finally, a Monte Carlo analysis of probability of detection is performed on the best windowed/nonwindowed combination from each technique evaluated. Because the covariance must be estimated, the results demonstrate that the windowed non-adaptive signal match processor can outperform partially adaptive STAP methods at normalized Doppler between 0.25 and 0.75, while partially adaptive STAP algorithms perform significantly better than the windowed signal match processor closer to the clutter normalized Doppler. [C1391]

## "Decision feedback detection and channel tracking for space-time block coded transmission systems over time-varying channels"

The paper proposes a new decision feedback decoding scheme for Alamouti-based space-time block coding (STBC) transmission over time-selective fading channels. In wireless channels, time-selective fading effects arise mainly due to Doppler shift and carrier frequency offset. Modelling the time-selective fading channels as first-order Gauss-Markov processes, we use recursive algorithms, such as Kalman filtering, LMS and RLS algorithms, for channel tracking. The proposed scheme consists of the symbol decoding stage and channel tracking algorithms. Computer simulations confirm that the proposed scheme shows better performance and robustness to time-selectivity. [C1392]

## "Performance of Doppler estimation for acoustic sources with atmospheric scattering"

A statistical analysis of differential Doppler estimation is presented for acoustic sources with a harmonic spectrum. Our model for the sensor measurements includes a physics-based statistical model for the scattering of the wavefronts by the atmosphere. We derive the Cramer-Rao bound (CRB) on differential Doppler estimation as a function of the atmospheric conditions, the frequency of the source, and the range of the source. We apply the CRB result for several cases of interest with simulated and measured data. [C1393]

## "Optimal invariant test in coherent radar detection with unknown parameters"

We propose a new detector to test the presence of a radar signal with unknown parameters in unknown variance additive white Gaussian noise. Uniformly most powerful invariant (UMPI) tests and unitary filter banks are combined in a new detector. This problem does not fit the linear model due to the unknown Doppler frequency.

It is found that the UMPI test does not exist for such a problem. In our detector, we apply an appropriate linear transformation, which is a unitary filter bank, to the concerned radar signal and the problem is converted to the canonical form. Since the UMPI test does exist for the canonical form, then we derive an optimal invariant test for our problem. [C1394]

## "An optimum design of continuous-wave ultrasonic tomographic technique"

Continuous-wave ultrasonic tomography is an imaging technique, which is used to produce an image (in a form of "slices") of the body (as in X-ray tomography). This imaging technique is an application of Doppler effect. Any object consists of scatterers (targets) at different positions. As rotating this object around an axis of rotation (with respect to a stationary ultrasonic beam) with certain speed, the position of each scatterer corresponds to a certain Doppler shift; the scatterers can be imaged at different positions. The final image of each scatterer can be reconstructed from the resulted power spectra (from the rotating object at different positions) by using a theorem called back-projection. This paper introduces the mathematical analysis of this imaging technique, and the main problems of it. New algorithm for reconstructing the images of rotating object is also discussed. [C1395]

## "Performance of wireless OFDM system channel estimation with different pilot patterns"

Orthogonal frequency division multiplexing (OFDM) is well-known to be effective against multipath distortion. Channel estimation for mobile OFDM systems requires transmission of pilot symbols. The paper addresses the important issue of selecting the location of these pilot symbols to achieve low error rates. It addresses the effect of Doppler spread of the channel on different pilot arrangements and proposes a new scheme for inserting pilot symbols. It is shown that, for pedestrian channels, the proposed scheme performs better than other pilot insertion schemes. [C1396]

## "Parametric resonance in a vibrating cavity"

First Page of the Article [C1397]

## "Wave effect on microwave scattering at water surface"

Microwave scattering at the water surface where a water surface wave coexisted with wind-waves was measured in an experimental water tank. Scattering characteristics, scattering coefficients and Doppler spectra of backscattering microwaves and the relation between scattering characteristics and physical properties of a water surface wave such as wave length, wave height, wave phase and orbital velocity have been investigated. The tilt modulation by water surface slope and the change of wind velocity near water surface by the fluctuation of water surface level were confirmed as influence of water surface wave in microwave backscattering strength. However, the hydrodynamic modulation could not be confirmed. The influence of a water surface wave in microwave backscattering had a strong showing at the Doppler spectrum of backscattering microwave. At first, the middle frequency of the Doppler spectrum of backscattering microwave from the water surface where a water surface wave coexisted with wind-waves was corresponding to that of the wind-wave water surface generated only by wind in the same incident angle and azimuth. The band width of the Doppler spectrum was the value that added 2 times of orbital velocity of water surface wave to that of the wind-wave water surface. The influence of azimuth to the band width was not shown [C1398]

## "Improve the Doppler frequency estimation accuracy using adaptive interacting multiple model algorithm"

Body target characteristic, multiple scatter point and multiple path effect shall make Doppler frequency become wave and skip than ideal case, especially near the point of approach. In light of the characteristics and changing orderliness of the Doppler signal, the paper presents a method that uses adaptive interacting multiple models algorithm to improve the estimate accuracy of Doppler frequency. The simulation results show that the proposed method can effectively improves the smoothness of the Doppler frequency curve. [C1399]

## "Improvement on an inertial-Doppler navigation system of underwater vehicles using a complementary range sonar"

This work presents an improvement of an inertial-Doppler underwater navigation system for unmanned underwater vehicles (UUV) using a complementary range sonar. The inertial-Doppler navigation system is generally based on an inertial measurement unit (IMU) and a Doppler velocity log (DVL) accompanying a magnetic compass and a depth sensor. Although conventional navigation systems update bias errors of the inertial sensors, scale effects of the DVL, the estimated position slowly drifts as time passes. This paper proposes a measurement model with additional range sonar to improve the performance of the IMU-DVL

navigation system for underwater vehicles. The proposed navigation model based on inertial navigation systems includes the scale effects, the bias errors of the DVL, and the error model of the range sonar, where the order of the system states is 21. An extended Kalman filter was adopted to propagate the error covariance, updated the measurement errors and correct the state equation when the external measurements are available. Simulation conducted with the 6-d.o.f. equations of motion of an AUV in lawn-mowing survey mode illustrates the effectiveness of the IMU-DVL navigation system assisted by the additional range measurement. [C1400]

## "Semiautomated analysis of Doppler images for quantification of changes in mitral inflow pattern during parabolic flight"

To study changes in left ventricular (LV) mitral inflow induced by gravitational stresses, and evaluate the effects due to different postures, we performed transthoracic Doppler imaging during parabolic flights on 7 normal subjects (mean age□SD, 46±5 years) in standing upright and resting position. To detect Doppler velocity profiles, a semiautomatically procedure based on local image properties, was applied. Then, LV inflow parameters were automatically computed and their modifications according to different gravity conditions were found: in standing, LV diastolic rapid filling parameters were significantly affected (E-wave peak, cm/s: from 54.7±11.1 at 1G to 85.8±12.1 at 0G; E-wave integral, cm: from 6.6±1.7 at 1G to 13.1±3.2 at 0G; E/A integral ratio, a.u.: from 1.4±7 at 1G to 2.5±8 at 0G), while late diastolic filling parameters were preserved (A-wave peak, cm/s: from 48.8±3.6 at 1G to 55.3±11.3 at 0G). No changes were noted while subjects were in supine resting. [C1401]

## "Prototype dual frequency bilaminar array transducer capable of therapeutic exposure at 500 kHz and Doppler monitoring at 2 MHz"

It is known that ultrasound can enhance thrombolysis with tissue plasminogen activator (tPA). Blood flow monitoring is required for optimum control of the tPA injection and the therapeutic sonication. In order to transmit ultrasonic waves at two frequencies, one for imaging and the other for therapy, from the same aperture, we propose a probe consisting of a therapeutic array with an imaging array overlaid on it. Between these two arrays, a frequency selective isolation layer is inserted to ensure independent oscillatory motions of the two arrays. The function of this layer is to reflect the waves from the imaging array and allow the waves from the therapeutic array to pass through. A prototype sector array transducer was designed and constructed based on numerical simulation. B-mode and color flow images of human brains obtained with the prototype were comparable to those obtained with conventional structure transducers with respect to sensitivity and resolution. Schlieren images showed that the sidelobe levels of the therapeutic beam were less than -20 dB when steering angle was limited to 45 degrees in each direction. [C1402]

## "Effect of pulse parameters on cavitation and acoustic streaming in ultrasonic surgical devices"

Over the last 15 years, ultrasonic surgical devices have become the preferred instruments for cataract surgery within the ophthalmologic community. This approach, called phacoemulsification, uses needle tips which vibrate longitudinally at frequencies between 28 and 50 kHz (depending upon the manufacturer). Mechanical impact and inertial cavitation at the tip both act to erode and liquefy the lens material, which is then aspirated out through the needle core. Surgeons have reported that despite the aspiration flow through the needle, which would tend to bring the lens material into contact with the needle tip, lens material seemed to be repulsed from the tip region. It was theorized that acoustic streaming caused by sound radiation from the tip was the reason for this effect. One recent advance in phaco technology was the introduction of microbursts, or very short (less than 10ms) pulse lengths. These short bursts appeared to reduce the repulsion effect, while at the same time retaining the cutting effectiveness of continuous wave (CW) excitation. The purpose of this study was to investigate both the potential acoustic streaming and cavitation effects as a function of burst length. Measurements of cavitation energy were made using PVDF membrane hydrophones and custom designed analysis software; visualization of flow patterns in the region of the needle were made using a high resolution diagnostic ultrasound imaging system in color Doppler mode. The results show that cavitation levels from these short burst modes are similar to CW excitation at the same excursion levels, while the streaming patterns in the tip region were markedly reduced. This matches with clinical results, which indicate superior cutting effectiveness when compared to CW operation, with better "hold" on the cataract. [C1403]

## "Target motion analysis via efficient acoustic matched processing"

In recent years matched processing techniques have emerged as a solution for the problem of target motion analysis. A target's motion parameters are estimated by determining which of a bank of replica signals best correlates with the signal received from that target. However matched processing is notoriously computationally demanding, requiring evaluation of complex equations for replica generation, and batch processing via an

exhaustive search of a multidimensional parameter space. This study presents a matched processing method for localisation of a moving acoustic source by matching Fourier coefficients from a single frequency bin. A simple range-dependent propagation model is assumed, and the Doppler effect is carefully modelled to produce realistic replicas. An efficient matching algorithm is presented which computes cost values in a recursive fashion, and does not fully evaluate poorly scoring replicas. A simulated example demonstrates the ability of the technique at extremely low SNR with a fraction of the cost associated with exhaustive search batch processing. [C1404]

## "Auto correlation on ultrasonic Doppler signals for pregnancy determination in sheep"

Knowing the reproductive status of his animals (sheep in the case of this project) is of utmost importance to the modern farmer. Decisions concerning the management of the flock are influenced by knowledge of the percentage of animals that are pregnant at any specific time. The aim of the project was to gain knowledge for the development of an instrument that is affordable and with which a farmer can do pregnancy determination himself, thereby enabling him to make the correct management decisions. Experimental data were obtained from pregnant Dorper ewes with the aid of a portable Doppler instrument. By using real data as input, simulations of correlation and auto correlation were done in MathCAD. In the simulations, known levels of noise were added to the Doppler signals. Satisfactory results were obtained from the simulations of auto correlation, which led to a DSP implementation of the method. In the DSP implementation of the auto correlation method, signals with an SNR of -6.5 dB were successfully identified. It can thus be concluded that the auto correlation method can be used successfully for the detection of the fetal heartbeat in noisy ultrasonic Doppler signals [C1405]

## "Modal analysis/filtering to estimate time-varying MIMO-OFDM channels"

In the multipatb multiple-input multiple-output (MIMO) channel, long-term/large-scale properties (e.g., delays, angles, powers) remain approximately constant over many coherence times (i.e., over many Doppler periods) and define the structural terms of the propagation channel referred as delay (powers and delays) and angular (powers and angles of departure and arrival) modes of the channel. Effective improvement of the channel estimate is obtained by estimating delay and angular modal spaces via modal analysis and by filtering the (original) least squares channel estimates as projection onto the modal spaces. The paper also provides experimental validation of the overall method with realistic channel models [C1406]

## "Shape and Doppler correction for a towed sonar array"

Anti Submarine Warfare (ASW) is more and more focused toward shallow water environments. Many complications have come up for ASW sonar performance as a result of this. The problem that is tackled in this article is the performance loss due to the shape and motion of the sonar during a maneuver. Standard beamforming in towed sonar arrays is based on the assumption that all hydrophones are on a straight line and have equal constant velocity. However, when the tow ship turns the array follows and gets bent. The two damaging effects are deviation from the straight line and variation in Doppler. The first issue can be solved by insertion of the correct positions in the beamformer as was shown in earlier publications. In this paper it is shown under which circumstances the second problem causes loss in the beamforming. A theoretical derivation of the performance loss in a turn is given. To tackle the problem of performance degradation, the signal processing has been improved. Three different methods are developed to compensate the effects. All of them are described, implemented, tested and compared with the conventional sonar signal processing. This comparison is first tested on simulated data, generated with a validated sonar simulator that is equipped with Doppler in an exact way. The result proves that the methods work and also shows how the degrading shape and Doppler effects manifest in the sonar images. The article is concluded with an experimental data analysis of a sea trial with a state-of-the-art ASW sonar. The conducted experiment involved a surface vessel with a low-frequency active sonar and a submarine target. A sequence of high-speed sharp turns was sailed in order to show the sonar performance degradation and the benefit of the newly developed signal processing methods. A statistical analysis is given with the sonar performance versus two varied parameters: viz. the target beam and the radius of curvature of the sonar track. [C1407]

## "Design of the robust demodulator for mobile broadband satellite Internet access system"

In this paper, we propose a robust demodulator structure for mobile broadband satellite Internet access systems. Especially, in order to achieve good synchronization under very low SNR, a large frequency offset, and Doppler frequency offset, with the constraints of mobile satellite communication, we design a demodulator which has robust algorithms for carrier frequency recovery compared with the conventional algorithms. The proposed technique can fulfill the stringent up-link link budgets at Ka band by operating at very low SNR. [C1408]

## "Innovations-based code discriminator for GPS/Galileo BOC signals"

Binary offset carrier (BOC) modulation was considered for modernized military GPS and for the European navigation system, Galileo. Although it performs better than conventional BPSK modulation, the BOC waveforms have autocorrelation functions with multiple peaks that lead to potential tracking ambiguities. We propose to minimize this problem with a bank of extended Kalman filters (EKF) that tracks the phase/frequency from the quadrature components of the incoming signal. The code discriminator is a weighted sum of code delays with the weights being nonlinear functions of the EKF innovations. When compared to the early-late power discriminator, the proposed algorithm is much less prone to lose the tracking of the BOC autocorrelation main peak. [C1409]

## "Novel dynamic phase estimator for robust ICI self-cancellation OFDM receivers"

OFDM has been widely applied in current wireless local-area networks and digital video broadcasting since it is robust in frequency-selective channels. However, there still exists a crucial intercarrier-interference (ICI) problem due to the Doppler effect, local frequency drift and multipath fading, in OFDM systems. ICI self-cancellation schemes have been proposed to significantly reduce the ICI and empirically they greatly outperform the convolutional coding schemes in the IEEE 802.11 standard. However, all current ICI self-cancellation receivers are still sensitive to the phase ambiguity due to the frequency offset, the local oscillator frequency drift and the multipath reflections. Therefore, in this paper, we propose a robust ICI self-cancellation receiver with a novel dynamic phase estimation mechanism. The proposed scheme can well solve the phase ambiguity problem and the Monte Carlo simulation results show that our phase estimator can greatly reduce the bit error rates for the final symbol detection. [C1410]

## "Effect of Cellular Elements on Pressure-Velocity Relationship in Mice"

The effect of cellular elements in the blood on peripheral vascular function in mice was evaluated using the pressure-velocity relationships in the iliac arteries of 5 wild type (WT) and 3 polycythemic (MH) mice. Pressure was obtained using a fluid filled catheter in the left iliac artery and blood velocity was measured in the right iliac artery using a 20 MHz pulsed Doppler probe. The proximal aorta was then occluded for one minute to allow flow velocity to decay to zero. The pressure-velocity relationship in the diastolic phase was determined before and after aortic occlusion. In both groups the pressure-velocity relationship was almost linear and the slopes were similar. However, the extrapolated zero-velocity intercept was significantly higher for the MH than WT mice before (55.4 ± 4.0 vs. 36.2 ± 4.1 mmHg, $p<0.01$) and after occlusion (50.7 ± 5.5 vs. 23.8 ± 3.1 mmHg, $p<0.01$). Hematocrits were 41%±3 in WT and 59%±3 in MH mice. These data show that cellular elements in the blood alter the pressure-velocity relationships in peripheral vessels of mice. [C1411]

## "Development of Markers of Valve Stiffness for Prediction of Hemodynamic Progression of Aortic Stenosis"

Degenerative aortic valve stenosis is a progressive disease with an unpredictable rate of progression. Early changes in the degenerative process include thickening and stiffening of the leaflets, reflected in altered rates of opening and closing. Methods have been proposed to measure this in vivo and relate it to the rate of disease progression. In this in vitro study, we tested the hypothesis that changes in ambient hemodynamics that might contribute to the wear and tear process that mediates the degenerative process affect valve mechanics, and that this is reflected in the rates of valve opening and closing. Evidence supporting this hypothesis is presented and an alternative method to account for these effects is proposed. [C1412]

## "Performance analysis of channel estimation in OFDM systems"

We investigate a practical pilot design for indoor channels with an analysis of channel estimation for block and comb-type pilot arrangements. For the pilot design over indoor channels, the performance is determined by the tradeoff between the interpolation error by frequency selectivity of the channel and the noise reduction by the interpolator, compared to the Doppler effect. Results show that the performance of channel estimation for the comb-type pilot symbol, with respect to the derived criterion, outperforms that of the block-type pilot symbol for indoor channels, whereas it is a slow-fading environment. [C1413]

## "Spectral properties of signal fading and Doppler spectra distribution in urban mobile communication links"

In this work we continue the analysis of a probabilistic approach and the corresponding stochastic multi-parametric model of wave propagation in built-up areas with randomly distributed buildings. Here we concentrate on the spectral properties of signal strength spatial variations and on Doppler spread spectrum distribution of signal power. The analysis is based on a unified stochastic approach of radio wave propagation above the built-

up terrain with applications to mobile communications. We analyze the signal power spectrum of spatial frequencies and the signal power distribution in the Doppler domain for moving vehicles, taking into account Doppler shift proportional to the vehicle antenna speed with respect to the base station. The comparison between the theoretical prediction and experimental data was motivated by the proposed stochastic model and by other existing statistical models to verify the signal power distribution in the Doppler domain for various urban environments and terminal heights with respect to building rooftops. New effects of terrain features on signal power spectrum distribution are obtained and examined through the comparison with existing models and experimental data. [C1414]

## "A novel frequency synchronization method for wireless OFDM systems"

In this paper, we propose a new frequency synchronization method for wireless orthogonal frequency division multiplexing (OFDM) systems. The method exploits the pilots' energy efficiently by collecting the energy leaked into the neighbor subcarriers, and provides the coarse and fine estimation of the frequency offset at the same time. Furthermore, an adaptive accumulator is used to attain a good tradeoff between the performance and the synchronization time. Computer simulation results demonstrate that the proposed method performs well at various Doppler frequency shifts with a fairly short synchronization time. [C1415]

## "On efficient link error prediction based on convex metrics"

A methodology is presented to predict the frame error rate (FER) in wireless links for a wide range of channel conditions and retransmission strategies. This method measures the variations in signal amplitude and noise variance within a frame and applies a convex metric based on Shannon's capacity formula to account for Doppler penalties and diversity gains due to multipath combining and retransmission strategies such as hybrid ARQ with Chase combining or with incremental redundancy. This method requires very little information about the received signals and uses a single (AWGN) reference curve for the given channel code. This link error prediction (LEP) method is of great value for system monitoring, scheduling and system simulations. [C1416]

## "Performances of differential-encoded FFHMA systems with space-frequency coding over Nakagami-m fading channels"

The performance and capacities of differential-encoded fast frequency-hopping multiple-access (FFHMA) systems under Nakagami-m fading channels are studied. A space-frequency coding (SFC) scheme is applied to gain diversity order. The proposed FFHMA transmitter can operate without an output hopping filter. The simulation results show that the receiver can detect the transmitted signal when the maximum Doppler frequency closes to 350 Hz. The performance of synchronous FFHMA systems can be improved by spreading factor and average SNR per bit. In a Rayleigh fading channel, the system capacity of FFHMA for BER about 10-3is derived from simulation and it is about 5, 24, and 61 users for spreading factor of 1, 2, and 4, respectively. [C1417]

## "Using the correlation property of subharmonic response as an index of cavitation of microbubbles [Cultrasonics contrast agent]"

In this study, we try to specify whether the weak correlation value of two consecutive Doppler signals for the subharmonics (SH) is only related to the reduced observation time, since the SH are generated from the smaller bubbles, the radiation force effect also reduces the correlation value. Our numerical results indicate that most bubbles producing the SH undergo cavitation while the applied pressure is increased to make the SH significant. In addition, the numerical results show that there are a non-negligible amount of bubbles, which produce the SH and undergo cavitation simultaneously, yielding the spiky Doppler response. Such behavior is demonstrated in the experimental Doppler power spectrum for the SH. The inspection of this spectrum shows that it does not look like the broadened spectrum due to the radiation force. In addition, an experiment diminishing the radiation force effect showed that the correlation is still very weak. Finally, the rapidly decreased SH intensity under continuous insonification can give us clear evidence that most of the bubbles producing the SH would be destroyed while they are moving through the sample volume. [C1418]

## "Interference suppression and multipath mitigation for global navigation satellite systems"

This paper considers interference suppression and multipath mitigation in global navigation satellite systems (GNSS). A self-coherence based antijam GPS receiver has introduced, in which interference suppression is performed by exploiting the inherent self-coherence feature of the GPS C/A signal. In this paper, we equip the antijam self-coherent technique to mitigate multipath. Additionally, the Doppler effect performance is examined. [C1419]

## "Iterative multi-user decoding with time-variant channel estimation for MC-CDMA"

We propose an iterative receiver for a multi-carrier (MC) code division multiple access (CDMA) system in the uplink for users moving at vehicular speed. MC-CDMA is based on orthogonal frequency division multiplexing (OFDM), thus time-variant channel estimation can be performed for every subcarrier independently. The variation of a subcarrier over the duration of a data block is upper bounded by a maximum Doppler bandwidth which is determined by the maximum velocity of the users and the carrier frequency. We exploit results from the theory of time-concentrated and bandlimited sequences and apply a Slepian basis expansion for time-variant subcarrier estimation. The Slepian basis functions are determined by two parameters, the block length and the maximum Doppler bandwidth. This approach enables time-variant channel estimation without complete knowledge of the second-order statistics of the fading process. The performance of the iterative receiver is validated for a wide range of velocities by simulations. [C1420]

## "An accurate velocity estimation algorithm for resource management in next generation wireless systems"

Information about a mobile user's velocity is important for efficient resource management and quality of service (QoS) provisioning in next generation (NG) wireless systems. A mobile receiver's velocity spreads the received signal envelope in the frequency domain. This spreading is directly proportional to its velocity. A novel algorithm called VEPSD (velocity estimation using the power spectral density of the received signal envelope) is introduced in this paper that uses the amount of Doppler spread in the received signal envelope to estimate the velocity of a mobile user. The Doppler spread is estimated using the slope of the power spectral density (PSD) of the received signal envelope. The performance of the proposed algorithm is evaluated in both Rayleigh and Rician fading environments. The sensitivity of the estimation error to additive white Gaussian noise (AWGN), the estimation interval (effect of finite sample size), the sampling period, Rice factor (K), and the angle of arrival of the line of sight (LOS) component is analyzed and compared with the level crossing rate (LCR) and co-variance based velocity estimators. Also, it is shown that the proposed algorithm, VEPSD, can be used for velocity estimation under non-isotropic scattering and frequency selective fading and is well suited for NG wireless systems. [C1421]

## "Second-order statistics of electromagnetic pulse propagation through the turbulent ionosphere"

The characteristics of the signal fluctuations and the channel model are described by several important coherence parameters, which are determined by a two-position, two-frequency and two-time mutual coherence function of the received signals after propagating through random media. The paper discusses these second-order statistical quantities by using an analytic solution to the mutual coherence function for a plane wave recently obtained by iteration of an integral equation. Afterwards, the power impulse response, spectra and delay-Doppler scattering function are also derived and discussed. [C1422]

## "Adaptive inverse control for pickup head flying height in near-field optical disk drives"

Near-field optical disk drives represent a novel technique for optical data recording. To achieve high precision in focusing for near-field data recording, it is essential to develop servo systems that can maintain a constant flying height. This study uses a piezoelectric bender can compensate the vibration of rotating optical disk. Due to the hysteresis phenomenon in piezoelectric material, adaptive inverse control is developed to overcome the nonlinear effect. The control scheme is implemented with least mean square sensed adaptive filter. Using a laser Doppler vibrometer for sensing, experimental results demonstrate that the present method results in only 2% displacement error in tracking command signals. [C1423]

## "Target detection improvement using blind channel equalization OTHR communication"

In this paper, we introduce a blind channel equalization method for over-the-horizon-radar (OTHR) system based on the sea clutter signal. First, we establish that the radar signal, at different time recurrences, can be represented by a MIMO model taking into consideration the propagation parameters (Doppler, delay and attenuation) of the multipath channel. Then, we show that thanks to the Doppler diversity, one can separate the two components of the sea clutter (referred to as Bragg lines) which allows us to reduce the problem to a SIMO one. A CMA-like blind equalization algorithm is then applied to invert the system and combine coherently the channel multipaths. The channel and Doppler information are finally used to mitigate the sea clutter interference and the multipath effect and hence improve the detection and Doppler estimation of the desired target signal. [C1424]

## "Fifty years of advance in frequency standards"

Fifty years ago next October, the VeCongrйs International de Chronomйtrie was held in Paris. In its proceeding there is a paper by L. Essen which shows a drawing of a caesium-beam frequency standard then under construction. Measurements in the paper were referred to quartz ring oscillators. The caesium apparatus was still for the future. here I draw comparisons with that time. I also collate new data and present a list of precise frequency measurements, primary at laser frequencies, following previous presentations of the list in 1997 and 2001. Recent advances have been accentuauted by the introduction of femtosecond lasers for measuring optical frequencies against the caesium standard, and by a laser-cooled fountain version of that standard. Measurements noted include narrow transitions in atoms or ions susceptible to cooling by optical techniques, and so capable of observation with reduced second-order Doppler effect. Applications include searches for change with time of the fundamental constant. [C1425]

## "Fast Doppler tracking DSP-based Earth station modem for LEO satellite applications"

A fast Doppler (carrier frequency drift) tracking Earth station modem is presented. The modem is designed to track high carrier frequency offsets for low-Earth orbital (LEO) satellite applications. LEO satellites have very high Doppler offsets with considerable Doppler rates (rate of change of frequency). The Earth station modem tracks Doppler offsets at a data rate of 128 ksym/s for QPSK modulation. The synchronisation circuit of the modem consists of frequency synchronisation, symbol timing synchronisation and phase synchronisation. We look into the design and performance analysis of the modem, particularly the synchronisation system of the modem. [C1426]

## "Characterisation of MIMO propagation channels using directional antenna arrays"

In this paper we investigate the effects of directional antenna arrays on the performance of indoor and outdoor MIMO (multiple-input multiple-output) links. Measurements are presented for 2 Ч 8 and 4 Ч 8 MIMO channels in the 2 GHz band. The results include delay/Doppler characteristics, and channel transfer functions, as well as link capacity. [C1427]

## "Adaptive blind MOE/PIC multiuser detector for multicarrier DS-CDMA systems"

Frequency selective fading occurs in mobile communication systems due to the Doppler effect. System performance is rapidly reduced due to the effect of multiuser interference under frequency selective channels in DS-CDMA systems. To overcome these problems, we adopted multi-carrier modulation techniques. The frequency selective channel effects can be solved by means of these modulation techniques, and interference problems due to multiuser access are solved by means of multiuser detection techniques. We propose a blind MOE/PIC multiuser detection method which is composed of a blind multiuser detection technique and a parallel interference canceller. Simulation results show that the proposed method performs better than conventional methods. [C1428]

## "The effect of phase noise on the remote sensing of ocean surface currents"

This paper studied the phase noise effect on the range spectrum and Doppler spectrum measured by high frequency (HF) radar which was used for remote sensing of sea surface state parameters. The presence of phase noise in the master oscillator caused a widening of the range spectrum and clutter velocity spectrum, degrading the range and velocity resolution. In this paper, a practical phase noise model is presented, and based on it, the relationship between the phase noise power spectrum density (PSD) and cumulative phase noise is investigated. Then, the basic minimum requirements for the PSD are calculated to maintain radar performance. The results show that a commercial off the shelf oscillator can meet the phase noise requirements. [C1429]

## "An orbit estimation for the spacecraft at closest approach phase to the planet"

This paper describes the results of an investigation of the expected navigation (orbit determination) accuracy during the approach phase of a planet orbiter mission. The target planet is "Venus". This expected accuracy was determined for Earth-based Doppler observation data with and without the addition of ranging or on-board optical observation data. The sensitivity of this expected accuracy to errors effecting the radiometric and optical data also was examined. It was found that unless planetary ephemerisis errors are reduced below their anticipated levels, the addition of ranging data does not significantly improve the estimate of the spacecraft's state near encounter. However, the addition of optical data could make a significant improvement in the encounter accuracy when the spacecraft is outside the sphere of influence of Venus. This improvement diminished as the spacecraft deeply penetrated the sphere of influence. [C1430]

## "Velocity and acceleration estimation employing nonuniform sampling"

Our group has previously proposed nonuniform sampling for flow velocity estimation. Standard pulsed wave Doppler (PWD) systems acquire an ensemble of N echoes per beam line at a constant pulse repetition frequency fprf. The total time span determines the velocity resolution, and fprfthe unambiguous velocity range. The ensemble size N is by approximation inversely proportional to the frame rate, assuming that the system performs interleaving. If sampling intervals are chosen nonuniformely, the total time span can be increased, while keeping N and the shortest sampling interval constant. In this example velocity range and frame rate are unchanged, and measurement accuracy for low flow velocities is gained at the expense of measurement accuracy for high flow velocities. The extended time span makes the flow estimation susceptible to effects of acceleration and decorrelation. Thus, we have refined the flow estimation algorithms by taking into account both effects. [C1431]

## "Effect of beam shape on techniques that use Doppler signal power for monitoring vessel size change [Cultrasonic blood flow measurement]"

Transcranial Doppler measurements of blood flow velocity in the middle cerebral artery are often used as the basis for non-invasive monitoring of changes in cerebral blood flow. Flow index techniques that include a measurement of signal power to take account of possible diameter changes may be hampered in this aim by non-uniform insonation of the vessel. A numerical model, created from in vitro measurements of ultrasound sensitivity and in vivo measurements of middle cerebral artery position, was used to calculate the magnitude of the effect. The calculated power change always underestimated the change in area, typically by 14%, but by 36% in the worst case. [C1432]

## "Contrast-enhanced flow imaging with phase-coded pulse sequences"

The measurement of blood flow velocities is a challenging task. The effect of nonlinear scattering from microbubbles is commonly used for contrast specific imaging. Linear scattering from microbubbles is not contrast specific, yet it contributes more to the echo signal. To optimize flow imaging with contrast agents, it is desirable to exploit linear scattering and nonlinear scattering to improve sensitivity without sacrificing specificity. This can be achieved by incorporating the amplitude and phase dependencies of the fundamental and harmonic spectral components in the Doppler processing. The separability of the aforementioned components is achieved by phase-coding (or amplitude-coding) of the transmit pulses. [C1433]

## "Beam steering in pulsed 'Doppler' ultrasound velocity estimation"

We have investigated the significance of beam steering as a potential source of error in ultrasound pulse-wave flow velocity estimation using computer simulation and experimental methods. A typical clinical transducer was simulated using a wide aperture setting for spectral flow estimation. It is shown that the effective beam-flow angle increases with the beam steering angle. For steering angles of ±20°, and beam-flow angles in the range of 60 to 70°, the resulting velocity error was found to be in the range from -5 to +7%. Much higher errors can occur at higher beam-flow angles, larger apertures and greater steering. With a tissue mimicking phantom and a pulsatile flow waveform, peak velocity estimations were made using a linear array pulsed system. From these, the overall velocity estimation error was determined for various beam-to-flow and steering, angles, and showed good qualitative agreement with the simulation. [C1434]

## "Some new experimental research of HF backscatter propagation in CRIRP"

This paper describes some new experimental research of HF backscatter propagation in CRIRP. This new experimental research includes the detecting of a target with two different polarization arrays using the Faraday rotation effects, the detecting of the HF Doppler spectrum of sea and land by an HF backscatter propagation experimental system (HF BPES) in CRIRP. Airplanes as far away as 2000 km are frequently successfully detected by the HF BPES with two different polarization arrays. The track points of the airplane were compared with that detected by VHF radar, and the difference of the two tracks is very small so that the square root difference is σ=13 km. The illuminated range by HF BPES is from land, by land, the sea boundary, and the sea over a long distance. The HF Doppler spectrum of ground, the sea echo Doppler spectrum and the HF Doppler spectrum of sea boundary and land are probed. It indicates the identification of both sea and ground. [C1435]

## "The united detection of the stationary or slow-moving-speed targets in the clutter based on the high range resolution (HRR) and Doppler beam sharpening (DBS) technique"

During air-to-ground guided missile scanning of the area of interest and detection of targets, mass ground clutter enters the radar receiver with the target echoes, so that the radar cannot distinguish targets from the clutter.

Therefore, the radar's detection capability is seriously influenced by the clutter. Because the ground clutter has a space-time two-dimensional property, traditional detection techniques cannot be used. The paper presents a united detection technique based on high range resolution (HRR) and Doppler beam sharpening (DBS) to fulfill the detection. The united detection technique uses simplified range-Doppler arithmetic to get the signal-to-clutter ratio gain and get the two-dimensional multiple scatterer image, thereby improving the radar's detection capability in clutter. A computer simulation has been done and the results demonstrate that the united detection technique achieves good results, and the technique is valid and easy to perform. [C1436]

## "The transverse strain response of electroactive polymer actuators"

Some electroactive polymers show large electric-field-induced strain. However, it is difficult to characterize the transverse strain response, especially the dynamic response, under high driving electric fields. In this work, a transverse strain measurement system based on a ZYGO laser Doppler interferometer has been developed. This system can measure transverse strain responses of polymer actuators of different sizes over a wide displacement and frequency range. By using this system, we have investigated the electric-field-induced strains of electroactive polymer actuators fabricated from silicone (Dow Corning HSIII RTV) films. The static and dynamic strains of the actuators have been measured under various driving electric fields and mechanical loads. Our results show that the polymers exhibit a non-linear relationship between strain and driving field. Mechanical loads have a significant effect on transverse strain responses. Transverse strains of 3.25% (static) and 2.08% (dynamic at 1 Hz) have been obtained under a load-free condition. Our experimental results can be understood on the basis of hyperelastic theory. The actuation of an electroactive polymer actuator is not only determined by its material properties, but also by the actuator structure. [C1437]

## "Transit time broadening: a pulsed Doppler ultrasound perspective"

Many studies on transit time broadening have been performed to characterize its effect on the Doppler spectrum. However, the dependence of transit time broadening on an important pulsed Doppler ultrasound parameter-the range gate used for depth localization-has not been rigorously addressed. The purpose of this paper is to provide an analysis of how the range gate may contribute to transit time broadening from a pulsed Doppler perspective. Our analysis and simulation results show that the range gate can contribute to transit time broadening at small beam-flow angles. In particular, at such angles, the spectral broadening bandwidth is dependent on the effective axial length of the sample volume. On the other hand, at higher beam-flow angles, the spectral broadening bandwidth is dependent on ultrasound beam parameters such as local length and aperture size: a finding that is consistent with previous studies. Our analysis also shows that there exists a transition beam-flow angle at which the parameters governing transit time broadening undergo a significant change. [C1438]

## "A new 3D ultrasonic model of pathologic carotid vessels based on generalized cylinders"

A novel 3D numerical model reproducing the acoustic behavior of human vessels is presented. The model, based on a right generalized cylinder (RGC), enables the representation of various vessel structures, including bifurcations, and the associated pathologies. Examples of simulated B-mode and Doppler images are presented to show the capabilities offered by the model. [C1439]

## "The electromagnetic compatibility of rass techniques under the airfield conditions"

The solution of the electromagnetic compatibility problem for radioacoustic atmospheric sounding equipment in the airfield conditions by using a special quasicontinuous condition is discussed. Namely, the sounding acoustic parcels are illuminated with radio impulses of a triangular pulse envelope form, and the spatial fronts duration providing the coverage of the whole working height interval. In the sounding height interval of about 500 m, the active spectrum-width of radiated radio signals is only 0.34 MHz, i.e. approximately five times less than that of short rectangular radio pulses. The sounding height measurement is made via acoustic channel with the margin error not worse than 0.8 %, the sound pulse parcels spatial duration is 30 m. Such radioacoustic techniques can be placed in immediate proximity to a runway in order to control mesoscale weather phenomena, dangerous for aircraft. [C1440]

## "A hybrid method for Doppler spread estimation [Cmobile radio systems]"

The Doppler spread estimator presented in this paper solves some problems encountered in some of the previously published solutions. The algorithm consists of two steps, both using the channel autocorrelation function. The first step is a coarse estimate, based on the sign change of the autocorrelation function. Depending on the coarse estimate, either a polynomial fit method (for low Doppler spreads) or a first zero detection method (for high Doppler spreads) is applied. The proposed hybrid Doppler spread estimator provides high estimation

accuracy for a wide range of Doppler spreads. [C1441]

## "An effective solution of wireless channel sounder and its channel modeling application"

A real time wideband wireless channel sounder based on WCDMA system is introduced in this paper. After installing a baseband data acquisition device to the base station and some modifications on test UE, a real time wideband wireless channel sounder is established with fairly high performance and low cost comparing to commercial channel sounders. The time resolution of this sounder is limited by the WCDMA system bandwidth and chip rate; however it can provide an extremely high data storing rate up to 100 Mbyte/s which guarantees a high sampling speed up to 15000 Hz of the time variant wireless channel and multichannel measurement simultaneously. The high sampling rate make it available to have a close sight of the time variant characteristics of the wireless channel such as small scale fading and Doppler effect. The performance of sounder is analyzed and summarized in detail; also the post-processing method of the measurement data is described briefly. Some measurement results corresponding to different wireless environments are presented as examples; wireless channel propagation characteristics analysis and a wireless channel modeling application are introduced finally. [C1442]

## "Noise reduction for quadrature Doppler ultrasound signal based on the adapted local cosine transform"

The spectral analysis of the Doppler ultrasound signal based on the spectrogram has been widely used in medicine for the assessment of blood flow in vessels. The additional frequency components arising from noise produces an adverse effect on the subjective study of the spectrogram and its quantitative analysis. A novel approach using the adapted local cosine transform, combined with the non-negative garrote thresholding method, is proposed to remove noise from the quadrature Doppler ultrasound signal. At first, the directional information is extracted from the quadrature signal. Then the denoising method based on the adapted local cosine transform is performed on the forward and reverse flow signals, respectively. At last, the estimated signal is reconstructed from the denoised signals using Hilbert transform. In the simulation study, the estimation precision of the mean frequency waveform and the spectral width waveform are studied for the signal after denoising. The simulation results for the simulated Doppler ultrasound signals have shown that this approach is superior to the one based on the wavelet transform, especially under low SNR conditions. [C1443]

## "A Rayleigh fading channel model for multicarrier systems: a tapped delay line model"

There are different approaches in the literature for modeling the Rayleigh fading channel. We focus on a model with low complexity to capture the channel effects which are relevant to simulate a wireless network. We use an algorithm which exploits the Toeplitz form of the channel covariance matrices to identify the coefficients of a coefficient matrix to generate random variates which have the correlation properties defined by the correlation functions in time and frequency. The correlation in time is given by the Doppler spectrum and the correlation in frequency is given by the power delay profile of the wireless channel. We demonstrate the properties of the simulator and show quantitative quality measures of the random variates. Up to now such an approach has not been presented for modeling of fading channels. The advantage of such a model is that the computational complexity may be reduced, depending on the application, by incorporating less taps. [C1444]

## "A Doppler offset estimator by using the signal's cyclostationarity in CDMA system"

In wireless communication, there may be a large frequency-offset between the transmitter and receiver due to Doppler effects. So it is very complex to synchronize the mobile unit with the base station, and the receiver's performance degrades rapidly. We propose a Doppler offset estimator using the CDMA signal's cyclostationarity. The CDMA signal's cyclic frequency drifts with the Doppler offset. Exploiting the CDMA signal's cyclostationarity and taking account of the finite sample data, we estimate the Doppler offset by calculating the signal's cyclic frequency. The estimator needs no training sequences, so it does not lower the data rate; the added stationary noise cannot affect the estimator. Simulation results show the estimator can estimate the Doppler offset quickly and correctly in fading environments. [C1445]

## "Role of combustion air swirl distribution in a burner on secondary atomization of droplets"

The effect of high shear in the flow on the spray flame characteristic has been examined. The shear was provided using different swirl combination in the inner and outer swirlers in the double concentric swirl burner. The burner allowed independent control of swirl and combustion airflow in the inner and outer annulus of the burner. Phase doppler particle analyzer (PDPA) laser diagnostics have been used to obtain comprehensive data related to droplet size, velocity, number density, size distribution of droplets. A commercially available twin fluid nozzle has been used in this study. Results have been obtained for a swirl combination of 65° in inner swirler

and 30° in outer swirler (referred to as 65°/30°). The results are compared with the a swirl combination of 50°/30°. The results show secondary break-up of the droplets with high shear that was not present with low shear in the flow. They also show new way to obtain smaller size of droplets from a spray. Smaller size of droplets allows one to easily control the size, shape, stability and structure of the spray flames. [C1446]

## "Role of combustion air swirl distribution in a burner on secondary atomization of droplets"

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## "Double time domain spread unitary space-time modulated OFDM for multiuser downlink broadband mobile communication"

In many wireless broadband physical channels, such as mobile urban radio channels, Doppler-spread is decidedly occurring and the channel characteristics are of both time-selectivity and frequency-selectivity (double-selectivity), which produces performance degradation for those systems only utilizing the frequency-selectivity channel characteristics. A double time domain spread unitary space-time modulated orthogonal frequency division multiplexing (OFDM) scheme is proposed for high data rate multiuser downlink broadband mobile communication. The proposed scheme makes the system not only capable of efficiently exploiting the double-selective characteristics of the wireless mobile fading channels to attain large diversity gain but also with both high data rate and high system capacity. [C1448]

## "Compression of associated signaling for adaptive multi-carrier systems"

Link adaptation technology has been introduced in new generation transmission systems, such as 3G and 4G, optimizing both their throughput and their power consumption. Adaptation of the radio configuration requires information about the radio link quality. The information must be exchanged between the access point and the mobile terminal, leading to an associated signaling load, whose amount may decrease the system transmission efficiency. A mechanism for reducing the amount of signaling information has to be designed to increase the overall system capacity (more users, more available bandwidth). The paper addresses multi-carrier systems whose link adaptation is carried out by means of bit loading algorithms. However, the associated signaling load increases quickly with the number of sub-carriers, modulation schemes and users. These bit loading vectors are considered a-priori known at the receiver, and almost no literature concerning transmission of such information is available. In realistic transmission systems, correlation exists in time due to Doppler effects, and in frequency due to multipath delay spread. We intend to exploit this twofold redundancy to decrease signaling information load. An adaptive lossless compression system for an optimized compression performance and complexity is proposed, giving much higher compression ratio than the existing LZW bit loading algorithm (Lestable, T. and Battelli, M., 2002). [C1449]

## "Calculations and analysis of signal processing by various navigation receivers architectures"

Calculations of receiver response based on the predicted instrument landing system (ILS) and VHF omnirange (VOR) signals at an observation point are presented. The information contained in the radiated signals are detected by an airborne receiver and processed to provide guidance indications. This is accomplished through the use of heterodyne amplitude modulation (AM) receivers. The ILS signal in space is a composite of the direct and scattered carrier-plus-sidebands and sidebands-only signals. For dual-frequency arrays, this includes both the course and clearance signals. The receiver antenna is designed to pick up only the horizontally polarized component of the electric field available at the antenna. The received signal is then amplified at the radio frequency. The guidance information is computed from the audio tones at the output of the respective audio filters. Several factors which affect the received signal are incorporated in the computation of the detected audio signal. These include the velocity of the aircraft [Doppler effects], multipath, and other spurious effects. Four receiver algorithms are defined and the results from these processing algorithms are compared with actual flight measurements. The VOR receiver operates essentially in the same manner as the ILS receiver, except in the audio filtering stage. Rather than compute a DDM, the VOR receiver employs a phase comparator to compare

the phases of two 30 Hz audio signals: the reference audio, and the variable audio. One of the two audio signals is obtained from an amplitude detector while the other is obtained through a frequency discriminator. Two algorithms are implemented, one for the Doppler VOR and the other for the conventional VOR. [C1450]

## "Increasing time domain diversity in OFDM systems"

Delay and Doppler spread of multipath fading channels have already been identified as sources of diversity in wireless communications systems. However, extensive delay- and Doppler spread may cause non-negligible intersymbol interference (ISI) and/or intercarrier interference (ICI) in OFDM systems. In this paper, we propose a method for increasing the Doppler spread of the multipath fading channel without causing additional ICI. The idea is to transmit the OFDM time domain signal predistorted via multiple transmit antennas. The proposed methods can be applied in addition to already existing OFDM systems without any modifications at the receiver, which makes them standards-compatible. [C1451]

## "Joint estimation of Doppler frequency and directions in channel sounding using switched Tx and Rx arrays"

To save hardware and reduce the effort to calibrate the system, channel sounding with Tx and Rx antenna arrays is commonly performed in TDM mode where the array elements are successively switched. We refer to this technique as TDM-MIMO channel sounding. The ISI-SAGE algorithm (Fleury, B.H. et al., 2003; Yin, X. et al., 2003), applied in combination with TDM-MIMO channel sounding, makes it possible to extend the Doppler frequency estimation range (DFER) (Yin, X. et al., 2003). The extension is significant when arrays with large element numbers are employed. We derive the signal model for TDM-MIMO channel sounding and report analytical investigations showing that this DFER extension requires selection of switching modes (SMs) tailored to the array characteristics. The SM of a switched array is the temporal order in which the array elements are switched. In fact, the traditionally used SMs of uniform linear and planar arrays, where the elements are switched according to their natural spatial ordering, prove to be inappropriate as they lead to an ambiguity in the joint estimation of DF and directions. We also introduce the concept of normalized sidelobe level (NSL) associated to the SM of a switched array. We show that minimizing the NSL is a sensible criterion for the identification of SM, leading to DF and direction estimates with nearly optimum performance in terms of root mean square estimation error. Finally experimental investigations illustrate the impact of the SM of a uniform planar array on the behaviour of the DF and direction of arrival estimates computed with the ISI-SAGE algorithm. [C1452]

## "On the error performance of linearly modulated systems with doubly selective Rayleigh fading channels"

Theoretical error performances of communication systems with doubly selective (time-varying and frequency-selective) fadings and fractionally spaced (oversampled) receivers are analyzed. Closed-form error probability expressions of MPSK, MASK and MQAM systems are derived as tight lower bounds of the symbol error probabilities. The effects of receiver oversampling, Doppler spread and fading power delay profile are quantified in the error probability expressions. Simulation results show that the new analytical results can accurately predict the error performances of MLSE and MAP equalizers in a wide range of SNR. Moreover, it is discovered that significant performance gain can be achieved by fractionally spaced receivers over symbol spaced receivers for systems experiencing fast time-varying fading, whereas the effects of Doppler spread are overlooked by most previous works. [C1453]

## "Efficient differentially coherent code/Doppler acquisition of weak GPS signals"

Differentially coherent combining of correlation results is proposed for the acquisition of weak GPS signals, i.e. signals down to -147 dBm received power. It is shown that, with a combined coherent/differentially coherent acquisition scheme, GPS signals can be acquired in 200 msec without any assistance data. By complementing the proposed scheme with methods to estimate the fractional delay, the acquisition unit can provide high quality Doppler and delay estimates such that additional tracking units seem obsolete. Since the need for a complex FFT post-processing of correlation results is avoided, the proposed scheme offers an efficient way of implementing a rapid acquisition GPS receiver in hardware. [C1454]

## "Intercarrier interference cancellation in OFDM mobile systems"

Orthogonal frequency division multiplexing (OFDM) is the projected modulation of choice for fourth-generation broadband multimedia wireless systems. However, for mobile applications, channel variations during one OFDM symbol introduce intercarrier interference (ICI), which degrades the performance. This gets more severe as mobile speed, carrier frequency or OFDM symbol duration increases. We analyze ICI for mobile OFDM systems

in terms of the complex weighting coefficients, which give the contribution of each transmitter subcarrier to each demodulated subcarrier. Then, we propose a new cancellation method to reduce the effects of Doppler frequency shift. The results show that by using the proposed cancellation scheme, the ICI can be reduced significantly. [C1455]

## "Chip-level LMMSE equalization for downlink MIMO CDMA in fast fading environments"

In this paper, we consider linear MMSE equalization for wireless downlink transmission with multiple transmit and receive antennas in fast fading environments. We propose a new algorithm based on the conjugate-gradient algorithm with enhanced channel estimation. In order to be robust to the channel variations, the channel coefficients are estimated by using a weighted sliding window. Two methods to determine optimal weights with respect to the Doppler frequency are proposed. The algorithm has been simulated in a fast fading environment (vehicular A with a velocity for the mobile station of 120 km/h). We show by simulations that good performance is obtained in a correlated fast fading environment with reasonable complexity. Moreover, this approach outperforms methods based on basic sliding window or forgetting factor and the LMS algorithm. [C1456]

## "Measured joint Doppler-delay power profiles for vehicle-to-vehicle communications at 2.4 GHz"

Measured per-tap Doppler spectra are presented for a frequency selective vehicle-to-vehicle or mobile-to-mobile wireless communications link in various multipath environments in Atlanta, Georgia. The measurements were taken using the direct sequence spread spectrum (DSSS) technique at 2.45 GHz. The environments, chosen for their exceptionally long delay spreads, include an expressway, an urban T-intersection, and an exit ramp. The different environments produced quite different spectra. Also, for a given channel, the spectra corresponding to different delays were different, implying a non-separable channel model. [C1457]

## "Research and simulation on separating multi-target with anti-helicopter mine"

The detecting error of azimuth with anti-helicopter mine (AHM) based on narrowband filter and the influence factors of the error are analyzed when the frequency of target sound source is the same as that of interfere sound source in perfect sound field. The analysing results show that the larger the flare angle of two sound sources to the AHM is, the larger detection error of azimuth becomes; because of the Doppler effect, the narrowband filter can decrease the detecting error to meet the system requirements under certain conditions. This lays the foundation of solving the problem with the mine field formed from some AHM. [C1458]

## "Intercarrier interference cancellation of OFDM for time-varying channels"

Orthogonal frequency division multiplexing (OFDM) is the projected modulation of choice for fourth-generation broadband multimedia wireless systems. However, for mobile applications, channel variations during one OFDM symbol introduce intercarrier interference (ICI), which degrades the performance. This gets more severe as mobile speed, carrier frequency or OFDM symbol duration increases. In this paper, we first analyze the ICI caused by time-variant channel in terms of the complex weighting coefficients, which give the contribution of each transmitter subcarrier to each demodulated subcarrier. Then, we propose a high efficiency intercarrier interference cancellation scheme to reduce the effects of Doppler frequency shift. Finally we derive the signal-to interference power ratio (SIR) for the proposed OFDM system. From the comparison between the normal OFDM and the proposed system, we can see that such an ICI cancellation scheme gives more than 5 dB SIR improvement. The simulation results confirm the analysis and show the SIR improvement. [C1459]

## "Multiple hypothesis channel estimation for the MIMO-OFDM system"

This paper proposes a time-varying, Doppler channel estimation approach using multiple hypothesis channel modeling for OFDM-MIMO systems. A non-linear estimation structure is derived using this problem formulation which is composed of a parallel bank of extended Kalman filters whose individual outputs are weighted and summed to form channel estimates. By using this approach, we can reduce the model-mismatch errors associated with fixed-parameter channel models which can be a significant source of channel estimation error. For time-varying, Doppler channels, the channel models (e.g. ITU models) are characterized by a small set of parameters such as Doppler frequency and spectral shape. [C1460]

## "The effect of mobile station rotation on a correlation model for microcellular environments"

This paper studies the effect of rotation of a mobile station (MS) on the cross-correlation function (CCF) derived for a microcellular isotropic wave propagation environment with enough number of scatterers. The statistical model characterizes the propagation media when the MS rotates with a constant angular velocity around an axis perpendicular to the azimuthal plane, and moves with a constant velocity on the azimuthal plane in an arbitrary

direction. The moving MS, with a constant speed, produces the conventional linear Doppler while the rotating MS introduces angular Doppler. The research shows that the rotation of the MS results in a non-stationary random process as the CCF. The only exception in which the result follows a stationary function is a narrow-band communication system, when either the MS angular velocity or the MS speed is zero. [C1461]

## "Increasing time diversity without increasing ICI in an MC-CDMA system"

This paper presents a novel approach of creating additional time diversity by using the existing Doppler spread and transmit antennas. The novel approach allows to increase time diversity without the loss of performance due to increasing inter-carrier interference (ICI). The time selectivity is artificially increased by applying at each transmit antenna a predistortion function to the multicarrier signal in the time domain. The increase in time selectivity is more favorable for the channel decoder at the receiver. The scheme could be easily applied in the transmitter as it does not need any changes in standardized multicarrier systems. The concept is investigated for a broadband MC-CDMA system. [C1462]

## "Sub-band rate and power control for wireless OFDM systems"

Adaptive resource allocation with water-filling has been considered to be an efficient way of increasing data throughput for multicarrier systems. However, the water-filling technique usually requires perfect channel state information; thus, its application is very limited in wireless environments where only partial channel knowledge is available at the transmitter. A sub-band rate and power control algorithm is proposed as a sub-optimal scheme of resource allocation for wireless OFDM systems. We analyze the effect of Doppler frequency in the sub-band rate and power control algorithm and show the capacity increase with the proposed algorithm. We also extend the algorithm to multiuser cases. For both single and multiuser cases, the rate and power control is evaluated in two senses: ergodic capacity and outage probability. [C1463]

## "New parallel algorithm for mitigating the frequency offset of OFDM systems"

We study the problem of frequency offset due to the Doppler velocity of orthogonal frequency division multiplexing (OFDM) systems. A regular OFDM has an IFFT at the transmitter and an FFT at the receiver. The proposed parallel algorithm employs an FFT at the transmitter and an IFFT at the receiver. The regular OFDM samples, which are generated by the IFFT, are transmitted as the first block, and the FFT outputs are transmitted as the second block. At the receiver, the results of the first output generated by the FFT are combined with the second output generated by the IFFT. This combined operation forms a parallel intercarrier interference (ICI) cancellation scheme for mitigating frequency offsets of OFDM systems. It provides: (1) a robust OFDM system in the presence of relative velocity, also known as Doppler frequency offset; (2) high signal to ICI ratio (7 dB better than that of the linear self-cancellation algorithms at N=1024 and $\Delta fT \leq 1\%$ of subcarrier frequency spacing); (3) backward compatibility with the existing OFDM system; (4) better BER performance in both additive white Gaussian noise (AWGN) and fading channels. [C1464]

## "Effect of Doppler spread on OFDM based UWB system"

We investigate the inter-carrier interference (ICI) caused by relative motion between transmitter and receiver in orthogonal frequency division multiplexing (OFDM) based ultra wide-band (UWB) communications. Since the Doppler shift is proportional to the subcarrier frequency, the time-selective fading is subcarrier dependent. An exact expression as well as bounds are derived for the degradation in performance, as measured by signal-to-interference ratio (SIR). A design example is given to illustrate the concepts developed In the work. [C1465]

## "A novel adaptive channel estimation method in WCDMA system based on weighed least squares"

Rayleigh fading channel estimation using time multiplexed pilot symbols in WCDMA system is considered. The WCDMA uplink signal model is established. Considering that channel parameter estimation in the pilot symbols which are far away from or near to data symbols have different effects on channel parameter of data symbols, weighted least square method is proposed to estimate channel parameter of data symbols. A novel adaptive channel estimation method based on weighted least squares (AWLS) is presented in this paper to meet simultaneously the needs of high speed, low speed, medium speed and varying-speed and the weighed combination function is introduced to solve this problem. Weight factor is determined by channel changing rate or maximum Doppler frequency. The method of the channel changing rate estimation is proposed in this paper and it has many advantages, such as small calculation and robust characteristic. The simulation results reveal that AWLS can track and estimate channel parameter of data symbol and RAKE receiver with AWLS method can perform well under high speed, medium speed, low mobile speed and varying-speed. [C1466]

## "Effect of spatial, temporal, and velocity resolution on doppler tissue image derived indices"

First Page of the Article [C1467]

## "Ultrasonic techniques for assessing wall vibrations in stenosed arteries"

Arterial stenoses are often associated with audible bruits. Quantitative analysis of the bruit spectrum has been successfully used to predict the residual lumen diameter in carotid stenoses. Arterial wall vibrations occurring due to turbulent pressure fluctuations in the post-stenotic jet are known to be the source of the bruits. We present novel signal processing techniques that enable the detailed noninvasive assessment of these vibrations in real time using color-Doppler and pulsed-wave Doppler ultrasound. A color-Doppler-based two-dimensional vibration imaging technique can be used to locate the source of the bruits relative to the underlying anatomy. Subsequently, a pulsed-wave Doppler-based technique can be used to analyze the bruit spectrum quantitatively. Experiments in ex vivo arteries indicate that these techniques can predict the location of the bruit as well as its spectral content. Case studies on human subjects with stenosed vein grafts are presented and the clinical applicability of this technique is discussed. [C1468]

## "Doppler Ultrasound Determination of the Distribution of Human Cardiac Output: Effects of Age and Physical Stresses"

Due to its high spatial, temporal, and dynamic resolution, noninvasive Doppler ultrasound can be used to determine the distribution of phasic cardiac output in humans. The effects of ageing and various common physical stresses on combined human major central and regional blood flows have not been reported. We tested the hypothesis that there are no significant age-related differences in steady-state human central and regional hemodynamics during leg exercise, hypoxia, eating, and standing. We used noninvasive, image-guided Doppler flowmetry (~7% linearity, ~11% accuracy) to measure absolute values and percent changes (%C) in phasic blood flows in the following major arteries: ascending aorta (CO, cardiac output), common carotid (CQ, brain), subclavian (SQ, arm), renal (RQ, kidney), superior mesenteric (MQ, gut), and common femoral (FQ, leg). Mean arm cuff blood pressure (BP), heart rate (HR), stroke volume (SV), and total peripheral resistance (PR) were also determined. We studied 16 young (Y, 24/3years, 8 males) and 16 elderly (E, 73/2years, 7 males) healthy, lean adults during separate experiments of: 50% submaximal leg exercise; 12% oxygen breathing; ~700 calorie meal; and 70° upright tilt. Exercise results (X/SD) are given as Y(%C) then E(%C) where (+) represents $p<0.05$ vs resting, fasting control: HR: 78/8+,66/7+; BP: 6/5,8/6; SV:-15/5+,21/4+; CO: 96/11+,87/9+; PR: -83/13+,- 76/10+; CQ: 16/8+,14/6+; SQ: -6/8,-12/8; MQ: -21/11+,-15/11; RQ: -14/8/-12/7; FQ: 919/88+,898/74 Importantly, there were no significant ($p<0.05$) age-related differences in the percentage changes in any of these hemodynamic variables. Similar results were found during hypoxia, eating, and standing. We conclude that although physical stresses significantly ($p<0.05$) affects various central and regional hemodynamics, there are no significant age-related differences in these variables between healthy, successfully aged, 20 and 70 year old cohorts. These data suggest that given an appropriate genetic template and behavior free of significant trauma and disease states, cardiovascular control mechanisms and the distributions of cardiac output dur- ing common, daily, physical stresses are maintained with age through 70 years of life. [C1469]

## "Variations of the Maximum Blood Flow Velocity in the Carotid, Brachial and Femoral Arteries in a Passive Postural Changes by a Doppler Ultrasound Method"

We have developed a blood flow velocimeter to measure maximum blood flow velocity (MBFV) in carotid, brachial and femoral arteries simultaneously by using a Doppler ultrasound technique. This measurement system is based on a continuous wave Doppler ultrasound method with two semicircular piezoelectric (PZT) transducers, one continuously transmitting ultrasound, and the other continuously receiving the echoes. This report is to investigate variations of MBFV in 3 arteries of 5 healthy normal male volunteers during passive postural changes in supine, 90 degrees head-down-tilt (HDT) and 90degrees head-up-tilt (HUT) respectively. As a result of these measurements, we could confirm that MBFV in those arteries especially in brachial and femoral are increased by supine to HDT posture and are decreased by supine to HUT posture. But, it's just changed a little in carotid artery. An increasing and a decreasing in MBFV are expected to be an effect of venous pressure and a constant MBFV in carotid artery is caused a cerebral autoregulation. [C1470]

## "Improved pilot symbol aided estimation of Rayleigh fading channels with unknown autocorrelation statistics"

New pragmatic pilot symbol assisted modulation (PSAM) techniques are proposed for the accurate estimation of time-selective Rayleigh fading channels. Unlike the optimal Wiener approach, the suggested techniques do not rely on knowledge of the fading autocorrelation function, and yet are shown to provide near-optimum channel estimation performance. While simple PSAM estimators published in the literature may appear to match this

claim, we demonstrate that the gap in terms of estimation mean-squared error between existing techniques, which do not rely on the channel statistics, and the optimum Wiener estimator is about an entire order of magnitude for small Doppler rates. This gap is significantly reduced by employing estimators which operate with partial knowledge of the channel statistics. Moreover, we develop two novel channel interpolation methods which can exploit estimates of the Doppler frequency and, optionally, the channel SNR. The accuracies of the developed estimators are characterized and compared to those of existing suboptimal PSAM approaches. We demonstrate that the proposed estimators provide significant performance gains for slow fading scenarios. For example, a gain of approximately 2.5 dB in SNR is found for BPSK error rate calculations and simulations in channels with a normalized Doppler rate of 0.005. [C1471]

## "Reduction of errors due to random FM noise"

This paper proposes a technique for reducing errors caused by random FM noise in land mobile communication systems. With this technique, we do not need the pilot or preamble signals that up to now have been indispensable. Changing the received signal by using this technique reduces the effect of random FM noise even in currently available radio systems without any change in signal format standards. Computer simulation results with DPSK, QDPSK, and 16-star QAM demonstrated the feasibility of this technique. Errors were reduced to about 1/100 of the conventional level for QDPSK when fDT was 0.012 (where fDis the maximum Doppler frequency and T is the symbol duration). [C1472]

## "The effect of bimodal sea spectra on HF radar wind analysis"

HF radar spectra have been shown to be able to produce wind direction information from the first-order peaks. The main error in this analysis is the spreading function which one adopts for the directional wave spectrum. There is increasing evidence in recent literature that the directional spectrum for gravity waves above the peak is bimodal in form. The bimodal shape has been recently modified to merge with the observations of omnidirectionality at wavelengths around 1.0-0.3 m. The analysis of HF radar data for wind direction determination is discussed in terms of the modified bimodal form for the wind wave spectrum [C1473]

## "Adaptive MIMO channel estimation for fast Rayleigh fading channels"

A novel adaptive channel estimation algorithm for fast fading channels is proposed. The algorithm is based on an adaptive multi-rate filter bank structure. Unlike conventional MIMO systems, where a block fading channel model is typically assumed, a continuous fading model is considered in order to deal with fast fading in MIMO systems. In addition to that, the channel estimator is designed to be adaptive to time-varying Doppler frequency. Simulation results compare the proposed algorithm with an adaptive Wiener (MMSE) channel estimator. [C1474]

## "Turbo array receiver for underwater telemetry"

We describe a novel, turbo-based array receiver architecture for underwater channels with large delay-Doppler spreading. We demonstrate performance on data from an underwater BPSK telemetry experiment with rapid fading, and on simulated data extended to MPSK. Compared to a classical decision-directed LS-MMSE receiver of comparable observation and filter sizes, our proposed algorithm shows dramatically improved performance. The architecture is built around a block-based multi-channel linear model that considers deterministic time-invariant (TIV) multipath and random fading. Symbol estimates are decomposed by approximated conditional mean and variance components to reflect varying degrees of uncertainty. By approximating TIV coefficients with previous estimates, observation components due to symbol uncertainty conform to a linear model. The turbo cycle refines estimates for both predicted symbols and multipath parameters, effectively mitigating decision delay in rapidly time-varying channels with large delay spread. Our presentation includes a practical and robust computation approach, essential for problems of this size. [C1475]

## "New space-time wireless channel model and its computer simulation method"

A channel model is essential for performance analysis in smart antenna systems. Parameters are not easily determined in the GBSBEM (geometrically based single-bounce elliptical model) model, which is commonly used in smart antenna systems. This paper presents a new space-time model, which combines the GBSBEM model and the mobile model suggested by UMTS-IMT-2000. Based on the GBSBEM model, the presented model absorbed some parameters like time delay and power from the UMTS-IMT-2000 suggested model. At the same time, the Doppler effect was also taken into account. The detailed simulation steps are included in this paper. Based on the presented model, a multi-user space-time model was also presented. Computer simulation shows that the presented model is feasible in smart antenna systems. [C1476]

## "Extension of 3GPP transmit diversity system"

In this paper, we extend the 3GPP transmit diversity system by increasing the number of antenna elements from 2 to 4, to improve the BER performance. The increase of feedback signal message bits is kept low. The effect of spacing distance between antennas, control delay time and the maximum Doppler frequency on BER performance is studied under flat fading and frequency-selective fading. [C1477]

## "Multi-equalization a powerful adaptive filtering for time varying wireless channels"

We propose and analyze a new equalization architecture which uses several equalizers having different structures that perform in parallel. Thus, for this technique, the received signal is filtered by all used equalizers. Then, a selection module chooses the "best" equalized signal based on an appropriate criterion. This scheme allows us to take advantage of several equalization architectures. For a time varying channel with fluctuations of the delay profile and changes in the rapidity of Doppler fading rates, multi-equalization becomes very profitable. In fact, during such communications, channel characteristics vary and so the best equalizer structure to use changes from one moment to the next. The overall performance analysis of the proposed equalization technique over Stanford University interim (SUI) channels was performed. Simulation results show the efficiency of the proposed multi-equalization technique. Error performances of the multi-equalizer combining three different equalizers are significantly better than those of each equalizer taken separately. The proposed strategy permits particularly important performance improvements with some communication scenarios combining either long and short echoes or a variation of fading rates. [C1478]

## "Doppler diversity and turbo coded CDMA"

In this paper, we track the performance of the turbo decoder as a function of the diversity order achieved by the 2D RAKE receiver and the number of MAP iterations performed by the turbo decoder. In particular, we show the benefits of utilizing Doppler diversity in addition to multipath diversity in CDMA systems. Simulations around the waterfall region of the turbo code show gains ranging from 1 dB to about 3.5 dB under different realistic channel conditions when Doppler diversity is exploited. Similarly, for a given BER, utilizing Doppler diversity is shown to reduce the number of MAP iterations required by a factor of approximately 2. [C1479]

## "MIMO space-time correlation model for microcellular environments"

We present a comprehensive cross-correlation model for a multiple-input multiple-output Rayleigh fading channel in an isotropic scattering environment. The scattering environment is assumed to be a microcellular media with sufficient number of scatterers. This implies uniformly distributed angle of departure and angle of arrival either at the transmitter or at the receiver. Simple and reasonable assumptions are made for various relevant physical parameters, such as exponential or normal time-delay distribution and uniform phase change in the receiving waveform. A novel method of modeling is suggested to consider a geometry for the local scatterers. This approach establishes a mathematical relation between the time-delay and the channel gain associated to each dominant propagation path, and uses appropriate probability density function (pdf) for the time-delay profile. This flexible method allows us to characterize a wide range of propagation environments. Cross-correlation function between channels appears to be a multiplication of tow Bessel functions, and two other multiplicative terms. Bessel functions represent the Doppler effect, the carrier frequencies, and the spatial separation, either at the transmitter or at the receiver. The effect of the carrier frequencies also appears on the other terms. Interestingly, the last two terms are η/2-order derivative of the moment generating function of the delay profile at two carrier frequencies, respectively, where η is the environment pathloss exponent. Overall, the model has a closed form and is a generalization of the Clark model. [C1480]

## "Modeling of Earth's rotation for space based radar"

Space-based radars (SBR) by virtue of their motion generate a Doppler frequency component to the clutter return from any point on the Earth as a function of the SBR-Earth geometry. The effect of Earth's rotation around its own axis also adds an additional component to this Doppler frequency. The overall effect of the Earth's rotation on the Doppler turns out to be two correction factors in terms of a crab angle affecting the azimuth angle, and a crab magnitude scaling the Doppler magnitude of the clutter patch. Interestingly, both these quantities depend only on the SBR orbit inclination and its latitude and not on the location of the clutter patch of interest. Further the crab angle has maximum effect for an SBR on a polar orbit that is above the equator. The crab magnitude on the other hand peaks for an SBR on an equatorial orbit. A detailed derivation of these results is presented in this paper. [C1481]

## "Effect of antenna phase center displacement on FM-CW measurements $application to radar

system"

The aim of this article is to study the phase center movement on a wide band antenna, and its effects on Doppler frequency measurements in FM-CW systems. In the first part, the FM-CW radar system is described. In the second part, the model used to compute the phase center position of a log-periodic dipole (LPD) antenna is presented and validated by measurements. In the final part, this method is applied to a HF-VHF LPD antenna and the Doppler effect of this antenna is computed in an FM-CW radar context. [C1482]

## "Wireless vital signal detection systems and its applications at 1.9GHz and 10GHz [Cbiomedical applications]"

A wireless vital signal detection system, which is analogous to Doppler radar, can measure respiration and heart rates with periodic movement of skin and muscle near the heart. The detection system consists of antenna, RF transceiver (transmitter and receiver), and baseband section. In this paper, the link budget of the detecting system is analyzed and the signal detected from the system is compared with the electrocardiogram (ECG) signal of a monitor which is used for patient monitoring in a hospital. Then, the detection of vital signs is also performed according to various environments, such as different distances and behind a wall. [C1483]

## "A modified fractional Fourier series for the analysis of finite chirp signals & its application"

In this paper, we propose to extend the recently presented fractional Fourier series (FrFS) concept to include a wider class of signals. Specifically, our modified FrFS can be applied to chirp signals with arbitrary central frequency and is not limited to those with central frequency equal to a multiple of a particular value. Examples, including Monte-Carlo simulations, are presented to show the improvement in performance of the proposed method compared to the existing one. In addition, an application of the proposed method in combating the Doppler effect in a mobile communication system is also presented. [C1484]

## "A new adaptive polarization-space-time domain radar target detection algorithm for nonhomogeneous clutter environments"

A new adaptive radar target detection algorithm, called the polarization-space-time localized generalized likelihood ratio (PSTL-GLR) test shall be exploited, which is of significant use in nonhomogeneous clutter environments. The key idea of the PSTL-GLR algorithm is that the degree of freedom (DOF) is controlled to avoid a serious detection loss due to limited secondary data vectors by transforming the data from space-time domain to angle-Doppler domain, while maintaining high performance of the joint polarization-space-time processing. The detection performance of the proposed algorithm is derived analytically in terms of the probabilities of detection and false alarm, along with numerical evaluation to illustrate its efficiency in limited secondary data environments. [C1485]

## "Adaptive MIMO-diversity selection with closed-loop power control over wireless CDMA rayleigh-fading channels"

This contribution considers adaptive (multiple input multiple output) MIMO-diversity selection at the receiver jointly with closed-loop power control (PC) to efficiently combat fading with only few transmit (Tx) and receive (Rx) antennas. Hence we avoid resorting to antenna selection among large MIMO-arrays without PC which would be otherwise required to keep complexity low. With low Doppler closed-loop PC significantly increases the transmission capacity and reduces the MIMO-array size. [C1486]

## "Narrow resonance of saturated absorption in an active cavity"

We present a new scheme of laser spectrometer based on an active optical cavity containing saturated absorbing and amplifying media. Such an active cavity may ensure enhancement in the amplitude of nonlinear optical resonances of saturated absorption at least by one order of magnitude as compared with similar passive system. The efficiency of the spectrometer was demonstrated by the observation of saturated absorption resonances in methane at a wavelength of 3.39 /spl mu/m under transit-time conditions. In these conditions, the contribution of fast molecules can be greatly reduced because of a finite interaction time of particles with the radiation field. In our work with a light beam 0.6 cm in diameter, we eliminated the transit-time broadening limit by using optical selection of slow methane molecules with a transverse velocity 20 times less than the mean thermal one, and obtained sub-Doppler resonances with a homogeneous width less than 5 kHz. [C1487]

## "Preliminary study on the inertial-Doppler localization of a deep-sea launcher hanging on a cable"

This paper presents a localization method of a deep-sea launcher with a hybrid underwater navigation system.

The under water navigation system mainly composed of an inertial measurement unit (IMU) and a Doppler velocity log (DVL). The implementation of DVL can improve the navigational performance of the IMU when an underwater vehicle works near sea bottom. A dynamic error model of a DVL-aided inertial navigation system is designed to implement an indirect feedback Kalman filter, and a measurement model is also designed. This paper demonstrates the enhanced performance of the DVL-aided hybrid navigation by conducting rotating arm test in ocean engineering basin at KRISO. The IMU and the DVL are embedded in a small fish attached at the rotating arm. Additional depth sensor and a magnetic compass are introduced in the measurement model. In addition, this paper also conducts a dead-reckoning navigation using the DVL and the magnetic compass. The dead-reckoning navigation system also shows better performance than the IMU-only navigation system. [C1488]

## "Frequency conversion using a moving plasma front generated optically in transmission lines-theoretical analyses"

A novel method for frequency conversion using a transmission line on a semiconductor substrate has been presented. Laser pulses move along the transmission line while generating an electron-hole plasma at the surface of the semiconductor substrate. The plasma in the transmission line acts as a moving short with a relativistic velocity, reflecting an incident microwave and up-shifting the frequency through the double Doppler effect. Power and energy conversion efficiencies have been theoretically analyzed for the frequency conversion. The results have shown that the converter can be used to produce short millimeter and submillimeter waves. [C1489]

## "Effect of imperfect channel information on M-QAM SER performance of orthogonal space-time block codes"

The effect of imperfect channel information on the performance of orthogonal space-time block codes is considered in this paper. The symbol error rate of the M-QAM constellation of an orthogonal space-time block code is derived taking into account the effect of imperfect channel information in a Rayleigh fading channel. Derived results show that imperfect channel information destroys the orthogonality of OSTBC, resulting in an error floor that increases with the channel estimation and the normalized Doppler frequency. [C1490]

## "Variable spreading factor-OFCDM with two dimensional spreading that prioritizes time domain spreading for forward link broadband wireless access"

This paper proposes the optimum design for adaptively controlling the spreading factor in orthogonal frequency and code division multiplexing (OFCDM) with two-dimensional spreading according to the cell configuration, channel load, and propagation channel conditions, assuming the adaptive modulation and channel coding (AMC) scheme employing QPSK and 16QAM data modulation. Furthermore, we propose a two-dimensional channelization code assignment scheme to achieve skillfully orthogonal multiplexing of multiple physical channels. Computer simulation results elucidate that bit-interleaving in the frequency domain is superior to chip-interleaving especially for a full channel load because bit-interleaving exhibits a large randomization effect of burst errors, while still maintaining code orthogonality. In time domain spreading, the optimum spreading factor, except for an extremely high mobility case such as for the fading maximum Doppler frequency fD= 1500 Hz, becomes SFTime= 16, and it should be decreased to SFTime= 8 for such a very fast fading environment using 16QAM modulation. When the channel load is light such as Cmux/SF = 0.25 (Cmuxand SF denote the number of multiplexed codes and total spreading factor, respectively), the required average received signal energy per symbol-to-background noise power spectrum density ratio (Es/N0) is reduced as the spreading factor in the frequency domain is increased up to say SFFreq= 32 for QPSK and 16QAM modulation, respectively (Note that, nevertheless, 16QAm modulation under such a lighter channel load condition is replaced by QPSK modulation together with two fold the channel load as 16QAM to achieve the same information bit rate). Meanwhile, when the channel load is close to full such as when Cmux/SF = 0.94, the optimum spreading factor in the frequency domain is SFFreq= 1 for 16QAM modulation and SFFreq= 1 to 8 for QPSK modulation according to the delay spread. Consequently, by setting several combinations of spreading factors in the time and frequency domains, the near maximum link capacity is achieved both in cellular and hot-spot cell configurations assuming various channel conditions. [C1491]

## "Space-time-frequency processing for OFDM wireless mobile communications"

Novel space-time-frequency processing schemes for OFDM mobile communication systems are implemented using antenna arrays, tap delay lines and Doppler branches to exploit angular spread, delay spread and Doppler spread, respectively. [C1492]

## "The performance of feedback type adaptive array antenna in FDD/DS-CDMA system"

This paper presented the performance of feedback type AAA in an FDD/DS-CDMA system. The results include the effects of antenna spacing, feedback control delay time and the maximum Doppler frequencies under flat fading and frequency-selective fading. All these results are investigated under an ideal condition that measured channel characteristics are sent back precisely to the base station. We compared the performances of our system with that of 3GPP transmit diversity system (mode1). [C1493]

## "Pilot power allocation for OFDM systems"

In this paper, the current analysis focuses on the demodulation performance in multipath fading propagation environments, which results from the pilot power variation of pilot symbol, assisted modulation (PSAM) M-PSK in orthogonal frequency division multiplexing (OFDM) systems. The pilot-to-data power ratio (PDR) is optimized analytically. Theoretical and simulation results show that the optimum PDR is effected by the signal-to-noise ratio (SNR), Doppler frequency and interpolation size etc, and provide a suitable tool for system design. [C1494]

## "Performance of OFDM based wireless LAN system under Doppler over Rayleigh fading"

Wireless local area network (WLAN) is considered as proper candidate of meeting the needs of next generation broadband wireless communications. OFDM outperforms other system for its capability of mitigates multipath effect under high data rate wireless environment, and it is adopted by 802.11a WLAN standard in its physical layer. This paper focuses on the performance of 802.11a system under two paths Rayleigh fading channel and the Doppler effect on this system. Simulation results show that there is 3 dB coding gain under 2 paths Rayleigh fading channel at BER of 10-3, also the relative movement of transmitter and receiver with high speed introduces 1 dB degradation around BER of 10-4. [C1495]

## "Range correlation effect on ISM band I/Q CMOS radar for non-contact vital signs sensing"

A quadrature direct conversion microwave Doppler radar has been fully integrated in 0.25 μm CMOS. This ISM band radar chip has been used to detect heart and respiration movement 50 cm from the subject. While oscillator phase noise is a performance-limiting factor in CW radar systems, the range correlation effect enables measurement of small phase modulations in spite of the notoriously high phase noise of the on-chip CMOS oscillator. This is the first reported quantitative experimental verification of the range correlation effect. [C1496]

## "Some issues of complexity and training symbol design for OFDM frequency offset estimation methods based on BLUE principle"

In this paper we present reduced complexity OFDM frequency offset estimation methods based on the best linear unbiased estimation (BLUE) principle. Firstly, reduced complexity version of methods from (H. Minn and et al., 2002) is presented. Secondly, a method that possesses both slight performance improvement of (H. Minn and et al., 2002) and complexity advantage of (M. Morelli and U. Mengali, 1999) is proposed. Furthermore, we present the effects of the number of identical parts contained in the training symbol on the frequency offset estimation performance. Our results indicate that an improper choice of the number of identical parts contained in the training symbol can cause significant performance degradation to the methods of (M. Morelli and U. Mengali, 1999) and (H. Minn and et al., 2002) while a proper choice can give extra MSE improvement. [C1497]

## "Detection of a line-of-sight connection to a UMTS base station for increased location accuracy of user terminals"

The location methods time-of-arrival (TOA) and time-difference-of-arrival (TDOA) become essential for position computation in UMTS networks. During absence of line-of-sight (LOS) propagation, timing errors will occur when these methods are applied. Hence, presence or absence of an LOS connection must be identified. The proposed algorithm detects a LOS connection of a moving user terminal by utilizing the channel coefficients estimated in a UMTS receiver. From the time variations of the first and second path coefficients, measures of the corresponding Doppler bandwidths are calculated. The difference in bandwidth between a reflected path and an LOS path allows a distinction between LOS and non-LOS (NLOS) propagation of the first path. Computer simulations prove the proper operation of the proposed algorithm in typical propagation environments, leading to a reliable indicator for the presence of an LOS connection. Changes in propagation conditions from NLOS to LOS are also tracked quickly. [C1498]

## "A low power PSK receiver for space applications in 0.35-μm SOI CMOS"

An all-digital and low power PSK baseband receiver circuit using silicon on insulator technology (SOI) is designed for space applications. The receiver employs double differential detection to improve the receiver's

robustness to Doppler effect as well as a 1 bit A/D at the front to reduce complexity and power. Operating at a UHF frequency (435 MHz), the receiver supports a wide range of data rates (0.1-100 kb/s). From test results, the power consumption of the baseband circuit, including the 1 bit A/D converter is below 1 mW for data rates up to 100 kb/s. [C1499]

## "Scattering statistics of Doppler faded acoustic signals using speckle noise models"

Understanding scattering multipath channels that fade randomly with respect to time, frequency, and space is very crucial for the accurate detection of objects and the study of their scattering characteristics when mapped by active radar or sonar systems. In this paper, we derive stochastic models for the probability density function (pdf) of the shift in the carrier frequency caused by the Doppler effect on the received illuminating signal. Our derivation is based on single- and multi-look partially developed speckle noise models, which are in perfect agreement with the Doppler spread in the Clarke's model. Finally, we study the problem of object detection in randomly faded channels by analogy to optimal detection of binary phase shift keying signals in digital communication. [C1500]

## "OFDM system performance over time-selective fading channels"

The paper deals with transmission of OFDM-BPSK signals over time-selective fading channels. The carrier frequency offset due to Doppler shifts is taken to be the main reason for the channel time-selectivity. Closed form analytical relation for bit error rate (BER) determination is derived enabling efficient evaluation of the inter-carrier-interference (ICI) effects introduced by the channel time-selectivity. [C1501]

## "Doppler effects on CDMA monouser detection with UMTS applications"

This paper presents a simulation method for UMTS radio link in the presence of the Rayleigh fading and Doppler phenomenon for different user equipment speeds. The propagation channel simulation method is described in detail. Finally, as an application of the presented radio link simulation, some results are highlighted for different user equipment speeds and a number of interesting conclusions are highlighted. [C1502]

## "Radiation spectra of electrons moving in a spiral in magnetic fields"

Analytical and numerical investigations of the radiation spectra of electrons moving in magnetic fields in transparent isotropic medium are performed. The results showed that the Doppler effect influence on the peculiarities of the radiation power spectral distribution of the electrons were essential near the Cherenkov threshold. [C1503]

## "DOA-and Doppler frequency estimation with array errors"

In the presence of sensor gain and phase uncertainties for sensor array, the problem of high-resolution estimation of DOA-Doppler frequency for multiple targets signals is addressed. Making use of rotational invariance technique and collecting data of targets signals at two known carrier frequencies, the proposed method in this paper can estimate DOA-Doppler frequency of multiple targets accurately. Simultaneously, sensor gain and phase factors can be estimated precisely, then the manifold of sensor array can be calibrated in the following step. Simulation and practical example results illustrate that this method has superior performance. [C1504]

## "Optimal number of phased array faces for horizon and volume surveillance revisited"

The problem of the optimal number of phased array faces for performing both horizon and volume surveillance over 360 degrees is revisited. Previously, assuming the detection performance is the same in all beam positions and the total number of T/R modules is constant, it was shown that for either horizon or volume surveillance, the optimal number of array faces was three. This was true whether the arrays were operating simultaneously or sequentially. In this paper a more realistic scan loss is used and the effects of fill pulses for pulse-Doppler waveforms are considered. It is shown that for array faces operating simultaneously, as the required clutter fill increases, the optimal number of array faces grows from three to four for both horizon surveillance and volume surveillance. For equal performance, the fill is about 50 km for horizon surveillance and in excess of 200 km for volume surveillance. However, the four-face systems may require additional electronics and an additional signal processor; and this needs to be taken into account. [C1505]

## "Starting currents in coaxial gyro-BWO"

In this paper, we conducted theoretical investigation of coaxial BWO, operating at resonance of relativistic

electron beam (REB) with back wave on the normal Doppler effect (gyro-BWO). Linear theory of exciting process is presented. The dependence of starting current values upon the coaxial waveguide length and the electron beam energy is investigated. [C1506]

## "Performance of a PSK system with wavelet time diversity over flat Rayleigh fading channels"

This paper presents a novel system for transmission over wireless channels. This system combines a smart interleaving that uses a Wavelet Coefficient Matrix (WCM) with a time diversity scheme. It is shown by computational simulation that the proposed system presents a good performance over channels with memory characterized by the flat Rayleigh fading. [C1507]

## "Joint maximum likelihood estimation of time delays and Doppler shifts"

This paper deals with the problem of estimating the amplitudes, time delays and Doppler shifts of a set of known signals received by an array of antennas in temporally white but spatially colored noise. Applying the maximum likelihood approach, the estimation reduces to an optimization problem where the nonlinear parameters such frequency shifts and delays are jointly estimated by means of a minimization over a highly nonlinear cost function, which is derived in this paper. In addition, an iterative algorithm that performs these estimations is also presented. [C1508]

## "Optimum coherent integration time for a surface target with periodic acceleration"

In this paper we consider the effect of surface target dynamics on the detection performance of coherent radar. The echo from a surface target traveling with a constant velocity, that is not radial to the radar look direction or constant rate acceleration is represented in the form of chirp function. This is a simplistic model that must be extended to account for other periodic accelerations acting on the target. The dominant periodic acceleration is the radial surge component that may result in the smearing of the targets Doppler. This radial surge component is a result of the interaction of the target with the ocean wave. This effect must be taken into account when determining the optimum coherent integration time (CIT). In this paper we extend the model to accommodate an echo from a periodic accelerating target with a frequency-modulated signal that represents the surge component. The optimum CIT is derived based on maximizing the signal-to-noise ratio (SNR) at the matched filter output. The results are verified based on data collected from a high frequency surface wave radar (HFSWR) operating at 15 MHz. [C1509]

## "Performance analysis of a Doppler-channel blind identification algorithm for noncircular transmissions in multiple-access systems"

The asymptotic performance analysis of a recently proposed Doppler-channel blind identification algorithm for noncircular transmissions in multiple-access systems is presented. It is shown that, under mild assumptions, the proposed algorithm provides mean-square consistent estimates of the unknown parameters. Moreover, it is shown that this algorithm is asymptotically near-far resistant. [C1510]

## "Multifractal identifying and characterization of ionospheric propagation modes"

The dynamic nature of the high latitude ionosphere leads to the formation of small-scale ionospheric irregularities capable of scattering HF radio waves. The large-scale irregularities were identified by many models, however, small-scale irregularities are not well identified and characterized. The aim of this paper is to present a new wavelet-based multifractal approach to identify the ionospheric propagation modes and to localize the small irregularities and quantify it by a multifractal dimension mapping. We have adopted the scattering function as a tool for the ionosphere channel characterization. The non homogeneity of the scattering function expressed according to the time propagation and Doppler shift led us to split it into two one dimensional vectors. Applying the scaling analysis to the two vectors, we have deduced a cut-off scale for wavelet decomposition used for the multifractal analysis. Our analysis was performed over experimental scattering functions of the ionospheric channel obtained with an experimental support: STU-DIO station installed near to Paris. Results will be very useful for further ionosphere modeling. [C1511]

## "Generalized ambiguity matrix of a vector time-spatial radar signal"

There is introduced the concept of an ambiguity function of a time-spatial vector signal. Unlike the well known radar signal ambiguity function, the introduced matrix allows the estimation of the potential resolution ability not only by range and Doppler velocity, but also by angle co-ordinate parameters in the case of joint estimation of all these parameters with the help of radars with full polarization analysis. [C1512]

## "Measuring the impact of slow user motion on packet loss and delay over IEEE 802.11b wireless links"

IEEE 802.11b compliant WLAN technology is increasingly used for cordless telephone services. Often, a WLAN phone is moved during a call. In the present paper we explore to what extent slow user motion influences the wireless link quality. We conducted extensive measurements with speech over commercial WLAN equipment using an experimental environment enforcing controlled motion. Our experiments show that-in contrast to the common assumption-an increase of motion speed can result in a better link quality: The packet loss rate and variance, measured after link-layer retransmissions, decreases. In addition, our measurements demonstrate that the modulation type, the maximal number of retransmissions, the experimental setting, and even the quality of power supply are the dominant influences on link quality. [C1513]

## "An analytical expression for the Doppler spectrum of forest clutter"

The dominant effect of the clutter Doppler spectra on coherent radar performance needs a detailed study of the Doppler process in the clutter. This paper introduces a method for characterizing the statistical properties of Doppler velocity of the radar clutter echoes from forest terrains. In this paper, a modified model is derived for the Doppler spectrum. The derived model provides a theoretical basis for the spectral shapes observed in the measurement tests for common ground clutter. The method presented here is directly applicable to many problems in the simulation of Doppler processes. [C1514]

## "The Cassini solar conjunction experiment: a new test of general relativity"

During the Cassini solar conjunction experiment, radio-metric data have been used to measure the space components of the sun's metric tensor. In the parameterized post-newtonian formalism, this quantity is controlled by a parameter (γ) which is unity in General Relativity but may assume slightly different values in other metric theories of gravity. The measurement of γ with Cassini is based upon a new observable quantity: the frequency shift induced on a radio wave when the spacecraft is near solar conjunction. The calibration of the large frequency fluctuations induced by the solar corona, necessary in order to guarantee the required signal stability, is performed using the novel Cassini radio frequency system, based on a multifrequency link. In this paper the operations performed and the results obtained from the preliminary analysis of the June-July 2002 Cassini solar conjunction data are described. The multifrequency link plasma calibration scheme is also illustrated along with the techniques for the reduction of the non-dispersive, tropospheric effects. The high quality of the calibrated Doppler data indicates that the experiment provides a high accuracy test of general relativity. [C1515]

## "Capacity autocorrelation characteristic of MIMO systems over Doppler spread channels"

To avoid excessive overhead, some MIMO systems adopt simple feedback that does not provide detailed channel state information (CSI) but also indicates the state of channel capacity utilization. According to the utilization information, transmitter can perform adaptive coding and modulation. The reliability of the feedback signal with delay Δt is studied in this paper in terms of the capacity autocorrelation characteristic, and impacts of antenna numbers and vehicle speed on the required delay are derived. [C1516]

## "On the robustness of decision-feedback detection of DPSK and differential unitary space-time modulation in Rayleigh-fading channels"

Decision-feedback differential detection (DFDD) of differential phase-shift keying (DPSK) and differential unitary space-time modulation (DUST) in Rayleigh fading channels exhibits significant performance improvement over standard single-symbol ML detector, but it requires the knowledge of fading correlation and SNR at the receiver. In this paper, we investigate the robustness of the DFDD to imperfect knowledge of fading correlation and SNR. We derive the exact and Chernoff bound expressions for pair-wise word-error probability (PWEP), and then use them to approximate the BER, finding close agreement with simulation results. The relationships between performance and various system parameters, e.g., DFDD length and Doppler mismatch are also explored. [C1517]

## "Impact of measurement errors on the closed loop power control for CDMA systems"

In this paper we present a simple analytical model to evaluate the impact of measurement errors on the closed-loop power control for code division multiple access (CDMA) systems. By introducing a new performance measurement, the probability of false command in power control, PFC, a closed form formula for calculating PFCwith consideration of measurement errors is presented. Furthermore, we derive a bit error rate (BER) performance bound in terms of PFCfor the CDMA system with closed-loop power control (CLPC). The proposed

analytical approach can quantitatively evaluate the performance of the CLPC taking into account of the effects of measurement errors and Doppler frequency under a Rayleigh fading channel. Through simulation and analysis, we show that the proposed analytical BER bound can accurately estimate the BER performance of the CLPC under the impact of measurement errors. Interestingly, we find that the CLPC is less sensitive to measurement errors due to the non-linear operation in the one step up/down power control scheme compared with the variable-step size power control. [C1518]

## "The application of ADCP to the measurement of current system at the hydrothermal active areas"

Direct current measurement in the hydrothermal area is one of the important factors to understand the hydrothermal system. The application of ADCP is known to an effective to measure the general understanding of the ocean current. The RDI Workhorse Sentinel 300kHz ADCP was tried to use attaching on the JAMSTEC/Deep Tow Sonar System, the manned submersible Shinkai 2000 and deploying at the seafloor by ROV Dolphin 3K during a few scientific cruises at the hydrothermal active areas in the Western Pacific. The JAMSTEC/Deep Tow Sonar was carried out to survey for precise topographic at the hydrothermal area in the Southern Mariana Trough in January 2000. During the survey cruise, the ADCP was attached on the sonar with down looking. It was towed about 80-120m above the seafloor as a speed of less 1kts. According to the observation, acoustic backscattering was too weak to measure over 30m ranges; in addition vertical component was difficult to measure depending on the heaving effect from the ship. It is necessary to reduce the heaving motion at the fish such as using sub-fish system that is separated from main-fish via a secondary cable. In the hydrothermal area of the Mid Okinawa Trough, which is known as several active hydrothermal. areas with huge chimneys which height about 30m as temperature of over 230°C, the current measurement by ADCP was carried out using the Shinkai 2000 in June 2000. ADCP was mounted down looking on the Shinkai 2000 as a payload. The Shinkai 2000 was operated with 0.3-0.5kts keeping its depths from 870m to 900m. During this observation, it was obtained the current profile as about 100m range. It was measured about 10-20cm/sec upward current in the hydrothermal active area. In the same area, ADCP was deployed for 23 hours as up looking at beside of the hydrothermal chimney. It was settled and recovered by the ROV Dolphin 3K in June 2000. Current measurement condition was changed about every 6 hours; in a half period of the observation, acoustic backscattering signal is too weak to measure over 30m range. This change was considered to cause by the tide. The water column of hydrothermal fluid contains enough particles for acoustic backscattering; however the standard deep water of this area is too clear to ob- tain the enough acoustic backscattering. During measurable period, upward current was measured as its maximum current speed as over 20cm/sec. [C1519]

## "Outside cell interference dynamics in cellular CDMA"

We study via computer simulation the computation of the outside-cell interference factor f for cellular code-division multiple access (CDMA) wireless communication systems. This factor is inversely proportional to system capacity, and so its computation is of great practical interest. To date, all studies have focused on the mean value of f, without regard to its extrema or temporal dynamics. We compute values of the extrema for several propagation path loss exponents and user velocities, and show that the maximum value of f can be many times its mean value, and f can change as rapidly as the mobile user Doppler spread. [C1520]

## "Maneuvering target detection in over-the-horizon radar by using adaptive chirplet transform and subspace clutter rejection"

In over-the-horizon radar (OTHR) target detection, the signal-to-clutter ratio (SCR) is very low, typically from -50 dB to -60 dB. Furthermore, for maneuvering targets, such as aircraft and missiles, Doppler frequencies of their radar return signals may be time-varying. In this case, the Fourier transform based techniques and super resolution spectrum estimation techniques may not work well since they use sinusoidal signal models. We propose a signal subspace clutter rejection algorithm combined with an adaptive chirplet transform technique for maneuvering target detection with OTHR. Simulation results of adding simulated maneuvering targets into raw OTHR clutter data are presented to illustrate the effectiveness of the proposed algorithm. The simulation results show that moving targets with -53.5 dB SCR can be detected. [C1521]

## "Robust estimation of fetal heart rate variability using Doppler ultrasound"

Heart rate variability (HRV) provides important information about the development of the cardiovascular system in fetuses. The paper presents a new measure of fetal HRV that can be estimated using Doppler ultrasound techniques. This measure employs the multiple signal characterization (MUSIC) algorithm which is a high-resolution method for estimating the frequencies of sinusoidal signals embedded in white noise from short-duration measurements. We show that the product of the square-root of the estimated signal-to-noise ratio (SNR) and the variance of the frequency estimates is independent of the noise level in the signal. Since

variations in the angle of incidence of the Doppler ultrasound beam effectively changes the input SNR, this measure of HRV is robust to the input noise as well as the angle of incidence. Presented analysis results validate the robustness properties and the usefulness of the HRV measure. [C1522]

## "Nonparametric Doppler spread estimation for flat fading channels"

Accurate estimation of the Doppler spread of a mobile radio channel is of significant value as it reveals the channel's rate of change. This information can then be used to improve the performance of many wireless communication subsystems. In this paper, a nonparametric technique is proposed to estimate the maximum Doppler frequency of narrow band fading channels. Moreover, a computationally efficient periodogram-based approach is formulated, and its finite sample performance is assessed and compared to parametric covariance-based estimators via computer simulations. On the basis of these comparisons, we claim that the simplicity of the proposed method, its accurate performance for small sample sizes in a wide range of propagation scenarios, and its robustness to low SNR conditions make it a strong competitor to the parametric approaches. [C1523]

## "Approximate equation of bit error rate in OFDM systems over specular multipath fading channels"

Orthogonal frequency division multiplexing (OFDM) systems avoid the effect of multipath fading by absorbing delayed waves into guard interval. But as the effect of delayed waves over guard interval becomes stronger, it causes the bit error rate (BER) performance in OFDM systems to be more degraded. This paper proposes the approximate derivation method of the BER in DQPSK/OFDM systems over frequency selective fading channels. In this study, we will derive the approximate equation of the BER with differential coding/differential detection in the time domain. We confirm that the BER derived from the proposed approximate equation coincides with that by computer simulation even when such parameters as the Doppler frequency shift, the delay spread, the Rician factor and so on are varied. [C1524]

## "Effectiveness of acoustical backscatter measurements from acoustical profilers for estimation of suspended sediment concentration"

In this paper the effectiveness of an approach proposed by Deines [1] for conversion of acoustic backscatter to suspended sediment concentration is verified with measurement data carried out in a tidal flat region of the German North Sea. Extensive measurement data using a 1200 kHz Direct Reading Broadband Acoustic Doppler Current Profiler (ADCP) from a moving vessel were considered. Field conditions with water depths varying from 5 to 20m, depth-averaged current velocities up to 1.4m/s and suspended sediment concentration up to 1350mg/l were covered. Acoustical profiling and optical transmission sampling of suspended sediment concentration over the depth were carried out in more than 200 locations. Comparisons between suspended sediment concentration profiles obtained by converting acoustic backscatter and optical transmission sampling were considered to verify the effectiveness of the approach. The effect of various parameters on the resulting suspended sediment concentration was investigated. The agreement between the concentrations obtained on. the basis of optical and acoustical devices is quite good. Considering the reference concentration values at mid-depth, 97% of the results based on the acoustical measurement lie within a factor of 2 with respect to the ones obtained from the optical sampler. [C1525]

## "Speed trap detection with Doppler effect"

In this paper, the 8-bit MC68HC11 MCU micro controller is used to receive data speed from Doppler radar speed sensor. Vehicle speeds are detected by Doppler radar speed sensor and then sent to a micro controller. The micro controller is programmed to detect the signal and calculate the speed of vehicle, display data on LCD, and concurrently send data to PC through RS-232 port via serial communication interface. The GUI for PC is developed with VB6 programming to receive data from micro controller and capture picture. VB6 is programmed to manual capture an image and also auto capture and auto save an image in directory if vehicle speed is over speed limit selected from micro controller. Also Microsoft's access database program is used to save/record data in a database. [C1526]

## "Refraction and shoaling of surface waves by currents and topography as observed by HF radars"

Phased-array Doppler radars were deployed immediately south of the mouth of the Chesapeake Bay during the COPE-3 experiment in the fall of 1997. The radars collected the Doppler spectra and extracted surface current vectors for a period of 45 days. Significant wave height and peak period estimates were obtained from the Doppler spectra using the method originally developed by Barrick (1977). The study region was strongly impacted by the outflow from the Chesapeake Bay. The buoyant plume that emanated from the bay during ebb tides was observed in the surface current maps produced by the HF radars. Significant surface current shear existed at the boundary where the buoyant plume overrode denser shelf water, resulting in a convergence

frontal zone. The refraction and shoaling of the surface waves was observed as they propagated over these regions. The current-induced shoaling of incident waves was isolated from the effects of local topography. The location of significant wave height growth and dissipation was found to be dependent upon the tidal stage and the wind and wave direction. Regional remote sensing of both waves and currents was necessary to identify these high energy regions which are of considerable interest for studies of mixing at the estuarine front as well as for the safe maritime operations. [C1527]

## "Wireless fading vector channel model for multi-antenna system at mobile terminals"

To investigate the performance of smart antenna technology applied in mobile terminals, the simulation of multi-antenna system requires a spatial channel model, which should reasonably characterize the effects of wireless channel, such as time-varying, multipath-fading and Doppler effects, between base station and mobile handsets. This paper presents a space-time vector channel model fit for these demands. Based on the lowpass-equivalent impulse response, the diverse stochastic parameters of the channel, such as DOA/TOA and Rayleigh fading, are discussed at full length. The final simulated channel data produced by this model is consistent with previous theory and measurement, which exhibits its feasibility for the further investigation of different smart antenna algorithms or joint detection techniques. [C1528]

## "Kalman filter estimator for WCDMA FDD Rake receiver"

Wideband demodulation performance can be hindered by the channel estimator. In particular, the fading property of the channel and high noise level signals will introduce a degree of discrepancy in the channel estimate. In this paper, we investigate the Rake receiver performance incorporating decision-aided Kalman filter estimation. The Kalman predictor estimates the present channel value, based on a first-order Gauss Markov model, for subsequent maximal ratio combining. Moreover, the decision-aided component uses data estimates based on linear interpolation, to correct the initial predicted complex channel amplitude. Simulation results show that the proposed scheme can overcome the channel fading effect for moderate Doppler spreads, and can offer significant improvement in performance compared to conventional schemes, in terms of estimation and complexity. [C1529]

## "Compliant mooring technology to separate buoy motion from in-line current meter observations"

To separate buoy motion effects from current meters and other sensors on the mooring line, compliant elastic elements have been used in the mooring directly under the buoy. This approach was used in the Massachusetts Bays Program to separate surface buoy motion from VACM current meters below. the elastic elements. Recently a mooring designed to measure waves with a surface following buoy was instrumented with an ADCP and water property sensors. Compliant elastic elements were used at the top of the mooring to allow the buoy to move freely with the waves without having to accelerate the mooring and deeper instrumentation. An ADCP was mounted near the bottom in an upward looking configuration. 0.5 kN of additional flotation (120 lbf) at the bottom of the elastic elements kept the lower part of the mooring taut to minimize motion. The elastic elements provided about 1.3 kN (300 lbf.) of mooring pretension, and, depending on the horizontal current and the wave activity, the tension at the buoy could rise to about 3.5 kN (800 lbf.). Computer modeling of the mooring showed no vertical and minimum horizontal motion in the lower part of the mooring and reasonable tensions that would allow the buoy to follow the waves. Data from the accelerometer in the buoy, the SeaCats in-line and ADCP near the bottom were of high quality. The mooring was recovered by releasing a float from mid-depth that brought a line to the surface from below the elastic elements to allow the mooring (with sensors) and anchor to be retrieved. [C1530]

## "The effects of mobile scatterers on the quality of ADCP data in differing marine environments"

Doppler Current Profilers are now regularly used to measure current profiles in waters from the shallowest coastal region to the most extreme deepwater site. Various different frequencies of instrument are employed to cover vertical bin depths of a few centimetres to many tens of metres. The common factor between them all is that they rely on particles (scatterers) within the water column to reflect back the acoustic signal transmitted by the instrument. In order for the technique to function, these scatterers must be assumed to drift with the ocean flow. Current velocity data have been collected in a number of geographical areas where these scatterers appear to move, independent of the current flow. Several different effects have been identified, the commonest being the diurnal vertical migration of plankton and grazers, which can be characterised by a high vertical velocity at dawn and dusk. At times, this situation is further complicated by animals that appear to swim with a significant horizontal component to their velocity against or at least non-coincident with the main current flow. This can be seen as troughs in the horizontal current speed trace from the ADCP at the same times each day. While the diurnal transports of plankton and nekton are well known, the paper focuses on the current velocity

data. Examples are shown of the main types of effect on data sets recorded in some of the major deepwater exploration regions of the world and looks at methods of removing the erroneous data from the real current velocity. [C1531]

## "The application of the Doppler shifted dispersion relationship to hurricane wave data from an ADCP directional wave gauge and co-located pressure sensor"

Waves from hurricanes Lili and Isidore were measured using an ADCP directional wave gauge and an independent pressure sensor. The array is part of Louisiana State University's WAVCIS ocean observing system located in the northern Gulf of Mexico. Data demonstrate the effects of strong storm surge induced currents on wavenumber. We investigate the effect of Doppler shifting of wavenumber to wave height estimates and wave direction. Comparison data are used from direct surface measurement and a co-located PUV sensor to show the extent of errors introduced by currents. The importance of accurately measuring wave heights during extreme events underscores the value of addressing significant error sources associated with storm surge. [C1532]

## "Can wave direction be measured from an AUV?"

AUVs on survey missions in coastal environments provide platforms of opportunity for making directional wave observations. However, there are several complications that arise when wave observations are made from a moving platform. One of these is a Doppler shift in the dispersion relation, which causes correctable distortion in the observed directional wave spectrum. A modified triplet algorithm is described that corrects for platform motion by subtracting bottom-track velocity. The Doppler distortion effect and the algorithm are illustrated using data taken using an ADCP on a moving platform. [C1533]

## "A piecewise parametric method based on polynomial phase model to compensate ionospheric phase contamination"

This paper addresses a parametric method based on high-order ambiguity function (HAF) to solve the problem of phase contamination of HF skywave radar signals corrupted by the ionosphere. When signal-to-noise ratio and data sequence available satisfy the predefined conditions, the ionospheric phase contamination may be modeled by the polynomial phase signal. As a new parametric tool for analyzing polynomial phase signal, HAF is applied to estimate polynomial phase model parameters and reconstruct the disturbance signal. Using the estimated reconstructed signal, compensation can be performed before coherent integration and the original radar return spectrum can be restored. A piecewise scheme is proposed to track rapid variation of the phase contamination in HAF method, and it can remove the Doppler spread effect caused by the ionosphere nonstationarity. Simulation is used to demonstrate the efficiency of the proposed method. [C1534]

## "A practical slotted quasi-synchronous CDMA access system for LEO micro-satellite short message transmission"

A system to provide non-realtime short message transmission service to a wide-area of users via low Earth orbit (LEO) micro-satellite is developed. To increase the system capacity, a novel and efficient slotted quasi-synchronous CDMA access protocol is specially designed to deal with the serious Doppler shift and propagation delay variation. Before each message burst transmission, the user will randomly choose an access slot to send a short request to satellite and listen to the echo from the satellite. The channel delay and Doppler shift are then estimated from the echo and compensated in the immediate following message transmission slot, thus to achieve quasi-synchronization between all user message bursts. The short request also acts as a reservation indicator, which prevents other users to use the immediate following message slot as access slots. The system throughput is analyzed by exploring the capture effects of the quasi-synchronous message bursts and the asynchronous request bursts, respectively. Transceiver requirements are implementation considerations are discussed, and the prototype is also described. [C1535]

## "Application of angular diversity in OFDM systems"

Orthogonal frequency division multiplexing (OFDM) can be successfully used in mitigating the effect of multipath in a wireless channel. However, its' performance degrade in the presence of Doppler spreading. In this paper, multiple beamforming using uniform linear arrays (ULA) is used for OFDM systems to reduce Doppler spread and exploit the advantage of diversity. Each of the beams receiver signal which equal Doppler spread, which are combined using equal gain combining (EGC). We also present a method of determining the frequency compensating parameters, for beams pointing in different directions. Finally, our simulation results show that angular diversity in OFDM systems can provide significant improvement as compared to using only single beamforming. [C1536]

## "Effects of geometry on clutter characteristics of bistatic radars"

This paper deals with the clutter characteristics of multichannel airborne radars. The analysis is performed using the clutter spectral center, which is a descriptive metric, in addition to commonly used measures such as Doppler-angle traces, iso-range, and iso-Doppler contours etc. The clutter characteristics of monostatic systems in the presence of crab angles and system errors are first examined. Then, the analysis of bistatic systems is focused on the effect of geometry on the clutter characteristics. Several interesting rules made from observation for the clutter characteristics with bistatic geometry are discussed. [C1537]

## "Optimum frequency-domain partial response encoding in OFDM system"

Time-variance of wireless channels destroys the orthogonality among subchannels in OFDM system and causes the inter-channel interference (ICI), which results in an error floor. In this paper, we study frequency-domain partial response coding (PRC) for reducing the effect of the ICI. Based on the general expression of the ICI power for OFDM with PRC, the optimum weights for PRC that minimize the ICI power are derived. From numerical and simulation results, optimum PRC for OFDM can reduce the ICI effectively by 4.0 dB for 2-tap PRC and 6.2 dB for 3-tap PRC, respectively. [C1538]

## "Low-biased Doppler frequency estimation scheme employing variable prefilter and sampling rate"

There are several popular Doppler frequency estimation algorithms using pilot symbols in wireless communication systems. When there exist additive noise, the estimates of these algorithms are upward biased. Prefiltering and down-sampling the received pilot symbols reduces the bias because it improves the signal-to-noise ratio and decreases the noise bandwidth. However, when the cutoff frequency of prefilter and sampling rate are fixed considering the expected maximum Doppler frequency, the bias at low Doppler frequency is not sufficiently reduced. In this paper, we propose several variable Doppler frequency estimation schemes employing variable Doppler frequency estimation schemes employing variable sampling rate, variable prefilter or the both of them. The performance of the proposed estimation schemes is analytically evaluated and verified by computer simulation. The evaluation results show that the bias due to additive noise is considerably reduced using the proposed schemes. [C1539]

## "A study on channel estimation methods for MC-CDMA systems"

In this paper, we propose a novel channel estimation method for time-domain spreading multi-carrier code division multi-carrier code division multiple access (MC-CDMA) systems. In time-domain spreading MC-CDMA systems, code-multiplexed pilot symbols are transmitted consecutively in both time and frequency domains. In our proposed method, weighted pilot symbols in both domains are coherently added to improve signal-to-noise ratio (SNR) of pilot symbols in channel estimation. However, the channel estimation quality degrades when the weights of pilot symbols are not selected appropriately according to the changes of propagation environments. We propose a method which the optimum weighting factors for pilot symbols are adaptively selected according to the changes of propagation environments, by measuring maximum Doppler frequency for the time domain and delay spread for the frequency domain at MS (mobile station). We evaluate our proposed method by computer simulation, and clarify improvement of channel estimation accuracy. [C1540]

## "Exhaustive search for Costas-type sequences for multi-target recognition"

Costas and sonar sequences were respectively introduced in [2] and [10] to deal with the following problem: "An object is moving towards (or away) from an observer, who wants to know effectively the distance to the object and its velocity." The solution to the problem makes use of the Doppler effect, which states the following: when a signal bounces off a moving target its frequency changes in direct proportion to the velocity of the object relative to the observer. In other words, if the observer sends out a signal towards a moving target, the change between the frequency of the outgoing and that of the returning signal will allow him to determine the velocity of the target, and the time it took to make the round trip will allow him to determine the distance. [C1541]

## "Application of neural fuzzy network to pulse compression with binary phase code"

To solve the existing dilemma between making good range resolution and maintaining the low average transmitted power, it is necessary for the pulse compression processing to give low range sidelobes in the modern high-resolution radar systems. The traditional pulse compression algorithms based on 13-element Barker code such as direct autocorrelation filter (ACF), least squares (LS) inverse filter, and linear programming (LP) filter have been developed, and the neural network algorithms were issued recently. However, the traditional algorithms cannot achieve the requirement of high signal-to-sidelobe ratio, and the normal neural network such as backpropagation (BP) network usually produces the extra problems of low convergence speed and sensitive

to the Doppler frequency shift. To overcome these defects, a new approach using a neural fuzzy network with binary phase code to deal with pulse compression in a radar system is presented in this paper. The 13-element Barker code used as the binary phase signal code is carried out by six-layer self-constructing neural fuzzy network (SONFIN) with supervised learning algorithm. Simulation results show that this neural fuzzy network pulse compression (NFNPC) algorithm has the significant advantages in noise rejection performance, range resolution ability and Doppler tolerance, which are superior to the traditional and BP algorithms, and has faster convergence speed than BP algorithm. [C1542]

## "Target detection in sea clutter using convolutional neural networks"

A detector based on convolutional neural networks is proposed for radar detection of floating targets in highly complex and nonstationary cluttered environments. This detector is coherent and monocell, i.e. it works with the complex envelope of the echoes from the same range cell. It includes a pre-processing time-frequency block implemented by the Wigner-Ville distribution, which provides a constant false alarm rate (CFAR) behavior regarding the clutter power when normalization is utilized. Simple theoretical models for the clutter and targets were allowed to study the impact of the correlation and Doppler of both target and clutter on its performance. This detector has also been tested with real-life sea clutter with an improved performance compared to classic detectors. [C1543]

## "A virtual representation for time- and frequency-selective correlated MIMO channels"

A key to reliable communication is a fundamental understanding of the interaction between the signal space and the channel. In time- and frequency-selective MIMO (space-time) fading channels this interaction happens in time, frequency and space. In this paper we propose a four-dimensional Karhunen-Loeve-like virtual representation for space-time channels that captures the essence of such interaction and exposes the intrinsic degrees of freedom in the channel. The four dimensions are: time, frequency and the two spatial dimensions at the transmitter and receiver. The key signal space parameters are the signaling duration, bandwidth and the two array apertures. The corresponding channel parameters are the delay, Doppler and the two angular spreads associated with the scattering environment. The representation induces a virtual partitioning of propagation paths in time, frequency and space that reveals their contribution to channel capacity and diversity. It also exposes fundamental dependencies between time, frequency and space thereby revealing the essential degrees of freedom. [C1544]

## "A new pilot assisted frequency synchronization for wireless OFDM systems"

A new frequency offset synchronization algorithm is proposed for OFDM systems over time varying multipath fading channels. This algorithm employs pilot symbols embedded in data symbols to estimate the frequency offset. In particular, a fine frequency offset estimate is achieved by properly combining frequency-offset estimates from pilots over different frequency locations. Moreover, the effects of time varying channels and the number of sub-carriers are analyzed and the rule for the selection of the number of OFDM symbols used for the synchronization algorithm is given. Simulations are conducted to demonstrate the effectiveness of the proposed scheme. [C1545]

## "Block differential encoding for rapidly fading channels"

Rapidly fading channels provide Doppler-induced diversity, but are also challenging to estimate. To by-pass channel estimation, we derive a novel block differential codec. Relying on a basis expansion model for time-varying channels, our block differential design is easy to implement, and achieves the maximum possible Doppler diversity. Simulation results corroborate our theoretical analysis. [C1546]

## "Channel modeling and associated inter-carrier interference equalization for OFDM systems with high Doppler spread"

We address the problem of OFDM transmission over a time-varying, frequency-selective channel with high Doppler spread. This creates situations where the channel significantly evolves over the time span of one OFDM symbol. We analyze the CP-OFDM transmission mechanism, and the impairments due to channel variations, using a decomposition of these variations over a base of sinusoid functions sampling the Doppler spectrum at subcarrier frequencies. On the one hand, this leads to a fairly parsimonious parameterization of the time-varying channel impulse response. On the other hand we show that, considering a whole CP-OFDM symbol, this leads to a duality between equalization of the delay spread of a time-varying channel in the time domain, and the equalization of the Doppler spread of a frequency selective channel in the frequency domain. Using this duality, we show that equalization in the frequency domain can benefit from all known time domain equalization methods. [C1547]

## "Medium PRF radar PRF optimisation using evolutionary algorithms"

In this paper we employ evolutionary algorithms for the selection of optimal pulse repetition frequency (PRF) sets to minimise range-Doppler blindness in a model of a medium PRF radar. Both eight and nine PRF schedules are considered and the algorithm ensures that all the solutions produced are fully decodable and have no blind velocities. We consider the detailed effects of side-lobe clutter and the many technical factors affecting the choice of radar PRF in a medium PRF mode of operation of a practical airborne fire control radar. [C1548]

## "Target detection in heterogeneous airborne radar interference using 3D STAP"

Heterogeneous interference is common-place in the airborne radar problem. Space-time adaptive processing fundamentals have struggled in the presence of such data. Originally, the solution involved simply increasing secondary data support, essentially "drowning" out heterogeneous interference effects. Research then progressed into identifying specific range cells containing heterogeneous interference and excising these cells from interference estimates. Yet, the target detection problem within heterogeneous interference remained. Therefore, research efforts abandoned statistical techniques and shifted towards deterministic methods with some success. Finally, the advent of a two-dimensional hybrid approach combined the diverse statistical and deterministic techniques into a single framework. This research effort continues in this vein by expanding the method into three-dimensions: azimuth, Doppler, and elevation. A 23 dB improvement over the three-dimensional joint domain localized method (3D-JDL) is shown for a specific heterogeneous interference case. [C1549]

## "Mitigating the effects of chaff in ballistic missile defense"

In this paper, an algorithmic (schema) approach for detecting and tracking targets in highly cluttered environments is presented. The approach is to accurately track the centroid of the chaff cloud using a combination of medium band (MB) and wide band (WB) range resolution radar waveforms. At moderate pulse repetition frequencies (PRFs), differential target velocities (about the centroid of the chaff cloud) are detected and tracked via Doppler banks of transversal filters that are tuned to detect the target velocity differences. Through sensitivity analysis using Matlab models, the theoretical lower bound on detectable differential target velocity as a function of the chaff cloud composition (e.g., clutter cross section, clutter spectral width, number of dipoles, and clutter velocity standard deviation) and radar related parameters (e.g., waveform frequency, bandwidth, integration times, PRFs, and signal-to-clutter ratio) is presented. [C1550]

## "High fidelity modeling of space-based radar"

Space based radar design are becoming more affordable given new technologies of solid state active apertures and advanced digital signal processing. However, it is important to be able to synthesize the design of the system with sufficient detail to anticipate the radar system's operation and interference effects expected in a space environment. This includes simulation of site specific clutter with realistic Earth rotation and statistical variation, wideband propagation of the signal from multiple phase center aperture, and impact of channel match and errors on adaptive processing for detecting targets. The research laboratory space time adaptive processing (RLSTAP) has been developed as a variable fidelity radar simulation tool to captures these effects. The paper will describe results of modeling an L-band multimode space based radar, including effective of ambiguities from antenna subarrays, and range and Doppler waveforms on adaptive processing. [C1551]

## "BER performance of differential demodulation OFDM system in multipath fading channels"

In this paper, the bit error rate (BER) performance of orthogonal frequency division multiplexing (OFDM) system in multipath fading channels using the frequency domain differential demodulation (FDDD) and time domain differential demodulation (TDDD) is analyzed. The results indicate that in frequency-nonselective fading channel, the BER performance of FDDD is better than that of TDDD. In frequency-selective fading channel, if the time delay doesn't exceed the guard time, the BER performance of TDDD is not affected by the multipath and time delay, but it is affected by the Doppler frequency; the BER performance of FDDD is affected by the time delay and the Doppler frequency at the same time. With the increase of Doppler frequency, the BER performance of FDDD is better than that of TDDD demodulation. [C1552]

## "ARFI imaging of the cardiovascular system"

We present results of a pilot study of ex vivo and in vivo acoustic radiation force impulse (ARFI) imaging demonstrating measurements of the mechanical properties of the medial and adventitial layers in the carotid, and popliteal arteries. The data was obtained on a commercial scanner, providing co-registered B-mode and Color

Doppler images. A real-time ARFI imaging system capable of achieving frame rates of 0.75 Hz was developed. The 2-D and 1-D images of the tissue's response to brief and localized applications of radiation force show good correlation with B-mode and pathology based characterization of vessel geometry and plaque stiffness. Measurements of arterial response during both systole and diastole are presented. We address implementation issues and discuss the potential applications of this new vascular imaging method. [C1553]

## "Ultrasound biomicroscopy for mouse imaging and Doppler: assessment of potential for biological effects in the embryo and at soft tissue-bone interfaces"

Ultrasound biomicroscopy (UBM) uses high frequencies to noninvasively yield high resolution real-time images. UBM can structurally and functionally assess development and disease models in the mouse. However, little has been reported on the thermal effects of tissue exposure to high-frequency ultrasound, and established guidelines for the safe use of clinical ultrasound use biophysical principles which have been adapted for diagnostic frequencies, and there are no published guidelines for the safe use of high frequency ultrasound. We assessed the potential of 40 MHz ultrasound to cause biological effects in mouse embryogenesis and at soft tissue-bone interfaces. UBM appears safe for mouse imaging, with thermal effects possible at tissue-bone interfaces. [C1554]

## "An analysis of the angle dependence in strain (rate) imaging of the left ventricle"

In this paper, we analyze the angle dependence of longitudinal strain estimates in the left ventricle (LV). We also assess the effect of moving the sample volume (SV) according to the left ventricular motion. The analysis was performed by calculating the true strain and estimated ("Doppler-based") strain in a thick-walled deforming ellipsoid that incorporates chamber deformation and torsion. LV diameter, wall thickness and base-to-apex length were measured in 15 healthy individuals, averaged to obtain a representative cardiac cycle and used as input to the model. Firstly, we simulated myocardial deformations as imaged from the apical view with the transducer at various lateral positions (0 mm corresponded to a position 10 mm straight above the apex). For the apical, mid and basal segments the true systolic strains were: -16.4, -16.7 and -17.0 %, respectively. The optimal transducer positions, giving negligible measurement errors, were (moving/fixed SV): 7/8 mm, 15/17 mm and 21/25 mm. When the transducer was positioned at 0 mm (i.e. straight above the apex), the estimated strains were (moving/fixed SV): -15.2/-14.7, -14.5/-14.0 and -14.3/-13.7%. The ranges of lateral transducer locations with estimated strains (moving SV) within 80% of the true strain were -5-17 mm, -4-32 mm and 3-45 mm. Secondly, we calculated estimated strain in the basal segment when varying the beam-to-wall angle from 0 to 30 degrees. The estimated peak strain was within 80% of true peak strain for beam-to-wall angles less than 16 degrees. In conclusion, the conventional clinical imaging window straight above the apex gives measurement errors for the mid and basal segments in the range 13-16% (moving SV), suggesting that the transducer position should be optimized with these segments in mind. A moving SV reduces the distance between the optimal transducer positions of the three segments. Since the actual transducer position is the same for all three segments, this in effect reduces the overall measurement error. A beam-to-wall misalignment of more than 15 degrees should be avoided. [C1555]

## "Estimating the spatial time correlation of signals from two obstructed mobile transceivers"

In this work formulations are designed to determine the spatial time correlation and the power spectrum of two mobile transceivers. In a CBD scenario, signals transmitted from the transceivers may travel longer path lengths due to reflective obstructions, and hence have longer delays than direct signals. This creates a reception problem due to the signal spread resulting in inter-symbol-interference. There is also a problem of trying to correlate two or more signals as the magnitudes and phases of these signals vary based on their specific path parameters. A means to estimate the signal at each receiver and account for the spatial time correlation of these signals is proposed in this paper. [C1556]

## "Numerical simulation of ultrasonic transit-time flowmeter performance in high temperature gas flows"

The use of electrostatic transducers avoids the limitations associated with piezoelectric transducers in gas flowmeters, such as their restricted maximum allowable gas temperatures and attainable measuring repetition rates. The measurement at high temperature (up to 600°C) has necessitated the development of a new and innovative electrostatic transducer. In this work a structured thermally oxidized silicon backplate covered with a bulk conducting 3µm titanium foil as membrane is used instead of e.g. a metallized polymer film. This configuration enables the application of transit-time flowmeters to the measurement of hot pulsating gas flows (up to 3kHz). Knowledge of the influence of the temperature and velocity profiles on the wave propagation in this high temperature range is essential for design improvements and operating and accuracy limits of the gas flowmeter. This paper presents a numerical 3-D procedure based on Ray-tracing to simulate the sound

refraction and drift due to different temperature and velocity profiles for several transducer arrangements. The limits and dynamics of the used profiles are taken from measured data acquired on an exhaust train of an automotive combustion engine, as an exemplary application under extreme operating conditions. The wave propagation is modelled for a heatable double-path flowmeter with transducers of finite surface. Due to the high dynamics of the temperature variations and the thermal inertia of the flowmeter, negative temperature gradients must be taken into account. Since they result in focusing the wave front and a reversed refraction direction. The physical limits of transit-time flow metering in such hot gases can be determined. The up and down stream travel times and the best-case-normalized transmitter-receiver pressure ratios are presented for different working conditions and measuring set-ups. These results have been used to optimize the design of the measurement cell and to find the temperature-induced correction of the usually used equation to calculate the gas flow velocity. Additionally, clear 3-D visualizations of the wave fronts and their temporal propagation through the gas are generated. [C1557]

## "Structural and Doppler imaging of Xenopus Laevis embryos in vivo: a comparison of ultrasound biomicroscopy and optical coherence tomography"

This study compares two non-invasive imaging modalities, ultrasound biomicroscopy (UBM) and optical coherence tomography (OCT), of Xenopus Laevis embryos. Differences in the underlining physics for image formation, and similarities in the signal processing will be presented in terms of imaging depth, spatial resolution, frame rate, and flow velocity estimation. Finally, the suitability of a combined UBM/OCT imaging system will be explored. [C1558]

## "Feasibility of haemostasis in prostate using a flat trans-urethral transducer"

The objective of this work is to demonstrate the feasibility of trans-urethral application of collimated high intensity ultrasound in order to coagulate blood vessels in prostate. The coagulating tool is a flat 6Ч10mm2transducer. It operates at a frequency of 10MHz. Doppler and conventional ultrasound imaging were performed before and after treatment. The effect of intensity, exposure duration and angular step between elementary exposures on therapeutic depth and thrombosed vessels density was studied. The therapeutic depth ranged from 6 to 10 mm. Hyperechoic spots were observed on sonograms for a few minutes right after treatment and a permanent hypoechoic zone remained in the treated zone. It corresponded in size to the histologically assessed zone of coagulation. A significant fall in Doppler signal amplitude immediately after treatment demonstrated the applicator's ability to achieve haemostasis. The coagulation rate obtained by dividing the vessel density of the treated sample by the vessel density of the controls ranged between 51% and 99%. We demonstrated that a miniature flat ultrasound 10MHz-transducer can be used to coagulate blood vessels with a diameter less than 1 mm and located at a distance less than 1 cm from the organ surface. This makes our transducer suitable for trans-urethral application of high intensity ultrasound to coagulate prostatic tissues and vessels. [C1559]

## "Ultrasonic self-normalized wavelet-based detection and estimation of unknown transient vibrations in colored Gaussian noise and strong, low frequency clutter"

The detection and quantitation of transitory audio frequency sounds originating from within the body are useful diagnostic tools. Such sounds arising from arterial stenoses, aneurysms and arterio-venous shunts, which are often superimposed on ultrasound Doppler data, may have short durations and varying frequencies. Automated detection and estimation (characterization) of these vibrations may enhance diagnosis of these disorders. The noise may be both non-stationary and colored, but can be assumed Gaussian; the clutter due to arterial wall movement may be extremely large. This paper addresses this detection challenge by using a binary hypothesis test for noise only, based on the continuous Morlet wavelet power spectrum normalized by adaptive noise variance estimates. The algorithm yields rough estimates of the amplitude, frequency range, time location and duration of detected vibrations. Simulated receiver operating curves are presented for short duration transient vibrations in colored and slowly time varying Gaussian noise and in 60 dB clutter. These curves indicate that this method achieves expected detection rates in excess of 99.8% at false alarm rates of 0.1% for (signal-on) signal to noise ratios as small as 1. A comparison is included to a slight modification of Wang and Willett's recently published self-normalizing extension of Nutall's power law detector. Although the two detectors yield similar results in the absence of clutter, the new detector achieves the same high detection rates when clutter is present while also providing estimates of the detected vibrations' parameters. [C1560]

## "Observations of radiations forces effects on individual air bubbles with high speed photography"

Background: Previous studies dealing with contrast agent microbubbles have demonstrated that an ultrasound (US) burst can significantly influence the flow of microbubbles and therefore the Doppler frequency shifts. This study presents the effect of the radiation force on individual air bubbles with various diameters using high-speed

photography. Method: A stream of uniform air bubbles with a diameter ranging from 31 μm to 80 μm was insonified with a single US pulse. The transmitted pulse contained 10 cycles at 130 kHz. The measured acoustic pressures ranged from 68 kPa up to 180 kPa. The maximal axial displacements of the bubbles produced by the action of the US pulse were optically recorded using a high-speed camera at a frame rate of 1 kHz. The camera was synchronized with the US burst. The experimental results were compared to a force balance theoretical model including the action of the primary radiation force and the fluid drag force. Results: Experimental findings agree with the theoretical predictions: the axial displacement varies with bubble size, reaching a maximum at the resonance size of 48μm. For an acoustic pressure of 100 kPa the maximal displacement was 83 μm for resonant bubbles. For bubble sizes of 37, 55, 69 and 75 μm the observed displacements were 33, 49, 19 and 10 μm respectively. The measured displacement increases linearly with the burst length and nonlinearly with the transmitted acoustic pressure. The calculated values from the model differ by 15% from the measured ones except for resonant bubbles where the displacement was overestimated up to three times. [C1561]

## "Pulse inversion Doppler for blood flow detection in the macro- and microcirculation"

Current techniques for imaging ultrasound contrast agents make no distinction between low velocity microbubbles in the microcirculation and higher velocity microbubbles in the larger vasculature. A combination of RF and Doppler filtering on a low-MI pulse inversion acquisition is presented that differentiates low velocity microbubbles, perfusion, from the higher velocity microbubbles in larger vessels. Both fundamental and harmonic Doppler signals from microbubbles are compared against conventional color Doppler signals. Due to the lower transmit amplitude and enhanced backscatter from microbubbles, the signal to clutter ratios for both the fundamental (-11 dB) and harmonic (-4 dB) vascular flow signals were greater than conventional power Doppler (-51 dB) without contrast agent. Clinical results demonstrated the feasibility and potential utility of displaying in real-time both perfusion and vascular flow using ultrasound contrast agents. [C1562]

## "Analysis and optimization of pilot-symbol-assisted-modulation M-QAM for OFDM systems"

In this paper, the current analysis focuses on the influence of demodulation performance in multipath fading propagation environments, which results from the pilot power variation of pilot symbol assisted modulation (PSAM) M-QAM in orthogonal frequency division multiplexing (OFDM) systems. The pilot-to-data power ratio (PDR) is optimized analytically, the loss due to imperfect channel estimation is calculated, and the probability is presented. Theoretical and simulation results show that the optimum PDR is affected by the signal-to-noise ratio (SNR), Doppler frequency and interpolation size etc. When the optimization parameter of PDR is used, the power of system transmission is minimum while still meeting a fixed bit error rate (BER) target, meanwhile the system can obtain to accurate channel estimation. [C1563]

## "Designing for electromagnetic compatibility in pulsed high power transmitters: a case study"

SAMEER has designed and developed a high power S band low noise transmitter for the Doppler weather radar being used by the Indian Meteorology Department at Shar, Sriharikota. The transmitter is capable of delivering 1.2 MW of RF output power. It packages a pulsed high voltage and current of 75 KV and 40 A respectively in the vicinity of low voltage CMOS and TTL logic based control and monitoring circuits. It also has low voltage circuitry floating at 80 KV DC in the vicinity of protective crowbar firing systems. The paper gives a brief case study of the system and the EMC plan followed to overcome the EMI problems faced during the development of the system. The EMI/EMC aspects and the grounding plan of the total system which has been implemented will be presented in detail in the paper. [C1564]

## "Effect of channel estimation error onto the BER performance of PSAM-OFDM in Rayleigh fading"

In this paper, the current analysis focuses on the influence of BER performance in Rayleigh fading propagation environments, which results from the channel estimation error of pilot symbol assisted modulation (PSAM) in orthogonal frequency division multiplexing (OFDM) systems. This paper first characterizes the distribution of the amplitude and phase estimates using PSAM, and the formula for BER as a function of channel correlation and interpolation filter in time and frequency is given. Also interchannel interference due to Doppler effects is taken into account. Theoretical and simulation results show that channel estimation error leads to a 1-dB degradation in average signal-to-noise ratio for the parameters considered. [C1565]

## "Performance evaluation of a data-derived iterative channel estimator for a COFDM system with receive diversity"

A low-complexity data-derived iterative channel estimator is evaluated in a receive diversity system for two and four receive antennas. The performance is shown almost to match the ideal (perfect channel knowledge) case in a low-Doppler environment. At higher Doppler frequencies, performance is still good, but deviates from the ideal

case. A Wiener filter tracking algorithm is proposed that is advantageous at lower Eb/N0ranges, however linear tracking is found to be better at higher Eb/N0ratios and therefore further improves performance for higher order modulation schemes such as 16-QAM. [C1566]

## "Experiments on throughput performance above 100-Mbps in forward link for VSF-OFCDM broadband wireless access"

This paper presents experimental evaluations on the throughput performance of the recently proposed variable spreading factor (VSF)- orthogonal frequency and code division multiplexing (OFCDM) broadband packet wireless access associated with adaptive modulation and channel coding (AMC) in the forward link multipath Rayleigh fading channel. The implemented OFCDM transceiver verifies the effectiveness of the combination of the OFCDM and AMC including QPSK and 16QAM data modulations with a fast round trip delay of 6 msec in improving the throughput performance by exploiting the frequency diversity effect in a broadband channel. The experimental results show that the throughput performance of 100 and 200 Mbps employing AMC is achieved at the average received signal energy per symbol-to-background noise power spectrum density ratio (Es/N0) of approximately 7.5 and 19 dB, respectively, for 15-code multiplexing employing time domain spreading with the spreading factor of SF = 16 in the forward link with a 100-MHz bandwidth, in a six-path Rayleigh fading channel with the fading maximum Doppler frequency of fD= 20 Hz. Furthermore, we elucidate that the throughput of more than 100 Mbps is achieved at the average received Es/N0of approximately 8-10 dB even for the root mean squared delay spread of 0.6 μsec (i.e., the maximum time delay of the path is 2 μsec) and for fD= 400 Hz (corresponding moving speed of approximately 90 km/h assuming a 5-GHz carrier frequency). [C1567]

## "Particle swarm optimization for worst case tolerance design"

Worst case tolerance analysis is a major subtask in modern industrial electronics. Recently, the demands on industrial products like production costs or probability of failure have become more and more important in order to be competitive in business. The main key to improve the quality of electronic products is the challenge to reduce the effects of parameter variations, which can be done by robust parameter design. This paper addresses the applicability of particle swarm optimization combined with pattern search for worst case circuit design. The main advantages of this approach are the efficiency and robustness of the particle swarm optimization strategy. The method is also well suited for higher order problems, i.e. for problems with a high number of design parameters, because of the linear complexity of the pattern search algorithm. [C1568]

## "Robust MIMO wireless communication in the presence of interference using ad hoc antenna arrays"

Wireless communication using multiple-input multiple-output (MIMO) systems enables increased data rates and link reliability for a given total transmit power and system bandwidth. Increased capacity is achieved by introducing additional spatial channels which are exploited using space-time coding. The spatial diversity improves the link reliability by reducing the adverse effects of link fading and shadowing. Because antenna arrays are used at both the transmitter and receiver, interference can be mitigated naturally. In this paper, MIMO communication is investigated using outdoor experimental data collected near the PCS frequency allocation (1790 MHz) in the presence of multiple jammers. Coherence issues associated with implementing antenna arrays using ad hoc groups of users are addressed. Presented here is an experimental example of demodulation of a space-time turbo code using a multichannel multiuser detector (MCMUD) that compensates for delay and Doppler spread, as well as local oscillator mismatch. In the experimental data the MIMO signal is transmitted from a moving vehicle. [C1569]

## "A virtual MIMO channel representation and applications"

A key to maximal exploitation of MIMO (multiple-input multiple-output) systems is a fundamental understanding of the interaction between the underlying complex physical scattering environment and the space-time signal space. In time- and frequency-selective MIMO (space-time) channels, this interaction happens in time, frequency and space. We present a four-dimensional Karhunen-Loeve-like virtual representation for spacetime channels that captures such interaction and exposes the intrinsic degrees of freedom in the channel. The virtual representation is a Fourier series dictated by the finite array apertures, signaling duration and bandwidth and corresponds to a uniform, fixed sampling of the angle-delay-Doppler scattering space. It provides a much-needed connection between the two existing (extreme) modeling approaches-idealized statistical models and detailed physical (ray tracing) models. In particular, it yields a simple geometric interpretation of the effects of physical scattering on channel statistics and capacity. We discuss various insights into the structure of space-time channels afforded by the virtual representation as well its application in capacity assessment, spatial multiplexing and space-time code design. [C1570]

## "A combined particle/Kalman filter for improved tracking of beam aspect targets"

Track continuity is difficult to maintain when tracking beam aspect targets. The loss of Doppler discrimination allows clutter to mask the target return, making it nearly impossible to detect. In order to improve tracking performance, a combination particle/Kalman filter has been developed. The tracking filters obviate each other as appropriate. When a target enters a Doppler blind zone, the particle filter replaces the Kalman filter as the tracking algorithm until the target exits the zone. The particle filter expands over the uncertainty region so that when the target is once again visible, it can immediately resume track via re-initialization of the Kalman filter. This paper discusses the design and simulation of this algorithm and shows the resulting improvement in track continuity. We briefly discuss how our combined particle/Kalman filter approach can be used to address the problem of targets obscured in altitude return. [C1571]

## "Microwave radiation stimulated by atom or ion beams"

Perspectives of high-frequency stimulated emission source applying accelerated beams of charged atoms which ones are widely used at present are analyzed. Radiation mechanism based on high-frequency intratomic electronic transitions due to anomalous Doppler's effect on slow waves is considered, while the low-frequency oscillations of atoms are neglected. Several slow surface wave systems with dielectric layers are estimated. In aggregate process has a complex nature since photon radiation is accompanied by excitation of atoms with following emission of more high-frequency photons. Requires to parameters of such systems and atomic beams for observation of stimulated emission needed for diverse applications are established. [C1572]

## "Effect of channel estimation errors and feedback delay on the performance of closed-loop transmit diversity system"

We analyze the performance of closed-loop transmit diversity systems in the presence of feedback delay and channel estimation error in Rayleigh time-selective flat fading. We formulate both the feedback delay and the channel estimation error as a function of Doppler spread, and derive the average bit error probability under such imperfect channel information. It is shown that the channel estimation error is more sensitive to system performance than feedback delay in slow fading environments. [C1573]

## "Speed-aware multicarrier transmission and resource allocation scheme for the uplink channel of highly mobile networks"

We propose a new transmission and resource allocation technique based on multicarrier direct-sequence CDMA (MC-DS-CDMA). The proposed system allocates subcarriers and spreading codes to users by considering their current bandwidth requirements and frequency shifts caused by their movement. Through the use of low-correlation spreading codes in close subcarriers, the scheme reduces the intercarrier interference generated by high-speed users while keeping the intersymbol interference at a low level due to multicarrier transmission. The analysis and results show that a substantial mitigation of both the intercarrier interference and bit error rate, without reducing the system bandwidth efficiency, can be achieved. [C1574]

## "Speed estimation for WCDMA based on the channel envelope derivative"

Reliable estimates of the speed or, equivalently, the perceived channel Doppler spread, are of great importance in mobile cellular systems for optimization of wireless receiver algorithms such as channel estimation, handoff algorithms etc. In this paper we propose a novel speed estimation algorithm based on the derivative of the received channel envelope. We characterize the effects of additive white noise analytically and verify against simulation results. Simulations illustrate high reliability, low complexity, and good robustness of the approach for various propagation conditions. The performance of the algorithm is demonstrated for WCDMA in the speed range from 0 to 250 km/h. [C1575]

## "Dynamic effects in microchip lasers"

This paper reviews recent results on three issues which are related to dynamic behaviors arising through short laser-cavity configurations inherent in laser-diode-pumped microchip solid-state lasers. These are (i) modal interference and high-speed modulation by asymmetric end-pumping, (ii) self-induced instability in multimode lasers operating on Λ-schemes and (II) real-time sound reproduction using self-mixing laser Doppler vibrometry. [C1576]

## "EM-based semi-blind estimation of time-varying channels"

OFDM systems traditionally perform channel coefficients estimation relying on known training sequences. However in wireless systems, performance and mobility can be further enhanced either by operating semi-blind channel estimation refinement or variation tracking between reference symbols. In this paper we propose an EM-based channel tracking method using a simple order 1 AR modelling of the channel variations. The proposed approach is applicable to both single carrier and OFDM systems. Simulation results presented in the context of 5 GHz WLAN show that this new algorithm allows us to reach the performance of a receiver having a perfect knowledge of the channel coefficients even in the mobile environment (3 m/s). [C1577]

## "Thick silicon strip detector Compton imager"

We present initial results obtained with double-sided, thick (2 mm) silicon strip detectors used as a Compton imager. A reconstructed image of a gamma ray source and a spectrum of the gamma ray energy are produced at room temperature using the multiple Compton technique. Multiple Compton interactions allow the energy and Compton scattering angle to be reconstructed without having to absorb the energy of the incident gamma ray completely. This extends our work on multiple Compton imagers using germanium strip detectors to silicon detectors that operate at higher temperatures. The detectors are 57 Ч 57 mm in active area and are 2 mm thick with 64 strips per side with a pitch of 0.9 mm. The energy resolution of the detectors for 60 keV gamma rays are 3-4 keV at room temperature and 2.1 keV at -20°C. Simulations of the imager are performed in GEANT4, including Doppler broadening, and show agreement with the real data. [C1578]

## "A study of the effects of melting snow on communications links in Scotland"

Melting snow, or sleet, is recognised as a potentially serious form of impairment on communications links in cooler temperate climates. Current models neglect sleet, and base their precipitation-related fade depth solely on rain. To develop an improved understanding of the potential effects of sleet, the Radio Communications Research Unit at RAL has developed a 3 GHz fully scanning polarimetric Doppler radar and deployed it at the University of St Andrews in south-east Scotland. It is designed for long-term, statistical observations of rainfall spatial structure and melting layer effects in Scotland. Data from the radar will augment measurements of precipitation-induced attenuation along operational microwave and millimetre wave communication links in the radar coverage area. Results are presented of a continuing study to quantify the annual statistics of the radar-derived melting layer height and its vertical extent and the correlation with ground temperature and raingauge measurements. Comparisons are made between radar-measured parameters and theoretical predictions from a melting layer model, developed at the University of Essex, UK, in an attempt to impose constraints on the model parameters. Once this is achieved, more confidence can be gained in the ability of the model to describe the additional attenuation to be expected in the melting layer. Finally, examples are shown where radar measurements support the idea that observed enhancements in link attenuation are related to a descent of the melting layer to intersect the link path. [C1579]

## "An efficient means of implementing spatial filtering of HF signals propagated over high latitude HF communication paths for the purposes of improving data throughput"

The high latitude ionosphere is a dynamic region that is subject to a variety of disturbed conditions, which affect the propagation of HF radio signals. Point-to-point digital communication systems at high latitudes attempting to utilise the narrowband HF ionospheric radio channel can suffer severe performance degradation when the time or Doppler dispersion exceeds certain, system dependent, bounds. The presented results are based around measurements of narrowband pulse compression channel sounding signals, made using a six channel spaced array receiving system, over two high latitude paths. Super resolution direction finding studies of this data revealed significant directional effects in the received signals. Of particular note is an often observed directional structure to received Doppler spread signals. These investigations indicate that spatial filtering, using simple arrays of antennas, can significantly reduce the level of Doppler spread presented at the inputs to modern high speed digital modems. The use of fast solver methods to find the best spatial filtering solutions results in very similar performance at reducing Doppler spread and massively reduced calculation times, thus raising the possibility of implementation of spatial filtering in a real system. [C1580]

## "Field experiments on adaptive modulation and channel coding coupled with hybrid ARQ with packet combining based on HSDPA air interface"

This paper presents field experimental results on throughput performance employing adaptive modulation and channel coding (AMC) coupled with hybrid automatic repeat request (HARQ) with packet combining based on the high-speed downlink packet access (HSDPA) air interface in the forward link under multipath fading channel. In the implemented equipment, optimum modulation and coding scheme (MCS) is selected among four candidates such as MCSI (QPSK data modulation with the channel coding rate R=1/2, hereafter simply referred

to as QPSK with R=1/2), MCS2 (QPSK with R=3/4), MCS3 (16QAM with R=1/2), and MCS4 (16QAM with R=3/4) according to the measured signal-to-interference power ratio (SIR) over one transmission time interval (TTI) (=2 msec) in AMC and both Type-I HARQ with packet combining, (hereafter Chase combining) and Type-II HARQ (incremental redundancy) are implemented in the preliminary evaluation on AMC by the laboratory experiments employing multipath fading simulators, we elucidate that the average throughput above 5 Mbps was achieved at the average received signal energy per chip-to-background noise power spectrum density ratio (Ec/N0) of approximately 17 dB in a 1-path fading channel with the fading maximum Doppler frequency of fD=5 Hz and nevertheless that the achievable average peak throughput becomes approximate 2.6 Mbps due to the multipath interference in a 2-path fading channel when the average signal power of the second path was lower by 3 dB than that of the first path. We compare the superiority of incremental redundancy and Chase combining in a slow-to-fast multipath fading channel along with the use of the AMC. Furthermore, we present the achievable throughput performance employing AMC coupled with HARQ with packet combining in a real multipath fading channel by field experiments conducted near Tokyo, in order to clarify the potential of HSDPA for actual system application. [C1581]

## "Blind multiple access interference suppression in a land mobile satellite fading channel"

We report the performance of blind orthogonally anchored adaptive algorithms for multiple access interference suppression in a land mobile satellite fading channel with asymmetrical Doppler power spectral density and lognormally distributed line of sight component, using code division multiple access (CDMA). Computer simulations show that the blind algorithms perform within 2 dB of a single user matched filter lower bound and provide significant improvement in capacity over the matched filter. [C1582]

## "A 3 GPS-channels Doppler-delay receiver for remote sensing applications"

This paper describes the hardware implementation and first tests of a 3 GPS-channels Doppler-delay receiver for remote sensing applications implemented by the Technical University of Catalonia (UPC) for the Institute of Space Studies of Catalonia (IEEC/CSIC). It can be configured for several applications. For altimetry applications: by looking at the differential delay between the correlation peaks ("waveforms") between the pseudo random noise (PRN) sequence from a visible GPS-satellite and the direct and reflected signals collected by one antenna with a broad beam pointing to the zenith, and another one pointing to the sea surface (not necessarily at nadir). For sea state determination: from the shape of the ambiguity function (both in the Doppler and delay). Additionally, the instrument can be configured for GPS occultation experiments, etc. This paper presents the description of the instrument implementation and two preliminary tests performed at the Garraf coast (South of Barcelona city, Spain) and at the Zeeland Bridge (The Netherlands). [C1583]

## "Doppler analysis of GPS reflections from the ocean surface"

The basic physics that governs the scattering of GPS signals from a wind-roughened sea surface (both delay and Doppler characteristics) is reviewed. We then describe the results of recent experimental campaigns in which reflected GPS signals have been recorded in the vicinity of coastal buoys or research vessels where independent in situ measurements were available. Comparisons between the measured and predicted Doppler spectra at both left- and right-hand circular polarization are presented and discussed. These polarization differences in the Doppler characteristics could lead to a more robust estimation of various geophysical parameters related to sea-surface roughness. [C1584]

## "Noise radar using random phase and frequency modulation"

Pulse compression radar is used in a great number of radar applications. Excellent range resolution and high ECCM performance can be achieved by wide-band modulated long pulses, which spread out the transmitted energy in frequency and time. By using random noise as waveform, the range ambiguity can be suppressed as well. The same limit in Doppler resolution is achieved as for a coherent Doppler radar when the time compression of the reference is tuned to that of the target. Mostly, the random signal is transmitted directly from a noise generating HF-source. A sine wave, which is phase or frequency modulated by random noise, is an alternative giving similar performance but higher transmitted mean power when peak-limited transmitters are applied. A narrower modulation noise bandwidth can also be applied to generate the same output bandwidth. For phase modulation, the bandwidth amplifying factor is simply the rms value of the phase modulation, and for a frequency modulating waveform, the output rms bandwidth equals the rms-value of the frequency modulation. The results also show that the range sidelobes can be highly suppressed compared with the sidelobes of the modulating signal. The mean and variance of the correlation integral are derived in terms of the autocorrelation function of the modulation. The combined effects of low range sidelobes and enhanced range resolution make frequency and phase modulation attractive. [C1585]

## "Extraction of momentum flux of monochromatic gravity waves using spectroscopic imaging"

Atmospheric gravity waves play a significant role in the dynamics and thermal balance of the upper atmosphere. The vertical fluxes of horizontal momentum characterizing the cross-correlation between the wave-induced vertical wind perturbations and the associated horizontal wind have proved to be difficult to measure. In this paper, we develop a novel technique for calculating momentum fluxes of monochromatic wave components from spectroscopic imaging and meteor radar wind measurement. Our approach uses the two-dimensional (2-D) cross-periodogram of two consecutive Doppler-shifted time differenced (TD) images to identify a dominant wave component and extract the wave parameters. Besides estimating the average perturbation of the dominant wave in the whole field of view (FOV), 2-D short-time Fourier transform is applied to the TD images to obtain the strongest perturbation of this wave in a portion of the FOV. With the wave parameters acquired, we calculate the momentum flux of the dominant wave component. The alternation of the direction and strength of dominant waves can be tracked for each clear night. Nightly averages provide information for investigating seasonal and geographical variation in momentum flux of gravity waves. [C1586]

## "Wavelet-based multifractal analysis of the HF channel scattering function"

We have developed a new multifractal modelling framework, called complex multifractal dimension, for characterizing the HF channel. Using the wavelet packet decomposition, and a special fractal dimension algorithm, the complex multifractal dimension provides a local characterization and a coherent physical interpretation, contrarily to others multifractal spectrums. We have adopted the scattering function as a tool for the ionosphere channel characterization. The non-homogeneity of the scattering function expressed according to the propagation time and Doppler shift led us to split it into two one dimensional vectors. Our analysis was performed over both theoretical examples and experimental scattering functions of the ionospheric channel obtained with an experimental support: STUDIO station. [C1587]

## "Dynamic effects in microchip lasers"

Thin-slice solid-state lasers possess 5-6 orders of magnitude shorter photon lifetimes as compared with fluorescence lifetimes and large lifetime ratios give rise to significant dynamic effects, leading to novel phenomena and applications. This paper reviews recent results on three issues which are related to dynamic behaviors arising through short laser-cavity configurations inherent in laser-diode-pumped microchip solid-state lasers. The three issues are: (1) modal interference and high-speed modulation by asymmetric end-pumping, (2) self-induced instability in multimode lasers operating on λ-schemes and (3) real-time sound reproduction using self-mixing laser Doppler vibrometry. [C1588]

## "A theoretical analysis of polarisation-bistable vertical-cavity surface-emitting lasers used as Doppler velocimeters"

This work presents a theoretical analysis that can explain the increase in sensitivity of a vertical-cavity surface-emitting laser (VCSEL) used as a Doppler velocimeter. The authors use an intensity rate equation model, consisting of two photon density equations (one for each polarisation mode) and one charge carrier equation. Effects of self- and cross-saturation between the modes are included, giving rise to a small region of bistability around the polarisation switching point. The Doppler-shifted optical feedback is introduced in the equations following the standard Lang-Kobayashi approach. When the VCSEL is biased inside the bistable region and when the induced modulation amplitude exceeds a critical level proportional to the width of the bistable region, the laser switches periodically between the two polarisation modes. In this way the polarisation resolved output shows a much better signal-to-noise ratio as the switching is between the on and off state of the selected mode. [C1589]

## "Sub-Doppler atomic vapor photon detection via electromagnetically induced transparency"

High spectral resolution photon detection has been achieved by exploiting the narrow absorption features of gas phase atoms. Velocity-selective excitation and coherent optical effects have allowed for increased spectral discrimination and laser Doppler velocimetry. [C1590]

## "A snake model for anatomic M-mode tracking in echocardiography"

The use of tissue Doppler imaging (TDI) has allowed to obtain velocity, strain and strain rate parameters in real time and is currently used routinely in the echocardiography lab. For analysis 2D image sequences, profiles are marked on the image, and quantitative time profiles are obtained from them, a procedure known as anatomic M-mode. For correct quantification, the position of the region of interest must be tracked along the sequence. We propose a model for tracking profiles using a dual grey level/TDI acquisition. Curves are tracked on the grey

level sequence using an optical flow-based snake model and accurate TDI values are obtained from the tracked curve. [C1591]

## "Frequency and scale domain analysis of complex quadrature embolic Doppler ultrasound signals"

Early and accurate detection of emboli is important for monitoring of preventive therapy in stroke-prone patients. One of the problems in detection of emboli is the identification of an embolic signal caused by very small emboli. The amplitude of the embolic signal may be so small that advanced processing methods are required to distinguish these signals from Doppler signals arising from red blood cells. The windowed Fourier transform has been widely used by commercial Doppler ultrasonic systems. An alternative approach is the wavelet transform. Here, we present comparison of time-frequency (based on complex fast Fourier transform) and time-scale (based on complex wavelet transform) analysis. The results reveal that the wavelet transform provides an optimized temporal resolution and time localization for analysis and detection of embolic signals. [C1592]

## "A study on an MMSE ICI canceller for OFDM under Doppler-spread channel"

In OFDM transmission, a loss of sub-carrier orthogonality due to Doppler-spread of the channel leads to inter-carrier interference (ICI). We have proposed a method to reduce the ICI caused by the Doppler spread of the channel. The transmission channel is modeled by a combination of multiple Doppler-shifted propagation paths, and their parameters such as attenuation, relative delay and Doppler-shift are estimated using scattered pilot symbols. The ICI is canceled by multiplying the inverse matrix of the estimated channel matrix with the received OFDM symbol vector. However, the ICI canceller causes enhancement of noise component, so it can't improve the bit error rate characteristics sufficiently. In this paper, we propose the new ICI canceller based on MMSE, which does not cause enhancement of noise component. As the result of computer simulation, it was confirmed that the ICI canceller based on MMSE could reduce the bit error rate more than ICI canceller based on zero-forcing under the Doppler-spread channel. [C1593]

## "Experimental evaluation on effect of hybrid ARQ with packet combining in forward link for VSF-OFCDM broadband wireless access"

This paper experimentally investigates the throughput performance employing hybrid automatic repeat request (ARQ) with a packet combining algorithm, i.e.. incremental redundancy and Chase combining, from the viewpoints of the achievable throughput satisfying the required residual packet error rate (PKR), coupled with real-time adaptive modulation and channel coding (AMC) operation, for variable spreading factor-orthogonal frequency and code division multiplexing (VSF-OFCDM) broadband wireless access in a forward-link multipath fading channel. Since the implemented base station (BS) and mobile station (MS) transceivers can achieve a high peak throughput of greater than 100 Mbps, the time diversity effect by packet combining or code combining in hybrid ARQ is thoroughly examined associated with the frequency diversity effect over a broadband channel and antenna diversity reception. The experimental results demonstrate that even in a six-path Rayleigh fading channel, incremental redundancy is superior to Chase combining under high Doppler frequency conditions such as fD= 140 Hz, especially when the number of maximum retransmissions is small, because the larger coding gain after code combining is effective in compensating for packet errors due to inappropriate modulation and coding scheme (MCS) selection caused by the tracking error of the AMC loop for the fast fading variations. Furthermore, it is elucidated that the throughput values of 7 Mbps and 10 Mbps (achieved at the average received signal energy per symbol-to-background noise power spectrum density ratio (EsM0) of approximately -5 dB) satisfying the required PER of below 10-4are achieved when the maximum number of retransmissions is approximately 3 and 7, respectively, in the six-path fading channel with fD= 20 Hz. [C1594]

## "Experimental evaluation of throughput performance in broadband packet wireless access based on VSF-OFCDM and VSF-CDMA"

We recently proposed broadband packet wireless access based on variable spreading factor (VSF)-orthogonal frequency and code division multiplexing (OFCDM) in the forward link and variable spreading and chip repetition factors (VSCRF)-CDMA in the reverse link for the systems beyond IMT-2000. This paper presents experimental evaluations on the throughput performance of that proposed broadband packet wireless access scheme associated with adaptive modulation and channel coding (AMC) in a multipath Rayleigh fading channel employing the implemented base station (BS) and mobile station (MS) transceivers. The implemented OFCDM transceiver verifies the effectiveness of the combination of the OFCDM and AMC including QPSK and 16QAM data modulations with a fast round trip delay of 6 msec for improving the throughput performance by exploiting the frequency diversity effect in a broadband channel. The experimental results show that the throughput performance of 100 and 200 Mbps employing AMC is achieved at the average received signal energy per symbol-to-background noise power spectrum density ratio (Es/N0) of approximately 7.5 and 19 dB, respectively,

for 15-code multiplexing for the spreading factor of SF=16 in the OFCDM forward link with a 100-MHz bandwidth, in a six-path fading channel with the fading maximum Doppler frequency of fD=20 Hz. Furthermore, we elucidate that the peak throughput of 20 Mbps is achieved at the average received Es/N0of approximately 9 dB by employing QPSK data modulation with R = 1/2 for three-code multiplexing for SF= 4 in a four-path fading channel in the broadband CDMA reverse link with a 40-MHz bandwidth. [C1595]

## "Polarization estimation of individual propagation paths using the SAGE algorithm"

This contribution describes an extension of the ISI-SACR (initialization-and-search-improved space-alternating generalized expectation maximization) algorithm originally published in [B.H. Fleury, et al., 2001] and [2002] to include polarization estimation. The proposed scheme allows for joint estimation of the relative delay, the direction (i.e. azimuth and co-elevation) of departure, the direction of incidence, the Doppler frequency and the complex polarization matrix of propagation paths between the transmitter (Tx) site and the receiver (Rx) site in mobile radio environments. This contribution presents the initialization procedure of the extended ISI-SAGR algorithm and discusses necessary and sufficient conditions regarding the responses of multiple-element Tx and Rx arrays for the system consisting of these two arrays to be able to estimate all coefficients of the polarization matrix. Experimental investigations in a line-of-sight microcellular environment illustrate the application potential of the ISI-SACR algorithm for gaining insight into the polarization states of individual paths. This information is of paramount importance for the design of stochastic and prediction models ut the radio channel for communication systems equipped with multiple Tx and Rx dual-polarized antennae. [C1596]

## "Decision feedback detection for space-time block coding over time-selective fading channels"

Most existing space-time coding (STC) schemes have been developed for flat fading channels. To obtain antenna diversity gain, they rely on channel state information (CSI) required at the receiver through channel estimation techniques. This paper proposes a new decision feedback decoding scheme for Alamouti-based space-time block coding (STBC) transmission over time-selective fading channels. In wireless channels, time-selective fading effects arise mainly due to Doppler shift and carrier frequency offset. Modelling the time-selective fading channels as the first-order Gauss-Markov processes, we use recursive algorithms such as Kalman filtering, LMS and RLS algorithms for channel tracking. The proposed scheme consists of the symbol decoding stage and channel tracking algorithms. Computer simulations confirm that the proposed scheme shows the better performance and robustness to time-selectivity. [C1597]

## "An ultra-wideband space-variant multipath indoor radio channel model"

We present a generic ultra-wideband (UWB) multipath radio channel model that has been designed for link-level simulations and is suited for indoor environments, e.g. for WPAN applications. It covers the FCC frequency band [FCC, Feb. 2002] and is capable of producing space-variant impulse responses (IR) and transfer functions. The model is of a hybrid type and combines a statistical approach to model dense multipath and a simple quasi-deterministic method to model strong individual echoes. These echoes are important to obtain a realistic spatial (Doppler) behavior. The architecture of the model facilitates the application to UWB MIMO analyses. For a few scenarios (e.g., intra-office and inter-office transmission), site-specific parameter profiles are given that have been derived from measured data. [C1598]

## "A new optical measurement method for local wall shear stress and its signal processing techniques"

A new optical measurement method for local wall shear stress is proposed. The method is an extension of laser Doppler technique. It has a possibility of detecting the both magnitude and angle of local wall shear stress. The principle was investigated for Doppler frequency and measurement volume. The Doppler frequency changes in a Doppler burst signal. The frequency variation depends on the magnitude and angle of local wall shear stress and the spanwise offset of scattering particle path. A signal processing technique is proposed to detect the magnitude and the angle of local wall shear stress. The technique consists of detecting Doppler frequency variation by time-frequency analysis and nonlinear least squares fit. A simulation was conducted to investigate the performance of the method. Simulated Doppler signals were generated by using the instantaneous velocity data of a fluid-flow simulation result. The generated signals with different noise levels were processed and the effect of the noise level was investigated. The local wall shear stress was estimated with moderate accuracy but its angle was not estimated with good accuracy. A further investigation is required to improve the accuracy of measurement for the method. [C1599]

## "Analysis of performance degradation due to channel estimation error in pre-Rake TDD/CDMA"

In recent years, pre-Rake combining technique has become a hot topic of research as it decreases the

complexity of the portable mobile unit, while achieving the same multipath diversity effect of the Rake receiver. In practice, the error in channel estimation in pre-Rake system occurs due to time variability in mobile radio channel. In this paper, we present pre-Rake performance under imperfect channel estimation due to time variability in TDD system, depending on Doppler frequency and compare it with the ideal pre-Rake system. [C1600]

## "Usability analysis of Ku wideband land mobile satellite communication system"

Usability is one of the important problems in Ku wideband land mobile satellite communication design. The difference between the mobile satellite communication and the fixed satellite communication is that the earth station is in motion when it works in mobile satellite communication. In addition, there are multi-path fading, Doppler shift, shadowing effect and rain attenuation in land mobile satellite communication. In this paper, the usability of the communication system is emphasized and appropriate measures based on four major characters in the Ku band land mobile satellite communication system is taken, and the system usability is then calculated, finally the calculation result is analyzed. [C1601]

## "Performance analysis of high QAM OFDM system over frequency selective time-varying fading channel"

This paper considers the performance degradation of a high QAM orthogonal frequency division multiplexing (OFDM) system over frequency selective time-varying fading channels. The time variation of the channel during one OFDM frame destroys the orthogonality of different sub-carriers and generates power leakage among the sub-carriers, known as inter-carrier interference (ICI). The statistics of the ICI for M-QAM systems are shown to be non-Gaussian distributed. However, the ICI distribution is well approximated by the derived 2-dimensional Gram-Charlier series. Finally, the degradation in the performance of OFDM resulting from Doppler effects over time varying, frequency selective Rayleigh fading channel is obtained by averaging the approximated ICI statistics over the ensemble fading. [C1602]

## "How often channel estimation is needed in MIMO systems"

In this paper we develop a unique framework for evaluating the required repetition rate of channel estimation for multiple-input multiple-output (MIMO) systems in continuous fading radio channels. An analytical formula for the interference due to the temporal variation of the channel coefficients is given. This makes it possible to evaluate the time interval in which the channel has to be estimated again in order to keep the error probability below a desired threshold. This interval depends not only on the Doppler spread of the channel but also on the antenna configuration, detection algorithm and modulation scheme. [C1603]

## "The Doppler spread-gaining diversity for future mobile radio systems"

In this paper the trade-off between time diversity and the inter-carrier interference (ICI) in an OFDM based MC-CDMA system is discussed. Our approach is to partially shift each spectrum of an OFDM symbol at the transmitter by using different phase shifts in the time domain at different antennas after the OFDM modulation. The summary signal at the receiver has a wider Doppler spectrum as the result of different uncorrelated Rayleigh fading channels. This leads to an artificially increased selective time channel transfer function, which is more favorable for the channel decoder at the receiver. The trade-off between Doppler diversity and ICI is found at about 9% maximum Doppler spread of the subcarrier distance for flat fading channels and frequency selective fading channel models. The distance to the independent Rayleigh channel bound by applying an MMSE detector is less than 2 dB for convolutional coding and about 2 dB for turbo coding at a BER of 10-3for flat fading channels. For frequency selective fading channels this approaches to less than 1 dB to the independent Rayleigh channel bound. [C1604]

## "Analysis of intercarrier and interblock interferences in wireless OFDM systems"

OFDM has been applied in the current wireless communications since it has the advantage over the conventional single-carrier BPSK, QPSK, QAM and MSK modulation schemes when enduring the nonflat fading. However, intercarrier-interference (ICI) and interblock interference (IBI) due to the Doppler effect, noncoherent phase and carrier frequency and multipath fadings limit the capability of OFDM systems. In this paper, a new generalized mathematical model for intercarrier and interblock interferences is derived for wireless OFDM systems, in which Doppler effect, carrier frequency drift, multipath fading, and cyclic prefix coding are all considered. [C1605]

## "Flexible architecture software radio OFDM transceiver system and frame synchronization analysis"

In this paper, we present findings relating to frame synchronization algorithms for software radio based OFDM systems in addition to an overview of the design and implementation of an (OFDM) software radio based on a general-purpose processor (GPP) platform. The objectives of this work are to advance on existing research carried out in the area of reconfigurable wireless flexible architecture nodes, which are subject to multipath fading, Doppler effects, and adjacent channel interference and have low cost yet robust and reliable operation requirements. We also include findings dealing with bit error rate (BER) versus channel signal to noise ratio (SNR) for BPSK and QPSK modulation schemes, and also the effect of non real-time operating systems (OS) running on GPPs on the transmitter processing time. [C1606]

## "Effect of packet duration and channel prediction in adaptive modulation"

In this paper, effect of packet duration and channel prediction is analyzed in adaptive modulation. Spectral efficiency equations are derived for both systems with and without channel prediction. Numerical results show that systems with channel prediction can get maximum spectral efficiency while systems without channel prediction but chosen optimum packet duration can get suboptimum spectral efficiency, which is inversely proportional to Doppler frequency. [C1607]

## "Effect of frequency offset on BER of OFDM and single carrier systems"

Performance of both orthogonal frequency division multiplexing (OFDM) and single carrier (SC) systems suffers from a carrier frequency offset (CFO) due to Doppler effect and the carrier instability between the transmitter and the receiver. We investigate the bit error rate (BER) performance degradation of OFDM and SC systems due to the frequency offset in an additive white Gaussian noise (AWGN) channel as well as multipath Rayleigh fading channels. We consider three effects to the BER degradation, i.e., phase shift, useful power decrease and intercarrier interference (ICI). We also derive the approximate expressions of BER under binary phase shift keying (BPSK) and quaternary phase shift keying (QPSK) for both OFDM and SC systems in the presence of CFO. In general, SC is more robust to CFO in the AVVGN channel than OFDM in terms of BER, while both of them suffer similarly from CFO in the multipath Rayleigh fading channels assuming the the same CFO. [C1608]

## "A simple channel estimator for OFDM with transmit diversity in rapid fading channels"

This paper presents a simple channel estimator for orthogonal frequency division multiplexing (OFDM) systems with transmit diversity in rapid fading channels. The channels at the training bauds are estimated using the EM (expectation-maximization) algorithm, while the channels at the data bauds are estimated based on the method that the time-varying channel can be modelled as the linear combination of several time-invariant "Doppler channels". Computer simulations show that this estimator outperforms the decision-directed tracking in rapid fading channels and the performance of this method can be improved by iteration. [C1609]

## "Application of GPS to exospheric target detection using missile-borne passive radar"

A novel missile-borne passive radar is proposed for the detection of exospheric target. For meeting the need of stealth, the universal GPS signal is applied to the passive radar for acting as the signal of transmitter. The system mechanism and the framework of the GPS signal receiver and scattering wave receiver for the passive radar is described for the next in-depth study. And the key performance of system and the problem of Doppler compensation for the passive radar are also elucidated. [C1610]

## "Layered turbo space-time coded MIMO-OFDM systems for time varying channels"

A joint detection-estimation scheme is proposed for multiple-input multiple-output orthogonal frequency division multiplexing (MIMO-OFDM) systems. The transmitter employs a layered turbo space-time code. The iterative scheme proposed for the receiver integrates in one scheme turbo decoding, co-antenna interference suppression and channel estimation. A main observation is that the high coding gain of the turbo space-time code can compensate for the application of a simple co-antenna interference suppression scheme and can also facilitate good channel estimates. The performance of the MIMO-OFDM system is validated by simulations under various channel conditions, including high Doppler. Numerical results show that for a 4 transmit 4 receive antenna (4T4R) system, with a data rate of 4 Mb/s over a 1.25 MHz bandwidth, a packet error rate (PER) of 10-2is achieved at a signal-to-noise ratio (SNR) of 16 dB for a typical urban channel with Doppler frequencies as high as 200 Hz. For a 4T6R system, the same performance can be achieved for only 6 dB SNR. [C1611]

## "Doppler frequency estimation for channel sounding using switched multiple-element transmit and receive antennas"

We proposed (Fleury, B.H. et al., Proc. XXVII Gen. Assy of Int. Union of Radio Scientists, p.2127, 2002; Proc.

IEEE Veh. Tech. Conf., VTC 2002, p.522-6, 2002) the ISI-SAGE (improved-search-and-initialization space-alternating generalized expectation-maximization) algorithm for joint estimation of the relative delay, the directions of departure and of incidence, the Doppler frequency (DF) and the complex weight (or attenuation) of waves propagating from the transmitter (Tx) site to the receiver (Rx) site in mobile radio environments. We now present theoretical and simulation results describing the performance of the scheme for DF estimation applied in combination with channel sounding using switched multiple-element Tx and Rx antennas. The maximum absolute DF that can be estimated is shown to be half the switching rate rather than half the measurement cycle rate as commonly believed. The switching rate is the rate with which the pairs of Tx and Rx elements are switched, while the measurement cycle rate is the rate with which any fixed pair of Tx and Rx elements is switched. The ratio of the former rate by the latter is larger than or equal to the product of the numbers of Tx and Rx elements. Hence, the scheme allows for DF estimation in a range much larger than commonly believed. Monte-Carlo simulations also show that above a certain signal-to-noise-ratio (SNR) threshold, depending on the characteristics of the TDM mode, the estimator performs close to optimum. The results make it possible to link the parameter setting of the TDM mode to the operational SNR range for individual waves to be estimated. [C1612]

## "Performance of a VHF ocean surface radar in the surf zone"

In the high VHF band (152.2 MHz) the Bragg scattering waves on the sea surface have wavelengths of about 1 m. The radar Doppler spectrum of echoes can be heavily modulated by swell in open water, and in the surf zone the effect is enhanced. Under these conditions the Bragg first-order lines are broadened This paper reports on a study to evaluate the integrity of the surface current maps produced by the VHF coastal ocean surface radar within the surf zone. Comparisons are made with radar data under calm conditions, and with currents measured with an acoustic current profiler mounted on the bottom. The radar current measurements are slightly more noisy under rough conditions, but it is clear that this technology has potential to monitor rip currents and coastal vortices in the surf zone when conventional techniques become strained. [C1613]

## "CHAMPS: a near-ML joint Doppler frequency/TOA search for channel characterization"

The paper introduces a frequency-domain near-maximum likelihood (ML) joint Doppler frequency (DF)/time of arrival (TOA) search for channel characterization. The search is iterative and operates by finding one or more DF/TOA pairs at each step that minimize the channel estimation mean squared error. Because of its excellent ability to estimate frequency-domain channels as well as identify channel parameters (i.e., DFs and TOAs), we call the algorithm CHAMPS (CHannel estimation via an Approximate ML Parameter Search). CHAMPS is used to characterize the channels measured from an experimental 18.775 MHz OFDM mobile system operating at 3.676 GHz. The experimental system was used to collect data in Schaumburg, Illinois, an environment characterized by both industrial and residential areas. Differential delays up to 24 μsec were detected as well as Doppler frequencies that are three times the expected Doppler frequency due to reflections off vehicles traveling in the opposite direction as the test van. [C1614]

## "Bound waves and radar backscattering from the sea surface"

New effects recently revealed in field experiments conducted in IAP RAS on radar probing of the sea surface and associated with strong nonlinearity of short gravity-capillary waves and generation of high-order harmonics and "parasitic" capillary ripples (bound waves) are discussed. Wave tank experiments on radar probing of short wind waves in the presence/ absence of films are also described and relative intensities of linear and bound waves are estimated. Field and wave tank experiments has confirmed the expected intensification of modulation of Bragg ripples due to long surface waves, the modulation coefficient has been shown to be several times the modulation on a clean water surface. [C1615]

## "Non-linear modeling of underwater acoustic waves propagation for multi-receiver channels"

A non-linear acoustic wave propagation model has been developed to determine the effects of ocean variations in the acoustic field, and to determine the signal measured by a receiver at any distance from an omni-directional source. The model accounts for environmental conditions that include bathymetry, bottom properties, sound velocity profile and sea surface characteristics. First, a stationary estimate of the complex sound attenuation is computed as a function of frequency and location, using the parabolic equation numerical technique. For a given range, the vertical profile of the attenuation frequency spectrum is decomposed in the wave number domain. A specific Doppler shift is associated with each wave number. The space-frequency attenuation filter obtained is applied to the transmitted signal to create time-frequency selective fading. The non-linear acoustic wave propagation model has been specifically applied to the area of Port Everglades, Florida, to simulate the performance of the FAU General Purpose Acoustic Modem (FAU-GPAM). The modem operates in

the 15.6 kHz to 31.9 kHz frequency band, with 192 dB of source level, and transmits Multi-Frequency-Shift-Key modulated sequences. The range of operation varied from 1 to 5 km, in 12 meters of water. The sea bottom is mainly composed of medium sand. Experimental data have been collected under sea-state 2 conditions. The performance of the acoustic communication system has been predicted using the non-linear model, the Crepeau model and experimental data. This work was sponsored by the Office of Naval Research, Code #ONR 321OM, Dr. Swean. [C1616]

## "Performance of a receiver in large time-frequency spreading channels"

In this paper, we investigate the communication over time-varying frequency selective channels that exhibit large delay spread and Doppler spread. The receiver consists of a decision-feedback equalizer (DFE) and a Kalman filter for channel estimation. Brief derivations for the algorithms are given. Simulation results show that there exists an irreducible error floor depending on the Doppler spread; the receiver can obtain a bit error rate (BER) of 10-2for channel with spreading factor up to 0.2. [C1617]

## "Comparison of space division multiplexing schemes employing multiple antennas in OFDM forward link"

The paper compares the achievable throughput performance of the multiple antenna transmission and reception technique called MIMO (multiple-input multiple-output) including the adaptive antenna array beamforming (AAA-BF) transmitter, using a 100 MHz bandwidth for the OFDM (orthogonal frequency division multiplexing) forward link in a multipath Rayleigh fading channel aiming at high frequency efficiency up to 10 bps/Hz. Simulation results elucidate that to achieve high frequency efficiency of greater than approximately 4 bps/Hz, MIMO multiplexing can decrease the required transmission power the most for two and four transmitter and receiver antennas, since lower-level data modulation or a lower channel coding rate is applicable compared to the AAA-BF transmitter and MIMO diversity schemes. We also show that an average PER of 10-2is possible for the information bit rate of 1 Gbps using a 100 MHz bandwidth (i.e., 10 bps/Hz) at the transmit signal energy per bit-to-background noise power spectrum density ratio (Eb/N0) of approximately 10 (13) dB using the combination of 16QAM modulation and the coding rate of 5/6 together with four-branch MIMO multiplexing in a 12-path fading channel with the maximum Doppler frequency of fD=20 Hz when the fading correlation between antennas is 0 (0.6). [C1618]

## "Level crossing rate estimation with Doppler adaptive noise suppression technique in frequency domain"

The maximum Doppler frequency, or, equivalently, the mobile speed, is very useful information for optimizing the performance of many wireless communication systems. The paper proposes an improved method for estimating the maximum Doppler frequency based on the level crossing rate (LCR) estimator. To reduce the effect of additive noise, the proposed algorithm uses a novel Doppler adaptive noise suppression (DANS) process in the frequency domain. The proposed DANS process does not require additional channel information such as signal-to-noise ratio (SNR). [C1619]

## "Effect of delayed commands on error probability and throughput capacity in a multiple access system"

The channel correlation coefficient is a function of maximum Doppler frequency shift and delay. The effect of the correlation coefficient on a multiple access system, that schedules for transmission to the user with the strongest channel, is characterized in terms of the probability density function (pdf). It is shown that the system performance-in terms of error probability and throughput capacity-degrades significantly with the decrease of correlation coefficient. Thus, in order to achieve the desired target performance in terms of error probability, additional transmission power is required to compensate for a low correlation coefficient. Error probability curves for fading channels can he derived quasi-analytically based on the corresponding curves obtained in additive white Gaussian noise (AWGN) channels. Also, for a constant transmission power, an analytical expression of throughput-capacity, a function of the correlation coefficient, is provided. [C1620]

## "Uplink spatial fading correlation of MIMO channel"

We derive an analytical space-time fading correlation for the MIMO channel as a function of antenna spacing, angle spread, and Doppler spread. We investigate the performance of uplink spatial fading correlation of the MIMO channel. We consider four uniform circular array (UCA) elements at both the mobile station (MS) and the base station (BS). The angle of arrival (AOA), and the angle of departure (AOD), at the BS and the MS is distributed by a truncated Gaussian PDF and uniform PDF, respectively. We also compare the analytical results

with the simulation results. For large values of N, the simulation and analytical results agree. [C1621]

## "Spatial channel models for multi-antenna systems"

A number of components of a spatial channel model are described, with details and discussion of parameter choices. The main characteristics of the model include a narrow angle spread (AS) per-path, with specific base station angle of departure (AoD) and mobile station angle of arrival (AoA) models. The large scale behaviors, described by the composite base angle spread (AS), delay spread (DS) and shadow fading (SF), are simultaneously correlated in the log-normal domain to produce the expected channel characteristics for each realization of the channel. Multiple delayed paths are defined temporally and spatially as a function of the correlated parameters. Each path is further composed of a number of sub-paths that are time evolved to produce a Rayleigh fading envelope, with a Doppler spectrum that is a function of the angle spread and angle of arrival of the sub-paths. Statistics of the output of the spatial channel model are presented to illustrate its behavior. [C1622]

## "Advanced synthetic aperture radar imaging and feature analysis"

We review and discuss advanced algorithms for synthetic aperture radar image formation, the effect of motion perturbation on radar imaging, synthetic aperture radar imaging of ground moving targets, and micro-Doppler feature analysis. [C1623]

## "Ionospheric propagation effects on ground and space based radars"

This paper discusses the application of EM propagation theory to account for observations of scintillation from equatorial satellite beacon and radar measurements of transionospheric propagation. Satellite beacon measurements from the wideband satellite experiment are used to calculate the degradation caused by scintillation in the radar coherent integration process. Coherent integration will be required in any space based radar to achieve separation in Doppler of moving targets from the large return of the earth. Measurements of ionospheric scintillation in the equatorial region taken with the VHF/UHF ALTAIR radar in the Marshall Islands are described. These measurements support the use of the strong scatter limit of the parabolic wave equation that accounts for certain features of the observations. A technique is illustrated to calculate realizations or sample functions of wide bandwidth radar signals that have passed through the ionosphere. This technique gives realizations that are consistent with the ALTAIR observations. Results are given for radar performance of target detection for several different radar signal combining techniques. [C1624]

## "Sub-Doppler cooling in a strontium magneto-optical trap"

A systematic study of the sub-Doppler cooling in a strontium magneto-optical trap is presented. A detailed theoretical analysis of this system, based on a fully expanded multi-level theory, is also discussed. Furthermore, density-related radiation heating dynamics are found to play a crucial role in this system with reduced sub-Doppler cooling force. [C1625]

## "Adaptive system for blood flow estimation"

Adaptive estimation of blood flow signals is performed resorting to a framework developed to support research on Doppler blood flow signals' analysis. Real time spectral estimation methods, real time performance evaluation and run-time adjustment of the estimation methods parameters are bound together, allowing the system to adapt itself to varying signal characteristic that are caused by physiological reasons. [C1626]

## "Manipulating individual atoms in microscopic optical dipole traps"

We have realized very small optical dipole traps to store and manipulate individual atoms. Due to the small trap volume, a "collisional blockade" mechanism limits the number of trapped atoms to 1 over a large range of loading rates. We have studied this collisional blockade effect, and measured the oscillation frequencies and temperature of a single trapped atom, that appears to be in the sub-Doppler regime. Various mechanisms for turner cooling will be described, as well as the perspectives for using this system for quantum information processing. [C1627]

## "On the operation mechanism of the microwave sensor for measuring human heartbeats and respirations"

A sensitive microwave sensor is established to measure human heartbeats and respirations. A large number of microwave cardio-graph (MCG) is collected and thoroughly analyzed. It concludes that the MCG is come from

the amplitude and phase modulation of the heart movement to the scattering field, instead of the indistinct Doppler effect, even though almost a similar apparatus is used. [C1628]

## "An improved digital communication system for doubly-spread underwater acoustic channels using evolutionary algorithms"

This paper presents an improved system for high data rate digital acoustic communication over a shallow underwater channel that is doubly spread. The method uses cancellation of interfering multipath signals rather than delay equalisation. In this improved system, an Evolutionary Algorithm is used to obtain an accurate estimate of the Doppler spread. This novel implementation of a Doppler estimator significantly improves the accuracy of the channel estimator thus enabling more effective interference cancellation. BER performance results of the improved system in a typical underwater scenario are presented. [C1629]

## "Compression ratio expansion for complementary code set compressing a signal to a width of several sub-pulses"

We present the compression ratio expansion methods for the complementary code set compressing a signal to a width of several sub-pulses. We also propose the complementary code sets that consist of more than three individual codes and compress a signal to a width of several sub-pulses. [C1630]

## "Ocean imaging using multichannel along track interferometry"

An airborne multichannel along track interferometer (MATI) is described and discussed. This MATI system is based on an X-band SAR installed in a BAE/BAC 1-11 aircraft which can be set up with 2, 3 or 4 beams. It is demonstrated that a MATI can be used to Doppler filter radar signals acquired from a moving platform which are scattered by moving and partially coherent scatterers. Processing techniques are described for the removal of phase errors. These phase errors are caused primarily by the separation of the antennas in range due to the aircraft installation, and by aircraft roll, pitch and yaw motions. The basis of the processing technique is a two stage phase screen which is capable of compensating the differential phase errors between each image in a multichannel set to the precision required for Doppler filtering. It is shown that optimal filtering may be applied to the scattered radar signals by adaptively varying complex weights applied to each channel until an extremum of a selected image measure is obtained. Hence, if a certain type of scatterer is associated with energy located in a particular part of the Doppler spectrum, and an image feature results from the modulation of this type of scatterer, then the visibility of the feature can be maximised using an adaptive MATI. An example is presented showing the technique applied to a sandbank image. [C1631]

## "Use of STAP techniques to enhance the detection of slow targets in shipborne HFSWR"

This paper addresses the detection of low velocity targets from a shipborne HFSWR (high frequency surface waves radar). In a shipborne configuration, as a consequence of the ship motion, the first order of Bragg lines is spread in the useful Doppler interval where detections of a ship target are expected to appear. Space time techniques like STAP, usually studied for airborne radar purposes, are candidates to reduce the effect of ship motion. The influence of pitch and roll components is also discussed. Simulations of STAP techniques are given, based on a conventional architecture of processing. Estimation of the clutter covariance matrix is studied with respect to the characteristics of the radar waveform. Interleaving between the classical HFSWR waveform and a wide band learning waveform is proposed, to enable the covariance estimation. [C1632]

## "Shoaling waves produced by offshore winds"

Directional spectra obtained from Doppler shifts mapped by a coherent, X-band, airborne radar show that offshore winds can produce shoaling waves on the same coastline. When wind blows offshore at an angle, the dominant wind wave does not propagate in the wind direction. Combined with refraction, this effect can produce shoaling waves. Data collected by the airborne radar are shown to be in good agreement with the JONSWAP parameterizations of dominant wave period and significant wave height. [C1633]

## "Radarsat Lagrangian flow effects on oil spill spreading"

This paper presents work done utilizing Radarsat fine mode data to model the Lagrangian effects on oil spill trajectory model. The input for the model is current field derived from a 2 D hydrodynamic model. The correlation statistical model was applied to modulate the Radarsat water movements with current field by applying Doppler frequency shift model. The study shows that current movements are the main effect on oil spill spreading compared to wind speed and direction. Verification of simulation results with those of tidal current model shows a good agreement in the direction of the oil spill movements. In conclusion, Radarsat data has good potential for

oil spills detection and mapping. Radarsat data could be used to model the Lagrangian effects on oil spill trajectory model. The main effect on the oil spill movements in Malacca Straits is the tidal current flow. [C1634]

## "An intelligent differencing GPS algorithm and method for remote sensing"

The idea behind differencing GPS (DIGPS), is not where in the world you are that matters, it is where you are with respect to a reference point; this is a variation of differential GPS (DGPS). With DGPS the user is more concerned with where they are in the world with respect to a latitude, longitude and height and they must be within a standard distance of DGPS base station. DIGPS uses two GPS receivers, like DGPS, and a system integration manager. The idea is for the user to know where they are in relationship to a reference GPS receiver set up by the user and navigate with respect to that reference receiver. With both GPS receivers seeing the same signal errors, and if the user is moving, using the Doppler method can be used for determining position and velocity. The inaccuracies normally associated with civilian GPS are ified and the user is not tied to an area where they must be in range of a standard DGPS base station. This could be important tool in the area of remote sensing where sub-cm accuracy is needed with respect to a reference point. This paper examines an intelligent DIGPS system using neural networks and expert systems in conjunction with utilizing the Doppler effect of the carrier wave to build a system that quickly and accurately determines a moving user's position and speed in relation to a reference point. [C1635]

## "Improved method for the estimation of the ionospheric irregularities by site dependent total electron content (TEC) amplitude fluctuation index"

The scintillation effects are known to degrade the tracking performance of a GPS receiver. Possible Doppler shift observed on the GPS signal due to rapid phase variations could extend the bandwidth exceedingly, forcing the phase locked loop to its tracking limits, and the lost of signal can be observed especially at the frequency L2. For this, accurate estimation of the ionospheric irregularities is often not possible since ionosphere is usually assumed to be locally isotropic. In this study, short time (15 min.) amplitude fluctuation index (fa) that is function of time, orbit number and satellite number, and hourly amplitude fluctuation index (Fa) that function of hour and orbit number only, are defined. facan be calculated at any point on the surface of the Earth for each 15 minute long time section using only one satellite, and Facan be calculated hourly and using satellites in the vicinity of the receiver. It is shown that utilizing the amplitude fluctuation indices faand Fa, oblique examination of the index is possible, without assuming a perfect vertical path. Finally, the variations on the total electron content corresponding to different cases are discussed on numerical results. [C1636]

## "Test results from a 1319-nm laser radar with RF pulse compression"

We report the results of a three-year, NASA-funded project at The University of Kansas Radar Systems and Remote Sensing Laboratory on the development of a laser radar that uses RF pulse compression to significantly improve system performance. Receiver sensitivities of less than -90 dBm have been demonstrated by applying heterodyne optical downconversion and RF pulse compression. With the improved sensitivity, the required transmit power is significantly reduced. This system approach also permits multi-kilohertz pulse-repetition frequencies that enable spatially dense range measurements. Compared to lidars like GLAS and MOLA, this sensor requires a lower peak transmit power while providing orders of magnitude more measurements per second. In the receiver design, we have evaluated two detection schemes: envelope detection and direct downconversion. Envelope detection provides the benefit of discarding the effects of optical phase variations on the detected signal consequently avoiding many temporal correlation issues, however it is less efficient in terms of the resulting signal-to-noise ratio (SNR). Direct downconversion to baseband is more SNR efficient, however the baseband signal contains the effects optical phase variations, which include laser phase noise, effects of atmospheric turbulence, and frequency shifting due to Doppler effects. We have demonstrated the feasibility of using a linear array of optical fibers in the telescope's focal plane to launch and receive the optical signals. Using separate fibers for transmit and receive while sharing telescope optics, we have achieved the required transmitter-receiver isolation of a bistatic system without the accompanying alignment difficulties. With our breadboard system ranging measurements from both man-made and natural extended targets have been made and the results are presented. These results support the feasibility of a satellite-based altimeter (600 km altitude), capable of making more than 4000 range measurements per second with 10 cm accuracy using less than 10 W peak transmit power. While the present breadboard operates at 1319 nm, the overall concept is wavelength independent. Benefits of this development may include increased system reliability, reduced power requirements, smaller sensor mass a- nd volume, improved eye-safety, and lower probability of signal detection. [C1637]

## "A super resolution SAR imaging method based on CSA"

Available conventional super resolution SAR imaging methods are based on complex images obtained by SAR imaging algorithms, and form super resolution SAR images via 2-D spectral estimation methods. A super resolution SAR imaging method combined with the chirp scaling algorithm (CSA) is presented in this paper. The new method forms a super resolution image by performing the range and the azimuth processing independently. This method can reduce the effects of phase errors on super resolution processing. The method is suitable for practical application since it does not require heavy computation. Experimental results show the effectiveness of the presented method. [C1638]

## "Anormal Doppler shifts of radar signals backscattered from marine slicks"

Results of field experiments on remote sensing of organic slicks on the sea surface using Ka-band radar are presented. Slicks of different surfactants with the film elasticity values ranging from some mN/m to some tens of mN/m were studied. It is shown that the radar Doppler shifts can change strongly in slicks, depending on the film elasticity, while the depression of radar backscatter in slicks is nearly the same for the different substances. A physical explanation of the effect is given assuming different contributions of free capillary-gravity waves and "bound waves"-nonlinear harmonics of longer surface waves in the spectrum of cm- to mm-scale wind waves. A simple theory of wave damping in slicks is used to explain qualitatively the dependence of the Doppler shifts on film elasticity. [C1639]

## "Further numerical studies of backscattering from time evolving non-linear sea surfaces"

Previous studies have demonstrated that the West et al. (1987) model for non-linear hydrodynamic evolution of a sea surface realization produces significant features in calculated L-band backscattered Dopper spectra compared to a linear sea surface evolution model. Previous comparisons, however, were limited to a maximum wind speed of 2 m/s due to failure of the West et al. algorithm when steep short-wave features formed in the surface. In this paper, L-band Doppler spectra with the West et al. model are reported for wind speeds up to 4 m/s through the use of a suppression filter to reduce steep short-wave features. Results again show significant effects on Doppler spectra, including a strong polarization sensitivity at 80° observation angle. [C1640]

## "Space-time block codes in Doppler spread channel"

Space-time block codes (STBC) can obtain full transmit diversity gain in a slow-fading environment. But it is not the case for STBC in a fast-fading channel where the estimator can not trace the channel variation instantaneously. This will cause decoding in error and hence the system performance is degraded. In this paper, we evaluate the performance degradation in a Doppler spread channel by computer simulation. Finally, we propose linear interpolation to trace the channel variation, and the performance can then be improved. [C1641]

## "Theoretical and simulation analysis of random noise monopulse radar"

Coherent random noise radar technology has been implemented successfully in buried object detection, Doppler estimation, SAR imaging, and ISAR imaging. These applications verified the desirable characteristics of random noise radar for stationary target applications. Since the system is phase coherent, we have demonstrated that it can be used for radar interferometry. We are currently developing a random noise monopulse system for angular tracking of moving targets in real time. This paper provides a preliminary analysis of compatibility of random noise radar with conventional phase-comparison monopulse. [C1642]

## "Determination of chip rate and center frequency for a spread spectrum acoustic ranging system"

Spread spectrum systems are commonly used for ranging. Perhaps the most pervasive system is GPS. Because such a system relies on a high frequency signal, the receiver must have an unobstructed view of the sky. There are situations in which one cannot use GPS, such as in an orchard or indoors. This paper suggests that ranging can be achieved by applying the spread spectrum technique to sound waves rather than RF. In using air as the medium, there are many different factors that must be considered in deciding what the appropriate chip rate and center frequency should be. The speed of sound is much slower than RF. It changes significantly with a change in temperature. There are Doppler shift effects. The available bandwidth relative to center frequency is enormous when compared to RF. The attenuation of the higher frequencies is very dramatic for sound. This paper considers these factors and others in determining an appropriate chip rate and center frequency for acoustic ranging. Low frequencies in sound are attenuated much less than high frequency signals and to capitalize on this it was found that a center frequency of zero hertz and a relatively low chip rate of 100 chips/sec would be suitable. [C1643]

## "Double mobility mitigates fading in ad hoc wireless networks"

By investigating Doppler effects in mobile ad hoc networks, we show maximum Doppler shift fmis proportional to a sum of speeds, Doppler power spectrum S(f) takes on an unfamiliar form, and an increase in mobility leads to lower RMS and effective Doppler spread and a more benign channel. [C1644]

## "Performance of orthogonal short-time Fourier signaling over doubly dispersive channels"

Orthogonal short-time Fourier (STF) basis functions are natural for communication over channels that are selective in both time and frequency. However, the STF basis functions in general interfere with each other due to the loss of orthogonality by channel dispersion. It is shown that the channel spread factor, the product of multipath and Doppler spreads, plays a key role in determining system performance. Smaller spread factors result in lower interference. A set of appropriately chosen STF basis functions serve as approximate channel eigenfunctions. A simple and approximately optimal pulse scale adaptation rule is derived to minimize interference by matching pulse properties to channel characteristics. It is also shown that ergodic capacity of doubly dispersive channels deviates from that of flat fading channels as channel spread factor increases. In particular, moments of the eigenvalue distribution of dispersive channels agree with those of flat fading channels up to certain order that is inversely proportional to channel spread factor. [C1645]

## "A novel approach to estimation of Doppler frequencies of a time-varying communication channel"

A new approach to estimation of characteristic frequencies (Doppler shifts) of periodically varying telecommunication channels is proposed. The cycles are estimated by means of performing parametric spectral analysis of the short-memory sliding window least squares estimates of channel coefficients obtained for the known, training part of the transmitted sequence. The new method offers better results than the existing approaches, both in terms of quality (better spectral resolution) and quantity (smaller estimation errors). [C1646]

## "Transportable multi-beam Doppler polarimetric radar"

TARA (transportable atmospheric radar), a unique radar system developed at the International Research Centre for Telecommunication transmission and Radar (IRCTR) of Delft University of Technology, can be used to observe the formation of precipitation and various other physical processes that occur in clouds. This provides important information that is used to map effects of global warming on the world's climate. The Delft radar system is sensitive enough to detect turbulent airflows. TARA may therefore be used to improve safety near airports. The TARA antenna system consists of a hybrid feed array in combination with a precision reflector to obtain instantaneous high-resolution, three-dimensional, dynamic measurements of wind and rain. The paper summarizes TARA's basic principles illustrated with initial measurements. [C1647]

## "Conditions to the radar vector signal providing simultaneous measurements of all back-scattering matrix elements"

The properties of the illuminating waveforms and conditions of the signals, forming orthogonal (by polarization) vector sounding signals are discussed. These signals are needed in order to estimate the back-scattering matrix (BSM) of real media and objects. It is shown that the correct BSM estimation of fluctuating objects, having a-priori unknown ranges and radial velocities, is possible only when complicated orthogonal signals are being used. The principles of forming the needed radar waveforms as well as principles of backscattered vector signal processing, assuming Gaussian noise at the receiver is formulated. [C1648]

## "Analysis of radial velocity effect on synthetic range profile of stepped-frequency waveform"

The stepped-frequency waveform is able to obtain large effective bandwidth by sequentially changing the carrier frequency in steps over pulses. However, this waveform is very sensitive to the radial velocity between the radar and the target. In this paper, the effect of the radial velocity on the synthetic range profile is discussed first, and then the range spread in terms of the processed range bin is defined differently from others, which is validated by the simulation. Furthermore, the relation between the processed range bin and the range resolution is also discussed. [C1649]

## "Multi-aperture coherent Doppler lidar for mitigation of turbulence and vibration induced speckle effects"

Summary form only given. A 1.55 μm coherent Doppler laboratory lidar system has been developed to study the enhancement in the measured lidar SNR through the use of a dual aperture balanced heterodyne array using incoherent and coherent summation of the detected array signals. A 30 mW, 1.55 μm, single frequency diode laser is used as the main excitation source. The beam is split into a LO channel and a main projected beam followed by a 27 MHz acousto-optic shifter. The main portion is sent to a rotating target and the reflected

backscatter is collected by two spatially separated single mode, polarization preserving fibers. The two collected signals are branched into in-phase and quadrature signals for balanced heterodyne detection. The four channels are detected and the electrical signals are analyzed using spectrum analyzers, channel oscilloscopes, and then computer interfaced. We have studied the effects of target rotation on the Doppler center frequency, spread of the Doppler shifted signal, and the influence of the geometrical and velocity aspects of the target. [C1650]

## "Application of six-port wave-correlator for very low velocity measurement using Doppler effect"

A new technique is proposed for measuring the Doppler frequency of a moving object by using the six-port correlator. The examination of this new proposal has been done with an object moving at a very low speed. The experiment and simulation results show the target velocity around 0.2 mm/s has been successfully inferred, which proved the validity of the proposed scheme. [C1651]

## "Compensated photorefractive phase demodulator for probing object in rapid motion"

Two-beam adaptive phase demodulators are used for noncontact and non-invasive measurements of the small surface displacements produced by ultrasonic waves propagating in an object. As an example the setup of a two-wave mixing-based photorefractive demodulator is shown. [C1652]

## "Controlled construction, rotation and translation of 3-dimensional, optically trapped structures"

Summary form only given. We have extended the concept of optical trapping and manipulation with Laguerre-Gaussian (LG) beams by overlapping two LG modes of opposite phase helicity (one with a positive azimuthal index l and one with a negative l) to create an interference pattern consisting of a set of bright spots. This pattern remains intact as it propagates in the z-direction, due to the matched beam parameters of the overlapping beams unlike patterns produced using phase or intensity masks. Simulations of such a pattern are presented. In this work the pattern was produced by splitting a holographically produced LG beam into two separate beams in a Mach-Zehnder interferometer with a dove prism in one arm to reverse the helicity of one beam. The two beams could then be recombined to form the spot pattern. [C1653]

## "Critical spacecraft-to-Earth communications for Mars Exploration Rover (MER) entry, descent and landing"

For planetary lander missions, the most challenging phase of the spacecraft to ground communications is during the entry, descent, and landing (EDL). As each 2003 Mars Exploration Rover (MER) enters the Martian atmosphere, it slows dramatically. The extreme acceleration and jerk cause extreme Doppler dynamics on the X-band signal received on Earth. When the vehicle slows sufficiently, the parachute is deployed, causing almost a step in deceleration. After parachute deployment, the lander is lowered beneath the parachute on a bridle. The swinging motion of the lander imparts high Doppler dynamics on the signal and causes the received signal strength to vary widely, due to changing antenna pointing angles. All this time, the vehicle transmits important health and status information that is especially critical if the landing is not successful. Even using the largest Deep Space Network antennas, the weak signal and high dynamics render it impossible to conduct reliable phase coherent communications. Therefore, a specialized form of frequency-shift-keying must be used. This paper describes the EDL scenario, the signal conditions, the methods used to detect and frequency-track the carrier and to detect the data modulation, and the resulting performance estimates. [C1654]

## "Opto-acoustical sensor to examine the structural integrity of complex systems"

In this report we present the results of the analysis and experimental study of defect detection with Laser Doppler Vibrometry (LDV). The Non-Destructive Inspection (NDI) procedure is based on the vibrational mode evaluation for a test-object with specified defect parameters. To evaluate the procedure a clamped aluminum drum with radius R was selected as the test-object. The introduced defect was a thickness loss of 2.5%, 5.0% and 7.5% at the central part of the drum. The data from computational examination, based on finite element analysis, are compared with experimental data. Additionally, we present data from interrogation of a multilayer (carbon composite) element with preset defects in a specific layer and examples of corrosion detection. The experiments show that the proposed technique enables reliable defect detection, location, and quantification. [C1655]

## "A Ca optical frequency standard based on ultra-cold atoms"

With recently developed strategies to reduce frequency offsets due to residual first-order Doppler effects the relative uncertainty of the Ca optical frequency standard at PTB was reduced to 2.7-10-14. The weighted mean of the optical frequency measured by a harmonic frequency chain and recently by a femtosecond laser comb is

(455 986 240 494 154 ± 13) Hz. The use of ultra-cold atoms prepared by a novel two-stage cooling method will allow to further reduce frequency offsets. [C1656]

## "High accuracy evaluation of CENAM's primary frequency standard: second order Doppler shift"

The Centro Nacional de Metrologia in Mexico has developed an optically pumped cesium beam frequency standard, the CsOP-1. Currently, the major sources of systematic effects are being analysed and their corresponding frequency shift effects in the CsOp-1. In this work, we re-evaluate the second order Doppler shift by taking into account the modulation parameter. [C1657]

## "Space-Doppler parameter estimation for space-time-Doppler reception in time-varying multipath DS-CDMA systems"

We propose a joint space-Doppler parameter estimation algorithm for fast-fading multipath DS-CDMA communication systems. The Doppler shifts induced by the relative motion between the transmitter and the receiver, together with the associated direction-of-arrival (DOA), are jointly estimated by a semi-blind subspace-type method. The Doppler effect is successfully eliminated by a space-time-Doppler receiver after the directional and Doppler parameters are estimated. [C1658]

## "Shape of phased array Doppler ultrasound sample volumes"

Some of the methods used to reduce estimation errors make use of simplified models of the Doppler sample volume (SV). However, these models do not accurately take into account the SV's shape and pressure distribution. The SV can be accurately simulated through the inclusion of a Doppler time gate to a B-mode simulation based on the underlying physics of ultrasound propagation and reception from a linear phased array transducer, including the effects of focusing and attenuation. A commercial diagnostic B-mode/Doppler ultrasound system was simulated to produce four SVs at different axial depths and lengths. It was found that every SV's axial length was larger than the theoretical length used in its design. The further the SV was away from a focal depth, the greater its size in that dimension. The pressure distribution was not symmetrical about the center of the SV, but rather skewed towards the transducer. [C1659]

## "Signal sonar processing"

This paper describes the major trends in sonar signal processing and gives some example of advanced algorithms to illustrate the need in computation power: adaptive beamforming for passive sonars, wideband Doppler code for active sonar in coastal/shallow water environment (reverberation limiting conditions) and synthetic aperture processing for minehunting sonars. The performances of these algorithms compared to conventional ones are shown on real data obtained at sea. [C1660]

## "Improving Doppler ultrasound spectroscopy with multiband instantaneous energy separation"

This paper deals with improving the time-frequency resolution of Doppler ultrasound spectroscopy, applied to blood flow analysis, by developing robust nonstationary spectrum estimation techniques based on Gabor (1946) filterbanks and multiband AM-FM demodulation that uses an instantaneous energy separation algorithm. [C1661]

## "Link-level simulation of W-CDMA satellite-UMTS random access channel"

In this paper, link level simulation for the W-CDMA Satellite-UMTS RACH (radio access channel) has been presented. Simulation results show improvements in detection using a longer preamble with differential accumulation. For a longer preamble, coherent processing suffers large losses in the presence of Doppler. Efficient channel estimation algorithms and pre-Doppler compensation are required if a coherent approach is used. The reduced sensitivity of coherent detection in the presence of Doppler could be compensated by adopting a differential approach even though this solution increases the complexity at the receiver. It can be seen that the modified ETSI proposal does not degrade the performance compared to the ETSI proposal in terms of detection probability. Hence, we can expect improvements in the RACH throughput efficiency and delay since there are more available signatures and so the probability that more than one user chooses the same signature that results in collision is lower. Also, to achieve a one-shot-acquisition for the random access burst, the performance of preamble detection and message detection must be aligned, i.e. at an Ec/N0, where the preamble detection is likely, the RACH message BLER (block error rate) must be adequately low. The alignment is done by adjusting the preamble detection performance setting the threshold of the received energy of the matched filter at the receiver. From the simulation results, it was shown that with the used threshold, the probability of detection corresponds to more than 0.9 at the required Eb/N0for a BLER of 10-1for the message part. [C1662]

## "Analysis of a multichannel wireless access protocol with non-instantaneous feedback under correlated fading"

Throughput performance of a multichannel wireless access protocol with non-instantaneous feedback taking into account the effect of bursty packet losses, caused by a correlation in the multipath fading process is analyzed. M equal capacity orthogonal traffic channels are shared by N mobile users (M≤ N) on the mobile-to-base link. Based on the status (busy/idle) of the M receivers transmission attempts are made on the uplink. The BS (base station) broadcast the status in every slot on the downlink (base station-to-mobile link). A first order Markov model is used to describe the correlation in the packet success/failure process on a Raleigh fading channel. Using the above method., analytical expressions for the average throughput per channel are derived for a multichannel wireless access protocol with non-instantaneous feedback. The effects of Doppler bandwidth on the performance of the protocol with and without capture conditions are compared. For fixed values of N the single channel system perform better than the multichannel system, but for a fixed N/M ratio the multichannel system perform better than the single channel system. [C1663]

## "Measurement of dynamics in strontium magneto-optical trap"

Summary form only given. The experiment consists of a Sr vapor cell magneto optical trap (MOT). Since for laser-cooled alkaline earth atoms the even isotopes have no hyperfine structure, they provide an ideal system for testing Doppler-cooling theory. (Alkali atoms are subject to sub-Doppler cooling mechanisms.) We have measured the spring constant (k) and damping coefficient (α) in a strontium MOT by observing the damped oscillation response of the trapped atom location to a square-wave chopped pushing beam. [C1664]

## "FPE approach to sub-Doppler cooling and atomic grating formation: analytical and numerical results"

Summary form only given. Kinetics of light-induced sub-Doppler cooling and spatial grating formation has been considered for atomic ensembles with dipole transitions in light spatial configurations, formed by coherent monochromatic non-collinear light beams with frequency ω. Consideration is based on a closed Fokker-Planck equation (FPE). [C1665]

## "Towards in-situ calibration of gyro and Doppler navigation sensors for precision underwater vehicle navigation"

Addresses a practical problem arising in the calibration of bottom-lock Doppler sonar for the navigation of underwater robot vehicles. Employing a least-squares method, the rotational alignment offset between a bottom-lock Doppler sonar and a north-seeking gyroscope can be experimentally determined using sensors commonly deployed with a vehicle in the field. It requires sensor values from the vehicle's Doppler sonar and 3-axis gyroscope, and absolute vehicle position fixes from a long-baseline or short-baseline acoustic navigation system. The performance of the calibration method is evaluated with simulated Doppler data possessing measurement noise typical of that found in actual in-water vehicle sensor data. [C1666]

## "Totally blind channel estimation for OFDM over fast varying mobile channels"

A blind channel estimation scheme for OFDM is proposed. The algorithm is based on the ML-principle and features a very fast convergence rate. No reference symbols are needed to resolve the phase ambiguity. Simulations show the performance in mobile environments at high Doppler frequencies and short to medium delay spreads. The proposed approach maximizes the spectral efficiency by avoiding any reference symbols or pilots, and it minimizes the BER by using a non-differential modulation scheme [C1667]

## "MMSE channel prediction assisted symbol-by-symbol adaptive OFDM"

Subband adaptive orthogonal frequency division multiplexing (OFDM) constitutes an effective method of compensating for the frequency selective fading incurred by mobile receivers. The channel transfer function estimation error increases both as a function of the Doppler frequency and that of the subband modem mode signalling delay. This leads to a degradation of the system's performance. In this article a 2D-MMSE channel-predictor is investigated as a means of compensating for these effects, which incorporates the scheme proposed Tufvesson, Faulkner and Maseng, (see IEEE Proc. of 6th International Workshop on Intelligent Signal Processing and Communications Systems, Melbourne, Australia, p.57-33, November 1998) into an adaptive OFDM scheme [C1668]

## "Estimating velocity of mobiles in EDGE systems"

A new algorithm is modified and applied for estimating mobile velocity for EDGE (enhanced data rates for GSM evolution) cellular systems. The algorithm uses normalized autocorrelation of filtered received signals to estimate the velocity of EDGE mobiles. The algorithm works well for both non-dispersive channels and dispersive channels including typical urban and hilly terrain propagation models. Simulation results indicate that the new algorithm is very reliable and effective for distinguishing fast and slow moving mobiles in EDGE cellular systems with both 900 MHz and 1900 MHz carrier frequencies. [C1669]

## "Intercarrier interference in MIMO OFDM"

We examine multicarrier transmission over time-varying channels. We first develop the model for such a transmission scheme and focus particularly on OFDM-based schemes. We analyze the impact of time-variation within a transmission block which could arise both from Doppler spread of the channel and from synchronization errors. We propose a time-domain approach to mitigate the effects of such time-variations. This approach reduces to the familiar single-tap frequency-domain equalizer when the channel is block time-invariant. We also develop this in the context of multiple transmit and receive antennas and specialize the receiver to space-time block-coded systems. Finally we provide numerical results [C1670]

## "A system for automatic classification of aircraft flyovers using acoustic data"

An overview of a system for the automatic classification of aircraft from flyover data is presented. The system is passive, utilising acoustic sensors to measure both broadband and narrowband energy. Aspects of the system architecture, sensor design and signal processing are covered. The processing is divided into three streams: broadband, narrowband and cepstrum. Each processing stream is capable of extracting flight parameter estimates from the acoustic data. Broadband estimation is based on the time-delay cross correlation of signals from multiple sensors. Narrowband estimation makes use of the spectrogram of the data to extract frequency lines produced by the aircraft and subject to the acoustical Doppler effect. Cepstrum processing tracks the primary rahmonic in the cepstrogram due to multipath interference. A novel hidden Markov model tracking technique is applied to form tracks on the noisy spectrogram and cepstrogram data. Examples of real data processing and flight parameter estimates for classification are given. [C1671]

## "Performance of orthogonal transmit waveforms for CDMA uplink systems in MIMO Rayleigh channels"

In this paper, we extend our previous work (2001) to design orthogonal transmit waveforms (OTW) for CDMA systems in MIMO (multiple transmit/receive antennas) mobile radio channels. We evaluate the performance of orthogonal transmit waveforms for uplink communications systems through the use of bit-error-rate (BER) simulation. We investigate the MIMO mobile radio uplink channels for both time-varying flat and frequency selective Rayleigh fading channels. The proposed OTW systems exploit both the spatial and temporal diversity of MIMO mobile radio channels. The effects of angle spread, Doppler frequency, and delay spread of MIMO mobile channels on the BER performance of the OTW system are considered. [C1672]

## "Spatial and temporal variations of MIMO channels and impacts on capacity"

This paper presents analysis for spatial and temporal variations of multiple-input-multiple-output (MIMO) channels at the mobile. The channel study is based on the narrowband measurements at 2.11 GHz in Manhattan, New York with 16 transmitting antennas and 16 receiving antennas. Doppler spread and angle of arrival (AOA) are derived from the temporal correlation of field components. The results show that the AOA at the mobile is not uniformly distributed. The restricted AOA distribution results in approximately twice the correlation distance and correlation time than the predicted values from the Jakes (1974) model. The measured median coherence time is at least a few seconds for stationary channels, and 90 ms at a mobile pedestrian speed of 3 km/hr. These observations hold for both vertically and horizontally polarized antennas. The measured median RMS angular spread at the mobile is 22.5° for horizontally polarized antennas and 25.5° for vertically polarized antennas [C1673]

## "Time frequency signal analysis of ground vehicle acoustic signatures"

The acoustic signatures of various types of ground vehicles are recorded during each vehicle's transit past a stationary microphone located just above ground level and the acoustic data are analysed using the short time Fourier transform. The spectrogram for each transiting vehicle exhibits a primary set and a secondary set of harmonic lines in the time-frequency domain that can be used for classification purposes. The frequency of each harmonic line varies with time due to the acoustical Doppler effect. The variation with time of the instantaneous

frequency of the strongest harmonic line is used to estimate the speed, ground distance at the closest point of approach to the microphone, and engine-firing rate of the vehicle. [C1674]

## "Short CPI STAP for airborne radar"

Circular, electronically scanned antenna arrays are currently being considered for use in airborne surveillance systems. These arrays are capable of pointing a beam in any direction at any time. This allows the radar to perform both 360° search and high update rate track modes simultaneously. To manage the radar's resources efficiently, shorter coherent processing intervals (CPIs) should be used for nearby or large targets. However, shortening the CPI effects STAP performance by increasing the amount of Doppler space that is lost to the clutter . This paper analyzes the useable Doppler space performance of short CPI STAP. It is shown that CPIs as short as 6 pulses can be used to track high velocity targets. Short CPI STAP performance is analyzed theoretically and by simulation. [C1675]

## "STAP with angle-Doppler compensation for bistatic airborne radars"

We study issues associated with applying space-time adaptive processing (STAP) techniques in bistatic airborne applications. We consider the performance of several STAP approaches in different scenarios. Specific consideration is given to the effects of bistatic clutter spectral dispersion on covariance estimation and the algorithm's resulting clutter rejection capability. Our prime focus emphasizes adaptive processing methods capable of high performance with efficient utilization of training data. A deterministic two-dimensional spectral compensation is used to align the clutter spectral centers and thus enhance the performance of the proposed approaches. Algorithm performance is assessed using the output signal-to-interference-plus-noise ratio (SINR) compared to that of the matched filter with known covariance. [C1676]

## "Acceleration compensation by matched filtering"

High radar sensitivities are required in the detection of small cross section targets or in ECM environments. An effective way of improving the radar sensitivity is to use long coherent integration times. Results of the work to be presented include studies of target decorrelation using actual magnitude/phase flight test data from aircraft and the resolution of the "filter fly-through" problem due to translational acceleration. The acceleration compensation technique described in this radar generates matched filters that compensate for each acceleration. The matched filters optimize the signal-to-noise ratio by weighting and combining the Doppler filters over which the target is spreading. Both coherent and non-coherent matched filters can be formed. This provides direct and precise measurement of target acceleration for enhanced detection and tracking of maneuvering targets. [C1677]

## "A new constrained joint-domain localized approach for airborne radars"

Critical issues associated with the application of multi-dimensional adaptive filtering including space-time adaptive processing (STAP) to real-world radar systems are considered. In particular, the design of transform domain localized techniques are examined from the perspective of receiver beam position and Doppler filter selection relative to mainlobe clutter as well as target returns. In particular, asymmetry in the selection of auxiliary beams and the effects of spatial tapering are shown to offer dramatic improvements in signal to interference ratio for targets with low Doppler. [C1678]

## "Design of a novel instrumentation for measurement of blood flow while gripping a handle"

The purpose of this study was to design a prehensile device which could be coupled with a laser Doppler flowmetry system to simultaneously measure components of grip force, push force and blood flow on the inside of the hand surface. This device will enable physicians, researchers, and designers of handheld equipment to study blood circulation in the hand under different grip forces, and hand-push loading conditions [C1679]

## "10 GHz Doppler radar sensing of respiration and heart movement"

A vital signs detection system, based on motion sensing principle of the Doppler effect, will be described. This system can be used to determine respiration and heart rates remotely, without any sensors attached to the subject. The system consists of a Doppler radar transceiver, an A/D converter, data acquisition software, and DSP software for rate extraction. The radar function can be realized with compact and inexpensive commercially available motion sensor detectors [C1680]

## "The problem of kill assessment .I.I. The Doppler effect and exo-atmospheric kill assessment"

For pt.I see National Radar Conference, Atlanta Ga, May 2001). In this paper, the future problems of kill

assessment in the exo-atmosphere is discussed. The concentration is on characterizing the Doppler spectrum of objects that are undergoing non-uniform motion. Then a data collection experiment is discussed for gathering exo-atmospheric Doppler data. [C1681]

## "Moving target detection in over-the-horizon radar using adaptive chirplet transform"

In over-the-horizon radar (OTHR) moving target detection, the signal to clutter ratio (SCR) is low. One method to detect a moving target is to first reject the clutter and improve the SCR before the detection, such as the adaptive Fourier transform developed by Root (see SPIE Conference, San Diego, p.19-24, July 1998) when a target moves uniformly. When a target does not move uniformly, the Fourier based techniques for the target detection including super resolution techniques may not work well. We replace the Fourier transform by the adaptive chirplet transform in the Doppler processing in OTHR when a target moves non-uniformly. [C1682]

## "Estimation of continuous flat fading MIMO channels"

Multiple input multiple output (MIMO) systems can provide high data rate wireless services in a rich scattering environment. We study one of the proposals for MIMO systems, the Bell Labs Layered Space-Time (BLAST) architecture. Channel estimation using training sequences is required for coherent detection in BLAST. We apply the maximum likelihood (ML) channel estimator and the optimal training sequences for block flat fading channels to continuous flat fading channels, and analyze the estimation error. The optimal training length and training interval that maximize the throughput for a given target bit error rate are found by computer simulations as functions of the Doppler frequency and the number of antennas. [C1683]

## "Decision-directed channel estimation for M-QAM-modulated OFDM systems"

When decision-directed channel estimation is used for QAM-OFDM systems, the optimal shape of the two-dimensional filter depends on the amplitudes of the modulated symbols as well as the channel characteristics such as delay spread. Doppler frequency, and signal-to-noise ratio. While most conventional channel estimation methods did not consider the amplitudes of the modulated symbols because of the large computational complexity, we propose a simple channel estimation method for multi-level-amplitude-modulated systems. The proposed method can effectively reduce the noise variance of the estimates with small-sized filtering and there is a possibility of reducing the implementation cost and producing better results by avoiding unnecessarily large biased term. [C1684]

## "Performance of multiple-receive multiple-transmit beamforming in WLAN-type systems under power or EIRP constraints with delayed channel estimates"

Downlink beamforming in a WLAN-type system employing access points and mobiles equipped with multiple antennas and associated receivers and transmitters are considered. The beamforming aims at maximizing the performance under constraints on transmit power or equivalent isotropic radiated power (EIRP). Solutions for the two constraints are derived and investigated using simulated and measured channels. Our simulation and experimental results shows that performance gains of 8-10 dB when using four directional transmitter antennas and two receive antennas (as compared with a base-line one-transmit two-receive), are possible under both constraints. For simulated channels, a delay between channel estimation and use of the same channel of up to 10% of the (inverse of the) Doppler frequency only degrades performance some tenths of a dB. In our measurements, very small degradations are seen with delays of up to 130 ms. The measurements were made under relatively stationary conditions with only occasionally moving people. Two different strategies for updating the beamforming vectors: sounding and ping-pong, are also considered in the paper. [C1685]

## "Quasi-static method for predicting link-level performance"

In this paper, we investigate the performance of a quasi-static method used to predict link-level error performance in dynamic system simulations. Two flavors of the quasi-static approach are used to model the link characteristics: (a) static curves with fudge factors; and (b) short-term frame error curves. For the fudge factor based method, we examine the various factors (or penalties) required for the method to work properly, their limitations in capturing the various features of the high-speed packet data channel, and their effects on the overall accuracy of the technique. Here, we concentrate on three important penalties: puncturing penalty, Doppler penalty, and demapping penalty. The quasistatic method based on short-term frame error curves is used to generate frame erasures for voice and control channels associated with high-speed packet data channels. From simulation results, it is shown that both variations of the quasi-static method can provide accurate prediction of link-level performance at certain operating ranges, provided that the penalties are correctly obtained. At low frame error rates and moderate to high speeds, however, the quasi-static method often fails to accurately reflect frame error performance at the link level. [C1686]

## "Average outage duration of multiuser wireless communication systems with a minimum signal power requirement"

This paper deals with the average outage duration (AOD) of wireless communication systems subject to cochannel interference. In particular, it presents closed-form expressions for the AOD when a minimum desired signal power requirement is specified for satisfactory reception. The results are quite general and account for systems operating over Rician and/or Nakagami fading environments. When applicable, these new expressions are compared to those previously reported in the literature dealing with the AOD of (i) interference-limited systems when both the desired and interfering signals are subject to Rayleigh type of fading and (ii) power-limited systems operating over Rician or Nakagami fading channels. Corresponding numerical examples that illustrate applications of the results are also provided and discussed. These results show that specifying a certain minimum desired signal power requirement induces a floor on the AOD. They also show that the AOD is essentially affected by the the maximum Doppler frequencies (or equivalently the speed) of the desired users. [C1687]

## "Blind space-time multiuser detector"

Space-time transmission diversity schemes have been known to provide considerable spectral efficiency as compared to other prevalent schemes. Space-time codes are also essential to exploit the full potential in a multiple antenna system. We propose a new blind signal detection of a user in a multiple user case where each of the users has multiple antennas. The transmission scheme employs space-time block coded symbols. The channel used for the simulations is a time varying channel based upon the classical model, which incorporates Doppler spreading, Rayleigh fading and multipath propagation with exponential delay. The blind detection scheme is based on constrained minimum output energy based detector at each of the receiver antennas. [C1688]

## "Space-time coding for doubly selective channels"

Relying on a basis expansion model (BEM) to capture time- and frequency-selective propagation effects, we prove that the maximum achievable diversity of multi-antenna transmissions over doubly-selective channels is determined by the rank of the correlation matrix of the BEM coefficients from all channels. The diversity order is multiplicative in the effective degrees of freedom that the channels exhibit in space-, time-, and frequency-domains. Furthermore, we design a block precoded digital phase sweeping transmission that achieves full space-Doppler-multipath diversity for any number of transmit-receive antennas, and without bandwidth expansion. The theoretical diversity results are corroborated by simulations, and the BEM is validated [C1689]

## "Doppler spread estimation in mobile communication systems"

A new technique based on the auto-correlation function is described for the estimation of the Doppler spread in mobile communication systems. We first propose to divide a uncertainty region of Doppler spread into multiple frequency bins. Based on the given multiple bins the correlator compares the estimated value at a certain time index to the theoretical exact value and then decides which bin the Doppler spread is estimated in. The certain time index can be optimized to give the largest decision region among multiple bins. We derive the optimum time index algorithm to give the largest decision region for each bin based on Rayleigh fading channel. We also apply the same Doppler spread estimator to the Rician case with the slight transformation of the received signal. We show that the proposed technique is not affected significantly by the Rician factor and the SNR degradation with the reasonable number of samples for estimation which is not the case of other estimators given in the literature. [C1690]

## "Absence of the transverse Doppler shift at microwave frequencies"

An experiment is described showing that a 36 GHz microwave signal received by rotating antennas or mirrors is not exhibiting the frequency shift ("transverse Doppler effect") predicted by the relativistic Doppler formula. The sensitivity of the apparatus used has been tested to be sufficient for detecting frequency shifts as small as 10-3Hz which corresponds to the value of (v/c)2= 5.10-14used in the transverse Doppler shift experiment reported here. From the observed absence of the transverse Doppler shift it is speculated that either the time dilation predicted by the standard theory of special relativity does not exist in reality or, if it does, is a phenomenon which does not depend on relative velocities but may be a function of absolute velocities in the fundamental frame of the isotropic microwave background radiation. [C1691]

## "0.25 μm CMOS and BiCMOS single-chip direct-conversion Doppler radars for remote sensing of

## vital signs"

Summary form only given. A fully integrated direct conversion Doppler radar that detects heart and respiration movement at a distance of 50 cm is described. The 1.6 GHz transceiver is implemented in both CMOS and BiCMOS technologies, with each chip occupying 14 mm2using a 0.25 µm silicon processes. The effects on system sensitivity of phase noise at small offset frequencies with range correlation are assessed [C1692]

## "Design of OFDM systems for frequency-selective and time-variant channels"

We show that frequency-selectivity and time-variance represent adverse constraints for the design of wireless OFDM systems. This observation is important since OFDM is a promising candidate for the realisation of broadband wireless systems, which by definition transmit over frequency-selective and time-variant channels. We present a convenient design criterion for the OFDM symbol duration. The criterion is relating the two basic channel parameters, the maximum excess delay time and the maximum Doppler frequency, with two design parameters reflecting the bandwidth efficiency and the robustness of the system. The introduction of the latter two parameters allows the efficient design of OFDM systems by providing information on the system reserves. Furthermore, we show how the use of multiple antenna arrays exploiting spatial diversity can be incorporated in the system design [C1693]

## "Performance evaluation of Viterbi decoded Reed-Solomon block codes in additive white Gaussian noise and flat fading channel conditions"

Much attention has been given to the decoding of linear block codes by means of trellis decoding algorithms, such as the BCJR and Viterbi algorithms. Not only do these algorithms support soft input decoding, but also the application of channel state information for improved decoding performance in fading channel environments. This paper presents a performance evaluation, based on an extensive simulation study, of Viterbi decoded Reed-Solomon block codes under additive white Gaussian noise and flat fading channel conditions. Special attention is given to the influence of channel state information on the bit error rate performance of Viterbi decoded Reed-Solomon block codes in flat fading channels with varying Doppler frequencies and line-of-sight signal strengths. [C1694]

## "Performance analysis of MTCM/CPFSK in correlated Rayleigh fading channels with perfect channel information"

The upper bound on the pairwise error probability of MTCM/CPFSK with coherent detection is derived using a linear transformation for orthogonalizing the autocorrelation matrix of Rayleigh fading process with perfect CSI in the presence of an additive white Gaussian noise and a correlated Rayleigh fading. The analyzed performance well estimates the simulated performance for Doppler frequencies when BER is lower than 10-3. [C1695]

## "A generalized simulation model for Rayleigh fading channels with accurate second-order statistics"

A new sum-of-sinusoids statistical simulation model is proposed for Rayleigh fading channels. The new model employs random path gain, random initial phase, and conditional random Doppler frequency for all individual sinusoids. It is shown that the autocorrelations and cross-correlations of the quadrature components, the autocorrelation of the complex envelope of the new simulator match the desired ones exactly even if the number of sinusoids is as small as a single-digit integer Furthermore, the probability density functions of the fading envelope and phase, the level crossing rate and the average fade duration of the new simulator asymptotically approach the desired ones as the number of sinusoids approaches infinity, while good convergence is achieved when the number of sinusoids is small. Statistical properties of the new simulator are evaluated by numerical results, finding good agreement in all cases. [C1696]

## "A space diversity scheme for in-house OFDM system in a quasi-static multipath environment"

A space diversity scheme for an orthogonal frequency division multiplexing (OFDM) system designed for in-house application such as wireless local area network (WLAN) or wireless home network is proposed. In the proposed scheme, the antenna is selected in accordance with the dip width of the frequency spectrum of the transmission channel. The diversity effect is evaluated by simulation in a typical multipath environment in a house. The delay spread of 30 ns and the maximum Doppler frequency of 0.5 Hz are assumed. In this paper, the PER is considerably improved by more than one order (1/10) by using the proposed scheme when the carrier to noise power ratio (CNR) is high. [C1697]

## "Doppler-adaptive multipath window tracking for WCDMA FDD-uplink"

A dynamic RAKE diversity combiner used in the 3rd Generation Partnership Project (3GPP) UTRA FDD (WCDMA) uplink (UL) mobile communication system includes a path searcher to estimate time delays of channel taps to be coherently combined. Due to varying propagation delay between mobile and base station, the channel taps change their position over time. The path searcher has to track these changes by adapting its search window. This paper describes the concept of adaptive window tracking algorithms (WTA) and presents different approaches for position adaptation of the search window with emphasis on the required search window size-a major index for implementation complexity of the path searcher. In addition, it introduces a novel Doppler-adaptive WTA and compares the behavior of the different algorithms by means of tracking accuracy, tracking speed, and required search window size. The simulation studies show that the proposed Doppler-adaptive algorithm reduces the implementation complexity, significantly. [C1698]

## "Residual frequency offset correction for coherently modulated OFDM systems in wireless communication"

Orthogonal frequency division multiplexing (OFDM) systems are very sensitive to frequency offset caused by tuning oscillator instabilities and Doppler shifts induced by the channel. The Schmidt and Cox (1997) algorithm (SCA) is quite robust in estimating the frequency offset for systems with large OFDM symbol lengths. It uses two OFDM symbols for training with the first one having two identical halves. The frequency offset is estimated by correlating a received sequence of samples equal to half the OFDM symbol length with the following received samples. The effect of additive white Gaussian noise (AWGN) in the estimation process is mitigated only if the number of samples used in the correlation, and hence the OFDM symbol size is large. However to be successfully applied to broadband fixed wireless access (BFWA) systems, OFDM should perform well even with smaller symbol lengths. We present the residual frequency offset correction algorithm (RFOCA), which uses the SCA for initial frequency offset acquisition and follows it with a stage which reduces the initial residual frequency offset by tracking the phase of the decoded data. We show through simulation that the RFOCA achieves an error variance that is many orders of magnitude lower than at the end of the acquisition stage using the SCA alone. [C1699]

## "Accurate and real-time Doppler frequency estimation with multiplicative noise for velocity measurements using optical feedback interferometry"

This paper proposes to analyze a real-time signal processing algorithm for on-line velocity measurement of a moving target, with a laser sensor using optical feedback interferometry. This velocity is based on an accurate estimation of the Doppler frequency from a spectral analysis of the laser diode output signal. This study takes into account both main causes of disrupting noises: additive noise and multiplicative noise caused by the speckle effect. A very simple expression is given for the Doppler frequency estimation bias based on an autoregressive spectral analysis method intensive Monte Carlo simulations, which are compared with experimental results, show that relative bias and standard deviations of about 0.1% and 0.5% respectively can be obtained for a wide range of velocities. [C1700]

## "A comparison of EM scattering results and radar sea clutter"

The characteristics of radar sea clutter have been studied for many years, mostly to develop empirical models for the average back-scattered energy, the amplitude statistics and the Doppler spectrum. These models have been successful at describing the variations of behaviour with sea-state and viewing geometry, but have not been able to establish the link between specific features on the sea surface and the radar backscatter. This paper describes a programme of work where carefully controlled radar and surface measurements in a wavetank are compared with real radar sea clutter and electromagnetic scattering calculations. The results show that a direct link can be made, thus allowing a causal relationship to be established between specific features on the sea surface and remotely gathered radar sea clutter. The EM scattering calculations provide the means for the results to be extended over a wide range of radar frequencies, resolutions, and grazing angles. Also the effect of modifying the sea surface wave spectrum may be calculated. [C1701]

## "Velocity compensation methods for the conical scan step-frequency waveform"

This paper analyzed the velocity interferences on the conical scan step frequency waveform and gave some velocity compensation methods. The holistic velocity compensation (HVC) is effectual for the accurately known velocity. The excursive velocity compensation (EVC) is fit for the case of inaccurate estimated velocity. [C1702]

## "Doppler processing on irregular PRT"

Irregular PRT improves the radar ECCM performance, but implies irregularly sampled signals. Conventional

Doppler processing can not suffice, because it is based on regular samples. Furthermore, the Nyquist sampling criterion cannot be met, because both time delays and Doppler frequencies are to be extracted from the radar samples. Applicability of wavelets, frames, and discrete Fourier transform (DFT) on uniformly extended samples, was investigated. Doppler ambiguity and clutter suppression are treated as most serious of all radar specific problems. [C1703]

## "Effects of bistatic clutter dispersion on STAP systems"

In this paper, we analyze the performance of several space-time adaptive processing (STAP) approaches in bistatic applications. Specific consideration is given to the effects of bistatic clutter spectral dispersion on covariance estimation and the algorithm's resulting clutter rejection capability. We emphasize the role of adaptive processing methods capable of high performance with efficient utilization of training data. A deterministic two-dimensional (angle-Doppler) compensation technique is used as a preprocessor and is compared to the Doppler warping approach. Algorithm performance is assessed using the output signal-to-interference plus noise ratio (SINR) compared to that of the matched filter with known covariance. [C1704]

## "Target decomposition through polarimetric, disjoint Doppler and frequency band (I)SAR images"

A fully polarimetric (I)SAR image target decomposition process has been developed to aid automatic target recognition (ATR) for disjoint Doppler and frequency bands. In this paper the principle of target decomposition into scattering primitives is first demonstrated for a flat plate and then for a more complex target. [C1705]

## "Symbol rate simulation of Doppler spectrum effects for WCDMA receivers"

Monotonic chip rate increase of wireless mobile CDMA systems had been observed in the last years (e.g. WCDMA, CDMA2000). One of the most demanding tasks when simulating a CDMA system is to pass a transmitted signal through a multipath-fading channel. Each channel tap is modeled as a time varying filter that represents the fading process of a single path. A conventional way of simulating the effect of the multipath fading channel is at a fractional chip rate. In this paper, we present an analysis and a method to simulate Doppler spread filtering in terms of the receiver symbol rate rather than chip rate; thus enabling complete fading channel simulation at the symbol rate. The analysis begins by employing a de-spreading element on a chip rate received signal. This operation translates the incoming signal of chip rate resolution into symbol rate resolution. The presented analysis leads to a closed form of the Doppler spectrum shaping in terms of the receivers symbol rate. The new form of the Doppler spectrum is given with respect to the conventional Doppler spectrum form. Furthermore, although the channel model is formulated in terms of chip rate, it is seen that the Doppler spreading can be applied in the receiver symbol rate. This results with a potential of substantial reduction in the simulation calculation effort. [C1706]

## "Sensor array shape estimation using active sonar clutter"

This paper concerns the problem of array shape estimation from clutter (ASEC) for a towed active sonar array. Although heading sensors can provide towed-array shape information, they are sometimes not sufficiently available or accurate to facilitate beamforming with low sidelobe levels necessary for detection of low-Doppler targets, especially in the presence of severe bottom reverberation. We propose a maximum likelihood array shape calibration technique that exploits the azimuth-Doppler frequency relationship of the clutter by fitting the reverberation snapshots from a single sonar ping to the low rank space-time clutter subspace. [C1707]

## "ARES: radar data generator for systems design and development"

The Airborne Radar Environment Simulator (ARES) is a radar data generator tool capable of simulating returns from airborne and surface targets, ECM and also includes surface and volume clutter and atmospheric effects. The data output is time series signals at baseband IQ level. This data can be used for various purposes in support of the design and development life cycle of a radar system: theoretical studies of radar phenomena, design of signal processing algorithms and in providing test vectors for software development, The GEDAE software development tool allows the import of the data generated by ARES to provide test vectors representative of real radar data for use in signal processor software design and implementation. [C1708]

## "Modulation effect analysis by rotating screw metal fans"

In this paper, the backscatter field of rotating screw metal fans is investigated based on PO/PTD (physical optics/physical theory of diffraction) and the method of equivalent currents (MEC), in conjunction with the quasi-stationary method. The time and frequency domain responses of the radar return signals are predicted. The modulation effects by the radar return signal of rotating screw metal fans are analysed. These results can be

used in target identification. [C1709]

## "Wavelet detection of low observable targets within sea clutter"

We observe scattering events in the Doppler domain via a continuous wavelet transform (CWT). By minimising the uncertainty in velocity and time, the dominant event in the non-stationary instantaneous Doppler spectrum can be isolated. Considering the returns to be discrete in nature leads to a physically motivated detection statistic termed 'persistence' that measures the observed lifetime of the scatterers. A Doppler detection scheme is formulated at low velocities within the clutter spectrum, an area neglected by current Doppler filtering. When operated on real data containing an oil drum target, results appear to be complementary to simple intensity thresholding; this suggests detection is made on secondary effects such as wake disturbance. [C1710]

## "Accounting for array effects in joint-domain localized STAP processing"

We study critical issues associated with the application of multi-dimensional adaptive. filtering, including space-time adaptive processing (STAP), to real-world radar systems. In particular, transform domain localized techniques are examined from the perspective of receiver beam position and Doppler filter selection relative to mainlobe clutter as well as target returns. It is shown that the selection of asymmetric auxiliary beams offers dramatic improvements in signal-to-interference ratio for targets with low Doppler. [C1711]

## "Monitoring antivascular therapy with high frequency ultrasound flow imaging"

The effect of antivascular therapy on blood flow in superficial mouse tumors was monitored using high frequency Doppler flow imaging techniques (HFD). Volumetric flow imaging of established melanomas detected a significant reduction in blood flow 4 hours after injection of the tumor vascular targeting agent ZD6126 followed by a recovery of flow by 24 hours after injection. Measurements of tumor perfusion in situ by Hoechst perfusion staining correlated with the ultrasound results. This study demonstrates the feasibility of high frequency flow imaging as a quantitative tool for following longitudinally the effects of antivascular therapy on blood flow in superficial tumors. [C1712]

## "A robust Doppler classification technique based on hidden Markov models"

A classification algorithm is presented that uses hidden Markov models (HMM) to carry out recognition between three classes of targets: personnel, tracked vehicles and wheeled vehicles. It exploits the time varying nature of radar Doppler data in a manner similar to techniques used in speech recognition, albeit with a modified topology, to distinguish targets with different Doppler characteristics. The algorithm was trained and tested on real radar signatures of multiple examples of moving targets from each class and the performance was shown to be invariant to target speed and orientation and was able to generalise with respect to variants within a class. [C1713]

## "Diverse radar pulse-train with favourable autocorrelation and ambiguity functions"

A coherent train of identical linear-FM pulses is a popular radar signal, mainly due to its good range and Doppler resolution. One of its drawbacks is the relatively high autocorrelation function (ACF) sidelobes. We show how to completely remove most of the sidelobes by diversifying the pulses through overlaying them with orthogonal coding. The technique applies to any other type of pulses-analog or digital. [C1714]

## "The effect of nonlinear propagation on heating of tissue: numerical modelling and experimental measurement"

A combination of finite difference and finite element models is used to model the nonlinear propagation of medical ultrasound fields and the resulting temperature rises generated in a tissue phantom. A non-axisymmetric finite difference model is used to solve the KZK equation, and so model the beam of diagnostic scanners in pulsed Doppler mode. The predictions are made for both water and a fluid-tissue path. The initial conditions used in the model were obtained from measurements made close to the scan heads of medical systems. The resulting losses from the beam intensity are then used as the source term for a finite element model of tissue heating. The resulting predictions are compared with experimental measurements of the temperature increases that were produced in a tissue mimicking gel by the diagnostic fields and found to be in excellent agreement. The results show that nonlinear propagation can increase the temperature rise significantly (50%) when there is a fluid path overlying tissue, but that this is not always the case, as saturation effects can become dominant. [C1715]

## "Wavimeter"

A new method of extracting wave parameters from wave height measured from a moving platform is presented. A least square approach is presented to estimate wave parameters using vessel velocity and perceived wave frequency that eliminates Doppler due to vessel motion. Two techniques for estimating wave frequency are presented: a block data method using MUSIC and a real-time method using demodulation. Sea trial results demonstrate that this method is as effective as a WaveRider buoy for estimating wave parameters. [C1716]

## "Bottom mounted active sonar for detection, localization, and tracking"

A bottom-mounted, wideband active sonar system designed to detect unfriendly vessels entering a closed area is described. We present signal processing algorithms for target detection, classification, localization, and tracking, and present performance predictions based on simulations. These algorithms are shown to be effective with state of the art, realizable sonar systems. The signals are binary phase shift keyed (BPSK) with a range resolution of approximately 0.01 m and Doppler resolution of 0.5m/s. Received signals from multiple directional receive beams are basebanded and Hilbert transformed to obtain complex representation. These signals are correlated with replicas of the transmitted signal time compressed or dilated to represent a number of different hypothetical target Dopplers, giving a processed signal with three dimensions: time, channel, and target Doppler. Background interference is estimated using a block-transversal filter. The processed signal is divided by the estimated background to obtain signal-to-interference ratio (SIR) and SIR threshold crossings are detected and contiguous detections are clustered. Range is estimated using arrival time. Bearing is estimated using amplitude comparison for adjacent receive beams. Elevation is estimated using split beam phase between signals from elements separated vertically. Finally, the crossings are clustered by location and Doppler. Clusters are classified based on amplitude and estimated physical extent and shape. Clusters with sufficiently high classification are passed to a tracking algorithm that computes a Kalman filter track using clusters derived from sequential transmissions. This filter operates using linked line of sight (LOS) coordinates, a technique long used in radar. The LOS coordinates used in this application are range, range rate, bearing, and elevation. Use of such coordinates is advantageous in this application because the errors in the coordinates are nearly independent of one another. Performance of this algorithm was investigated using active acoustic signals synthesized by the Sonar Simulation Toolset (SST), a digital program written by Robert Goddard at the Applied Physics Laboratory. This program generates a complex baseband representation of the acoustic signal in each chan- nel. This signal is processed by the detection, classification, and tracking algorithms. SST simulates effects of acoustic propagation including refraction and scattering and reflection from a target. Several simulated encounters with different target geometries are presented to illustrate detection, localization, and tracking performance. [C1717]

## "Localized three-dimensional adaptive spatial-temporal processing for airborne radar"

Radar space-time adaptive processing (STAP) techniques have classically focused on azimuth-Doppler adaptivity while placing minimal emphasis on elevation. Elevation adaptivity offers significant clutter suppression improvement, allowing further suppression of interference sources having identical Doppler and azimuth as the expected target. This work incorporates elevation adaptivity using two approaches: (1) a factored approach and (2) a joint domain approach, both greatly improving clutter suppression performance. The proposed concepts are validated using results based on simulated range ambiguous airborne radar data. Target detection improvements on the order of 8 dB and 10 dB (as compared to standard 2D-JDL processing) are demonstrated for the factored and joint domain approaches, respectively, using an 8 Ч 8 non-uniform rectangular array. [C1718]

## "Intercomparison of MAVS with VACM, VMCM, FSI 2-D, and Aanderaa RCM 11 current meters from a mooring"

An intercomparison of four current meters at 2000-m depth in the Ultramoor experiment of Woods Hole Oceanographic Institution near Bermuda in summer 2000 provided an opportunity to examine characteristics of mechanical, Doppler, and acoustic travel-time current meters in a very low velocity environment. This mooring in 4000 m depth had subsurface buoyancy at 300 m. Typical tidal current of only 4 cm/s added to mean current of only 2 cm/s caused the mechanical VACM sensors to stall intermittently. The two acoustic travel-time current meters, MAVS and FSI 2-D, tracked tidal fluctuations well although there was some offset drift over two months of recording. The Aanderaa RCM 11 acoustic Doppler current meter response to tidal fluctuations fell between that of the acoustic travel-time current meters and the mechanical sensors. Energetic vertical oscillations for 24 hours in two events 50 days apart suggest mooring response to possible hurricane passage. Only MAVS sensed vertical velocity so there is no corroborating evidence that the subsurface buoy responded to internal wave oscillations excited by the hurricane passage. In addition to testing three sensing modalities, the intercomparison displayed benefits from alternative sampling schemes, one being the monitoring of mooring motion with a vertical axis of velocity sensing. An advantage of acoustic travel-time sensing in such low currents is the linearity of the technique through zero velocity but a disadvantage is the uncertainty in the exact zero point. At 2000-m depth,

fouling is not an issue but availability of acoustic scatterers for Doppler sensors is a concern. Dropout of scattered signal from the fluid may lead to spurious lock-on to side lobe signals scattered from mooring hardware. This may contaminate estimates of velocity and mimic the effect of stalling from the mechanical sensor of the VACM. Short intervals in time show these effects during the several months of the deployment. Selection of sensors for deep current monitoring is important for observations of global transport of heat, water, trace gases, and dissolved chemicals. Tests of sensor characteristics in actual moored configurations are invaluable. [C1719]

## "Doppler compensation for JDL for airborne bistatic radar"

In airborne bistatic radar the clutter Doppler is range dependent. STAP processor using training data from other range gate will experience widening of clutter notch. Widening of the clutter notch causes a major problem in detecting slow moving target. In this paper, Doppler compensation using interpolation in the angle-Doppler domain, for joint domain localised processor (JDL) is proposed. Comparison is made with Doppler compensated processor proposed by Kreyenkamp and Klemm (see IEE Proceedings: Radar, Sonar and Navigation, vol.148, no.5, p.253-58, 2001). Significant improvement in processor performance is observed across the whole frequency spectrum. [C1720]

## "The discrete-time canonical model of time-varying dispersive channels"

In this paper, we researched on the model of time-varying dispersive channels in signal processing perspective, and proposed the new concept of discrete-time canonical model, This novel model is developed by canonically sampling the delay-Doppler spreading function of the time-varying dispersive channels under CDMA circumstance firstly. Then it is extended to common time-varying communication systems based on the multirate theory. In the end the proposed discrete-time canonical model is compared with two other typical deterministic Models of time-varying channels, and we get to the conclusion that this new model is better than the other two models for blind signal processing. [C1721]

## "Performance of efficient tactical UHF-satcom waveforms: occupied bandwidth, coding gain, spectral efficiency, bit error rate, and adjacent channel interference"

The purpose of this paper is to provide a detailed description and experimental and simulated performance results for some of the current Raytheon satcom high efficiency tactical waveforms, namely the dual-h quaternary continuous phase modulated (CPM) waveforms and the shaped phase shift keying (SPSK) waveforms. The emphasis is on the performance in terms of adjacent channel interference (ACI), bit error rate (BER), coding gain over conventional waveforms, and the ability of the radio to acquire these waveforms while being subjected to a Doppler frequency of ±1200 Hz. This paper first introduces the mathematical representation of the dual-h quaternary CPM waveform. Then the principle of the data demodulation including carrier and symbol timing acquisition and tracking using the MIL-STD-188-181B-specified preamble is illustrated. Finally, with the use of computer simulations, the spectral envelope and bandwidth efficiency of these efficient waveforms are compared to conventional counterparts. [C1722]

## "A new simplified temporal-spatial maximum likelihood algorithm for DOA estimation"

For the purpose of improving DOA estimation performance, we propose a new simplified temporal-spatial maximum likelihood algorithm. Instead of using discrete Fourier transform (DFT) filters, the proposed algorithm uses special Doppler filters to process the received data according to the signal's Doppler frequency. The processed data are then used by the maximum likelihood algorithm to estimate DOA. Because the special Doppler filters can greatly reduce the influences between signals, the proposed algorithm works significantly better than the simplified temporal-spatial maximum likelihood algorithm. Computer simulation results are presented and demonstrate the merits of the proposed algorithm. [C1723]

## "A new OFDM frame structure in time-varying channel robust to Doppler frequency spread"

How to reduce or suppress the intercarrier interference (ICI) is one of the key problems in OFDM systems. In this paper, we propose a new frame structure for OFDM transmission and the corresponding demodulation algorithm in mobile communications. Analysis and simulation results indicate that without-loss of bit rate, this signaling structure can ideally achieve the same BER performance at two times Doppler frequency spread of the classical OFDM in flat fading channels, and it can improve greatly the BER performance of the OFDM system in multipath fading channels. [C1724]

## "Improving the LPI and self-interference characteristics of the STANAG 4415 very robust HF

## waveform"

STANAG 4415 is a very robust waveform intended to provide communications under extreme HF channel conditions: negative signal to noise ratios, large Doppler spreads, large multipath delay spreads and in interference environments where the interferer may be 40 dB stronger than the signal of interest. The self interference specification provided in the STANAG 4415 document is, at best, achievable over short time periods because of limitations imposed by the STANAG 4415 waveform structure. We show how the STANAG 4415 waveform can be modified to provide improved self-interference rejection capabilities. Two examples where the modifications have significant beneficial impacts are provided. The utility of the modified STANAG 4415 waveform as a low rate, engineering order wire transport in an HF network application is shown. In this application, the improved self-interference rejection translates into an increased probability of successful transmission when two transmissions overlap. These same modifications, used to enhance the self-interference rejection performance, can also significantly enhance the use of STANAG 4415 as a low probability of intercept (LPI) waveform when used appropriately. This aspect is also explored and demonstrated. In particular, the interference environment and other unique characteristics of the HF channel, which are normally impairments to communications, are shown to be of significant benefit for LPI communication, when properly exploited. [C1725]

## "Passive coherent detection via exploiting illuminator of opportunity"

An experimental passive coherent target detecting system via exploiting illuminator of opportunity (also can be considered as external illuminator, such as broadcast, television etc.) is constructed, based on this experimental system, the principle of coherent receiving is analyzed and its power coverage is estimated, also, an applicable signal processing scheme is described. With the help of real data collection and processing, researches on the influence of direct signal rejection, channel properties and multi-path clutter rejection on the performance in passive coherent detection are investigated, results show the effectiveness of such system can be implemented by employing elaborated system allocation and advanced signal processing. [C1726]

## "Wavelet domain communication system: bit error sensitivity characterization for geographically separated transceivers (U)"

(U) The wavelet domain communication system (WDCS) uses a packet-based transform to estimate the electromagnetic spectrum. Adaptive thresholding and 'notching' is applied to remove sub-bands containing interference, effectively excising the interference. A unique communication basis function is generated from the notched spectral estimate and ideally contains no information bearing energy at notched locations. The basis function is data modulated prior to transmission. For this work, WDCS performance is evaluated for various scenarios using a MATLAB® model and simulation results. Bit error rate (PB) provides the key metric for analysis and performance evaluation. Bit error "sensitivity" is examined for geographically separated transceivers "observing" dissimilar electromagnetic environments. Previous WDCS research constrained transceivers to a localized geographical region such that nearly identical basis functions were created for communicating. Given sufficient transceiver separation, dissimilar basis functions are more likely to occur and PBperformance degrades. WDCS PBrobustness is addressed for scenarios including effects of: (1) Doppler variation between transceivers; and (2) operation over a fading channel. For binary, 4-Ary, and 8-Ary CSK data modulations, PBsensitivity analyses indicate the WDCS communicates effectively under nonideal 'real-world' conditions while exhibiting average Pbimprovements of 5.4, 5.1, and 5.8 dB, respectively, relative to systems having no interference suppression. [C1727]

## "DOA estimation based on least squares fitting with sensor gain and phase uncertainties for Doppler signals"

We propose several preprocessing techniques that improve the performance of the LSF based method for DOA estimation in the presence of rank deficiency in time correlation matrix, which frequently occurred in practical applications. In these given methods, the degrees of freedom are reduced with several novel schemes being taken to fulfill the ill conditioned optimization problem. The given techniques include temporal smoothing, subspace constraint, DFT transformation and diagonal loading. Monte Carlo simulation results verify the efficacy of the proposed modifications. [C1728]

## "Robust detection of underwater targets using a nonlinear energy tracker"

The use of sonar systems is widely applied to detection of underwater targets. Conventional detection methods estimate the Doppler characteristics of an underwater target by processing the received signal in the frequency domain, for example by the use of the discrete Fourier transform and filter bank structures. We propose a robust scheme for estimation of the Doppler characteristics of an underwater target by employing nonlinear processes. Since the proposed method is processed in the time domain, it can significantly reduce the computational

complexity. The proposed scheme can also be used for estimation of the velocity and distance of the target. The performance of the proposed scheme is analyzed and verified by computer simulation. [C1729]

## "Effect of employing beamforming on OFDM systems in Rician channel"

We analyze the inter-carrier-interference (ICI) caused by multiple Rician path and Doppler spreading in orthogonal frequency division multiplexing (OFDM) systems. The general form for the ICI power is derived by taking into consideration the correlation equation of the Rician channel. We have derived a equation for estimating the frequency tracking parameter. We also present examples by using ideal beamforming at the mobile. For a multiple Rician channel, it shows that the reduction in ICI power is not as much as in the case of Rayleigh channel. However, in the presence of only one Rician path, the reduction in ICI power is marginally better than the Rayleigh channel. [C1730]

## "Low-complexity receiver design for OFDM packet transmission with mobility support"

We design a complete baseband system of a high data rate packet-type OFDM receiver. For mobility support and channel-gain phase tracking, we propose a simple pilot tone insertion method that not only facilitates low-complexity channel gain tracking but also enables carrier frequency tracking. Besides, an efficient mechanism for packet boundary detection is also provided. In addition to channel gain tracking and packet boundary detection, timing synchronization, coarse frequency offset estimation, and fine frequency offset tracking issues are also discussed and simulated. [C1731]

## "Equalizers for PCC-OFDM with overlapping symbol periods"

Polynomial cancellation coded orthogonal frequency division multiplexing (PCC-OFDM) with overlapping symbol periods is a modulation technique which overcomes many of the disadvantages of OFDM. Overlap PCC-OFDM is much less sensitive to frequency offset and Doppler spread and has better performance in channels with long delay spread than OFDM. This paper analyzes the equalizers that are required. Results are presented for linear and decision feedback equalizers of varying length in the presence of additive white Gaussian noise. The performance is degraded by two effects: the nonorthogonality of the basis functions, and the limited span of the equalizers. Despite these effects, for the same bandwidth efficiency overlap PCC-OFDM systems can be designed to have similar performance to OFDM with a cyclic prefix even when the only channel impairment is noise. [C1732]

## "Joint Doppler frequency and frequency-rate estimation in LEO satellite communications"

We propose an algorithm for the joint estimation of frequency and frequency-rate in signals affected by fading and AWGN. Instead of processing the raw data directly, a stochastic nonlinear filter (NLF) is used for sequential phase estimation; the concatenated ML frequency and frequency-rate estimators are then fed by the NLF phase outputs. As a result of employing stochastic filtering the ML estimators exhibit enhanced robustness to changes of the signal-to-noise ratio and smaller threshold effects. An application of the proposed algorithm to the quasi-coherent detection of M-DPSK signals in nongeostationary satellite communications is also presented. Simulations show that the proposed receiver is rather insensitive to (time-varying) Doppler frequency shifts in flat-fading Rician channels. [C1733]

## "Variable rate noncoherent MFSK modulation over Nakagami fading channels"

We propose a new adaptive scheme for power limited systems. For such systems, we offer a variable-rate and fixed-power non-coherent M-ary frequency shift keying (NC-MFSK) modulation scheme and analyze its performance over Nakagami fading channels. We recently addressed the system performance from the average link spectral efficiency, the average bit error rate (BER), and the probability of outage perspectives assuming that perfect channel estimates are available at the transmitter within a permissible delay. In this paper, we study the system performance in the case of outdated estimates. It is shown that only the average BER gets affected by outdated estimates. Our analysis shows that the system is insensitive to normalized delays fdτ up to 10-2where fdis the Doppler frequency and τ is the time delay. We then propose an adaptive switching thresholds system to better mitigate the effect of the delay. [C1734]

## "Adaptive ground clutter cancellation of slowly moving targets with the multi-channel airborne SAR"

The detection of slowly moving targets and the estimation of their position and velocity are difficult problems for conventional airborne SAR systems with a single antenna, due to the spread of the clutter Doppler spectrum caused by the platform motion and the ambiguity between the cross motion and azimuth position. These problems can be solved via the use of multi-channel SAR and the space-time adaptive processing technique

(STAP). In this paper, the clutter model and moving targets model suitable for airborne multi-channel SAR are presented and an efficient algorithm is proposed. Simulation results are illustrated, applying data produced by the proposed clutter model and moving targets model. [C1735]

### "A case study of real-time ground position determination using single LEO micro-satellite"

A novel ground positioning method with combined Doppler measurements and received signal strength indication (RSSI) is proposed. This method provides an insight of how to achieve a real-time ground positioning with moderate accuracy with a single LEO satellite. Simulation results indicate that the proposed methodology is feasible, although accuracy limited. [C1736]

### "Efficient random access channel transmission method utilizing soft-combining of retransmitted message packets according to QoS"

This paper proposes an efficient random access channel (RACH) transmission method that utilizes soft-combining of consecutively retransmitted message data packets according to the quality of service (QoS) requirements for broadband multi-carrier/DS-CDMA (MC/DS-CDMA) in the reverse link. In the proposed scheme, the relative transmission power of message data compared to that of a successfully detected preamble for non-real time (NRT) traffic data is significantly reduced to achieve error-free transmission by soft-combining several retransmitted message data packets thanks to time diversity since the delay requirement is relaxed. Meanwhile, for real time (RT) traffic data with rigid delay requirements, the relative transmission power of the message data compared to that of the detected preamble is increased to reduce the residual packet error rate with a limited number of retransmissions. Simulation results elucidate that the total required average received signal energy per bit-to-background noise power spectrum density ratio (Eb/N0) for error-free transmission with time diversity for NRT traffic data is reduced by approximately 2.4 dB compared to that for RT traffic data in a 12-path fading channel with exponential distribution at the fading maximum Doppler frequency of fD= 20 Hz. [C1737]

### "Beam-forming for MC-CDMA systems"

In this paper, the use of adaptive antenna arrays for MC-CDMA systems in an interference-dominated environment is investigated. We present two different beam-forming approaches, namely, frequency domain and time domain beam-forming. Beam-forming performance over different channel conditions such as flat fading, frequency selective fading, low and high angle spreads and low and high Doppler spreads are studied. [C1738]

### "Delay and Doppler estimation using cyclostationarity based cross correlation in a multipath environment"

Cyclostationarity based cross correlation delay estimation is known for its substantial tolerance to noise and interference. The multipath echoes of a transmitted signal presented at the receiver, which are not similar to noise and interference, hamper the delay and Doppler estimation from the reflection of the moving target. Thus, suppression of the multipath signals is necessary. In this paper, a cyclostationarity based multipath suppression technique is presented. An example is illustrated to demonstrate its advantage. [C1739]

### "A multipath resistant PN code tracking algorithm"

Multipath propagation is a major source of degradation in the performance of conventional PN code tracking loops. The mean-square tracking error of a conventional delay-locked loop (DLL) exhibits an irreducible floor due to the presence of closely spaced multipath components. We present a new PN code tracking algorithm that does not suffer from the presence of multipath components. This algorithm utilizes a finite impulse response (FIR) adaptive filter to mitigate the effect of multipath on delay estimation. It is shown that the tap-weight vector of the adaptive filter can be used to provide accurate estimation of the multipath delays. It is also shown that the mean-square tracking error of the proposed scheme is not affected by paths that are very close (within 1 to 2 chips apart). The effect of terminal mobility is also investigated by simulating the performance under frequency selective fading channel conditions with different Doppler frequencies. The proposed scheme is well suited for wideband CDMA systems where a large number of closely spaced multipath components need to be tracked and used in RAKE combining. [C1740]

### "Theoretical derivation method of bit error rate in maximal ratio combining TDD transmitter diversity"

The paper proposes a theoretical method to derive the BER performance in maximal ratio combining (MRC) time division duplex (TDD) transmitter diversity, with parameters of CNR, Doppler frequency, etc. The proposed

theoretical approach can be applied not only to single-carrier transmission under flat fading, but also to orthogonal frequency division multiplexing (OFDM) under frequency selective fading. We choose OFDM transmission, in addition to single-carrier transmission, as a system model example to obtain numerical results, and the comparison between the theoretical results and simulated ones is demonstrated to confirm the validity of the proposed theoretical approach. [C1741]

## "Adaptive channel estimation in DS-CDMA downlink systems"

We design an adaptive channel estimator (ACE) in the DS-CDMA downlink that has a common pilot channel (CPICH). The proposed ACE first estimates the channel condition, including the maximum Doppler frequency, without requiring exact a priori information on the operating condition. Then, it adjusts the impulse response of the channel estimation filter in response to the estimated channel condition. The performance of the proposed ACE is verified by computer simulation. The performance improvement with the use of the proposed ACE increases as the channel experiences severe frequency selective fading or the mobile is getting closer to the cell boundary. [C1742]

## "A first order Markov chain based model for flat fading channel"

The paper introduces a new flat fading model based on the separation between the fading evolution frequency and the transmission rate. The model is obtained by building a first order Markov chain from samples taken at a suitable sampling frequency satisfying the Shannon theorem and an information theoretic metric. This step guarantees the adequate correlation behavior of the generated process. Then an interpolator is used to preserve the process properties and generate the fading values at the transmission rate. [C1743]

## "Evaluation of throughput employing hybrid ARQ packet combining in forward link OFCDM broadband wireless access"

The paper presents the throughput performance when employing hybrid automatic repeat request packet combining, i.e., Chase combining and incremental redundancy, in forward-link orthogonal frequency and code division multiplexing (OFCDM) broadband packet wireless access achieving a peak throughput above 100 Mbps. Simulation results elucidate that the achievable throughput at the average received signal energy per symbol-to-background noise power spectrum density ratio (Es/N0) of 4 dB and 10 dB, employing incremental redundancy, is increased by approximately 50% and 70% in a 12-path exponentially decayed fading channel compared to that using Chase combining for QPSK and 16QAM data modulation, respectively. However, we show that despite the superiority of incremental redundancy to Chase combining in the achievable throughput for the respective modulation and coding schemes (MCSs), the total throughput when employing incremental redundancy associated with a near optimum MCS set in an actual adaptive modulation and coding (AMC) operation becomes almost identical to that using Chase combining in a low maximum Doppler frequency, fD, channel. Finally, we show that incremental redundancy coupled with a higher channel coding rate is still more effective than Chase combining in improving the throughput for a high fDchannel owing to its large coding gain. [C1744]

## "Influence of design parameters on sound power spectrum for general aviation propellers in forward flight"

Theory and results are presented for the sound power and sound power spectrum of a single rotation propeller in forward flight. Calculations are based on the linear wave equation with sources distributed over helicoidal surfaces to represent effects of blade thickness and steady loading. Sound power is distributed continuously over frequency, as would be expected from Doppler effects, rather than in discrete harmonics. The theory is applied to study effects of number of blades to the total sound power produced for cruise mode and their sound power spectrum. [C1745]

## "The blood flow measurements at ischemic area of rabbit's decubitus ulcer model"

The purpose of this study has been to clarify the effect of sustained compression on skin surface blood flow at the edema stage and flare in the initial phase of decubitus ulcer formation with the use of rabbit ears. Experimental protocol is compared between point analysis and two-dimensional analysis. At the point analysis, a laser Doppler perfusion monitoring probe is contacted with the skin surface continuously. At the two-dimensional analysis, the scanning probe is not contacted with the skin. Experimental phases are divided as following: 1) initial (pre-compression), 2) edema, 3) compression and 4) release from compression. The results are the following: 1) At the point analysis, it has been measured blood flow rate continuously on a point from initial phase to release from compression phase. 2) When it has compared two protocol, it was observed similar blood

flow changes. 3) From results of two-dimensional analysis, during the compression phase and during release from compression, the blood flow rate in the peripheral part of the compressed area was found to change proportionately to the applied compressive load. [C1746]

## "New 4-phase complementary codes compressing a pulse to a width of several sub-pulses"

The new 4-phase complementary codes, by which a pulse is compressed to a width of several subpulses, are introduced. At first, it is shown that many such complementary codes with small code length exist. It is also shown that the longer such complementary codes are acquired, using the method shown by M.J.E. Golay. Another important result introduced in this paper is that there are also many complete complementary codes in the proposed complementary codes. It is further shown that the auto-correlation sidelobe of each code for the proposed complementary code pair is smaller than that for the conventional. [C1747]

## "Mean acquisition time of serial spread spectrum PN acquisition system in the presence of Doppler code"

This contribution evaluates the influence of Doppler code on mean acquisition time of a serial search direct sequence spread spectrum pseudonoise code acquisition system in Gaussian channel. The quadrature correlator with quadratic output is employed. Results of this analysis enable us to set the parameters of this system to optimum values and to minimize the mean acquisition time. [C1748]

## "Performance analysis of diversity transmission modes in UTRA FDD under time-varying multipath channels"

This paper analyses the effect of the propagation environment on the theoretical performance of the downlink transmit diversity techniques specified in the standard of the UTRA FDD mode. These techniques are classified as open loop and closed loop modes. Simulation results, obtained via a C simulator of the physical layer of UMTS, show the negative effect of mobility. The diversity gain obtained with the closed loop techniques, which are the best ones, drops drastically when the Doppler frequency rises. In that case, the open loop mode of diversity performs well. Nevertheless, it is highly dependent on the correlation of the antennas, which reduces the theoretical improvement. [C1749]

## "16-DAPSK innovations-based sequence detection for satellite communications with imperfect carrier synchronization"

The adoption of spectrally-efficient modulation in future satellite standards has to take into account the increased sensitivity to carrier synchronization, the nonlinear distortion caused by high-power amplifiers and the need for a precise decision threshold adjustment. These issues are considered in the proposed receiver. We use a 16-DAPSK (differential amplitude phase shift-keying) scheme with one bit absolutely encoded in amplitude and the other two bits differentially encoded in phase by an 8-state Ungerboeck trellis-code. Sequence detection is performed by the Viterbi algorithm with the branch metrics being computed from the innovative processes of a bank of stochastic nonlinear filters. These filters estimate the fading and the phase drift induced by the Doppler effect and/or oscillator instabilities, thus avoiding the need for a pilot carrier (or pilot symbols) and an autonomous decision threshold mechanism. Simulations show that the receiver is robust to fair amounts of fading and phase drift within the symbol interval, being suitable for nongeostationary-satellite communications with nonlinear amplifiers. [C1750]

## "Cell selection based on shadowing variation for forward link broadband OFCDM packet wireless access"

This paper proposes cell (sector) selection based on shadowing variation for forward-link orthogonal frequency and code division multiplexing (OFCDM) packet wireless access. We clarify its effects using a broadband propagation channel model in a comparison with fast cell selection (FCS) which tracks the fading variation and conventional cell selection (CS) utilizing the distance-dependent path loss, based on radio link level simulations that take into account instantaneous fading and shadowing variations. The simulation results clarify that the achievable throughput with FCS improves slightly in a broadband channel with an increasing number of paths when the average path-loss difference between two cells is greater than 2 dB. Nevertheless, we elucidate that the optimum CS interval equals that for tracking the shadowing variation, i.e., approximately 100 msec considering high mobility, caused by reducing the degradation in throughput when the cell with lower received power is selected, which suffers from shadowing variation. Consequently, we show that the average throughput by employing CS based on shadowing variation with the selection interval of 100 msec is increased by approximately 5 and 15% compared to that with the selection interval of 1 sec, which only tracks distance-

dependent path loss, for the maximum Doppler frequency of 20 and 200 Hz, respectively. [C1751]

## "An OFDMA/CDMA-based bandwidth resource allocation scheme for future broadband mobile networks"

We propose a new transmission and multiple access method for future broadband wireless networks. The scheme combines the advantages of orthogonal frequency division multiple access (OFDMA) and code division multiple access (CDMA) to cope simultaneously with both frequency spread produced by the Doppler effect, and time spread caused by the multipath channel. Through the code orthogonalization of neighboring (close) OFDM subcarriers, the method mitigates the intercarrier interference generated by high speed users while keeping the advantages offered by OFDMA to diminish the intersymbol interference produced by multipaths. In this way, the method optimizes the reliability of the communication channel provided to every user according to its speed, position and channel characteristics. The allocation of subcarriers and orthogonal codes to users is carried out dynamically with time by considering parameters such as required bitrate, speed, level of interference, multipath effects and physical location. The results show that a substantial reduction of intercarrier interference can be achieved by using our proposed method, which makes it a good candidate for highly-mobile networks based on OFDMA. [C1752]

## "MIMO capacities for different antenna array structures based on double directional wide-band channel measurements"

We present an approach for investigating the performance of generic multiple-input multiple-output (MIMO) wireless systems in a realistic way using wideband real-time propagation measurements of the double-directional radio channel. Applying a multidimensional high-resolution channel parameter estimation procedure the descriptive parameters for any relevant propagation path including the path weights, time-delay, Doppler shift and the propagation directions at both ends of the wireless link are extracted simultaneously from the measurement data. from the estimated parameter sets then a local reconstruction of the multidimensional wave fields in the vicinity of the measured aperture volumes in time, space and frequency is possible. Since this way the measurement antenna properties are excluded from the channel, the influence of a variety of application specific array architectures can be investigated. Here, we use this synthesis approach to analyze the performance of given target systems with smart antennas in terms of the resulting channel capacities and eigenvalue distributions. [C1753]

## "Matched filter performance of receive antenna arrays in dispersive Rayleigh fading channels"

The matched filter bound for binary signaling in continuous Gaussian WSSUS channels with receive diversity is derived. The treatment is quite general as the case of discrete multipath channels with correlated fading is a special case of our results. Furthermore, we impose no constraints with regard to the selectivity of the channel, i.e. the channel may or may not be time, frequency, and space selective. It is assumed that a statistical characterization of the channel is available through its direction-delay-Doppler power spectral density. The derivation is based on using a discrete representation of the received signal obtained by the Karhunen-Loeve-expansion. Arbitrary propagation directions of the waves impinging at the antenna array can be taken into account. The behavior of the matched filter bound is analyzed with respect to the parameters characterizing the mobile radio channel and the properties of the antenna array, i.e. the number of sensors, the antenna pattern, and the array geometry. [C1754]

## "A target detection method in range-Doppler domain from SAR echo data"

The direct evidence of radar target recognition is the backscatter energy and its distribution of objects, which is concluded by the imaging process of synthetic aperture radar (SAR) in a two-dimension image domain. Thus, the issues about automatic target recognition of SAR are often a "post-process" following SAR imaging. A method of target detection in the state of non-imaging based on analyzing the features of all kinds of targets on SAR echo data is presented in this paper, where the targets are defected in range-Doppler domain (RDD). Based on the analysis of target features in RDD, an algorithm of target detection in a RDD image is developed. The experimental results indicate the validity of the algorithm for special kinds of target detection. The algorithm is simple, able to recurrent, easy for real-time processing and hardware implementation. It can also be applied to getting target alarm with real-time SAR data for the pre-selected targets and do the imaging process selectively at the same time. [C1755]

## "Joint channel estimation and equalization for fast time-variant multipath channels"

The paper presents a method for joint channel and data estimation for transmission over frequency-selective and

time-variant channels. Hereby, fast time-variant channels can be tracked, which is important for mobile communications at very high velocities. We approach the problem by estimating the scattering function, which is assumed to be limited in delay and Doppler frequency. At the transmitter, a short training sequence is inserted at the beginning of the data block. This sequence is used for initializing a Kalman filter, which carries out the joint channel and data estimation adaptively. After the training sequence, hypothetical data symbols are considered to extend the persecuted paths in the data tree. [C1756]

## "Robust Doppler spread estimation in nonisotropic scattering environments"

A new parametric approach is proposed for estimation of the maximum Doppler frequency, or equivalently the mobile speed, in narrowband mobile radio channels. Such information is of interest as it reveals the channel's rate of change, which can be used to improve the performance of many wireless communication subsystems. In this work, simple and efficient Doppler frequency estimators are formulated based on using a small number of samples of the channel autocorrelation function. Unlike previous approaches, the chosen parameterization is shown to be robust in a microcellular propagation environment, which may be characterized by nonisotropic scattering and/or a specular component. Simulation results are described to illustrate the effects of additive noise and the finite data record performance. [C1757]

## "Impulse compression for OFDM transmission over time-varying multipath channels"

In today's multicarrier modulation systems such as orthogonal frequency division multiplexing (OFDM) a circular extended guard interval is inserted between successive multicarrier symbols in order to reduce intersymbol and interchannel interference. The length of the guard interval is determined by the length of the channel impulse response. In this paper, we consider an equalizer to compress the channel impulse response for OFDM transmission. Due to the compression effect, the guard interval can be reduced and the efficiency of the OFDM system increases. The system performance is demonstrated for transmission over several time-varying multipath channels with additive white Gaussian noise (AWGN). [C1758]

## "Probing magnetic field effects in 12-pole linear ion trap frequency standards"

The second-order Zeeman shift in a 12-pole buffer-gas-cooled linear ion trap frequency standard is characterized. Results for magnetic shielding effectiveness and long term stability against magnetic field perturbations are presented. The clock frequency is found to be stable against typical ambient magnetic field fluctuations to less than 2Ч10-16. The frequency shift as a function of ion number is also studied and a plausibility argument is given relating this to magnetic field inhomogeneity. [C1759]

## "Velocity from corrected Doppler bandwidth-a simulation study"

Use of the Doppler spectrum width, when this is dominated by intrinsic spectral broadening, has been proposed as a means to determine velocity magnitude when the Doppler angle is unknown. Correction of the measured spectral width for the effects of velocity range within the sample volume (SV), window broadening and acceleration broadening in order to extend the conditions under which this method may be used has been explored. A correction method using a simple approximate expression for rms spectral width together with three sample volumes to measure velocity shear and three windows to measure acceleration has been tested by computer simulation and found to improve velocity estimation from spectral width. [C1760]

## "Effect of compliance on Doppler diastolic flow patterns seen in coarctation of the aorta: a numerical study"

In the echocardiographic evaluation of coarctation of the aorta, the degree of antegrade diastolic flow (diastolic runoff) noted on spectral Doppler tracings traditionally was felt to be solely dependent on lesion severity. However, recent in-vitro experiments suggest the presence of this saw-toothed spectral Doppler pattern has less to do with severity than it has to do with changes in aortic compliance. Using state of the art multidisciplinary numerical analysis tools, the purpose of this study was to investigate the specific fluid and wall mechanics in coarctation of the aorta. Three models of coarctation were developed with high, low, and zero wall compliance. In both the low output and high output states, the degree of diastolic runoff increases with increasing vessel compliance. The high compliance model had larger changes in aortic dilatation in the pre-coarctation region compared to the low compliance model. In conclusion, increased aortic compliance brings about greater dilatation of the precoarctation aorta in systole leading to an increase in stored energy in systole. This increased stored energy, released in diastole as the walls contract, leads to increased degrees of diastolic runoff. Numerical methods offer a unique perspective into the understanding of the mechanisms behind such clinical measures. [C1761]

## "Microbubble destruction-reperfusion in the non-invasive measurement of the vascular targeting effects of the anti-cancer drug ZD6126"

A new and promising strategy in cancer therapy targets the proliferating endothelium of a tumour's blood vessels rather than the cells of the cancer itself. Among other advantages, such therapies may evade the drug resistance that many tumours acquire during treatment, rendering the drugs appropriate for long term use. However, because the tumour vasculature lies below the threshold of detection for conventional radiological techniques, new methods are required to determine the effect of such therapy on the tumour microvasculature. The combination of microbubble contrast and nonlinear imaging methods such as pulse inversion Doppler have been shown capable of detecting (but not resolving) flow at the capillary level. In this study, we use a combination of microbubble destruction-reperfusion flow measurement and real time contrast Imaging to assess the effects of an anti-vascular agent ZD6126 (AstraZeneca Inc, NJ) on experimental VX-2 tumours in the rabbit. The active component of this drug, N-acetyl colchinol, causes tubulin depolymerisation, thereby inducing neovascular endothelial cell rounding and subsequent vascular collapse. The effect is selective to tumour blood vessels (whose endothelial cells rely on tubulin for their structure) and is thought to be an acute one, occurring within hours of administration of the drug. Our objectives in this study were to make haemodynamic measurements of tumour blood flow rate and vascular volume, then to use these to determine dose response to the anti-vascular drug and to demonstrate the evolution of this effect with time following drug administration. We intended that the method used should employ a commercially available scanner and be suitable for translation to clinical contrast imaging of breast cancers. [C1762]

## "Measurements of air-borne ultrasound by detecting the modulation in optical refractive index of air"

Sound pressure was measured by a laser Doppler velocimeter (LDV) through the acousto-optic effect of air. First, the author studied the acousto-optic coefficient of air and gave the quantitative relationship between the sound pressure and the LDV output. Then, two-dimensional measurements were demonstrated for a standing wave and a radiated field. [C1763]

## "Combined differential Doppler and time delay compensation for an underwater acoustic communication system"

This paper describes a new system architecture for high data rate digital acoustic communication over a shallow underwater channel that is subject to severe Doppler and time delay spread. The method uses high-resolution channel characterization in the time and frequency domains to resolve the main multipath components. This is followed by successive interference cancellation using the Doppler and time delay information for each of the multipaths independently. Directional antennas are not required to spatially filter the multipath components and the simulation results presented are for an omnidirectional receiver. The method works at SNRs as low as 5dB. [C1764]

## "Effect of ambiguities on GMTI radar"

We focus on the effect of range and Doppler ambiguities on the ability to detect slow moving targets by STAP radar. This work has been conducted in the context of international projects such as SOSTAR and AMSAR.The detection of moving targets by a moving radar (air- or spaceborne) is seriously degraded by strong clutter returns. Space-time adaptive processing (STAP) techniques can implicitly compensate for the motion induced Doppler shift and thereby improves the capability of slow target detection. The effect of ambiguities on the target tracking capability of a STAP radar is discussed in conjunction with a companion paper by Koch (see Radar 2002, Edinburgh, Scotland, October 2002). [C1765]

## "Effect of Doppler ambiguities on GMTI tracking"

We focus on the effect of Doppler ambiguities on target tracking with airborne GMTI radar. Even after platform motion compensation by STAP techniques, GMTI tracking proves to be a challenging task. Unless appropriately handled, Doppler blindness can cause serious problems, which seem to be even more difficult in the presence of Doppler ambiguities producing multiple clutter notches. We develop an appropriately modified GMTI sensor model and evaluate its impact on the GMTI tracking process. By this approach the minimum detectable velocity (MDV) and the pulse-repetition frequency (PRF) explicitly enter into the GMTI tracking algorithms. [C1766]

## "Modelling of the littoral environment for real-time radar performance assessment"

The role of the Royal Navy has changed dramatically since the end of the Cold War. Ships and personnel are now expected to fulfil a wider range of possible missions in theatres all over the world. Consequently ship's radar

systems are now expected to give a high level of performance in regions that include the Middle East and the Eastern Mediterranean, despite being originally designed to operate predominately in the North Atlantic. The problem is that the local scenario and environmental conditions can dramatically affect radar system performance in two important ways. Firstly the environment can change the way that energy propagates outwards from the radar leading to large variations in target and clutter strength between different locations. Secondly these variations are often hidden by automatic threshold changes that reduce sensitivity to prevent the radar picture from becoming cluttered. This can give the false impression that the radar is operating optimally and could prevent ship's personnel from adapting their tactics to fit to the local situation. This paper outlines an updated model that is compared to real data in ducting conditions. The model is used to examine radar performance in littoral scenarios and to estimate sea state and duct strength from real radar data. The ultimate aim is to combine information collected by the ship's surveillance radar with modelling to allow ship's personnel to monitor the effect of the local environment on radar performance. [C1767]

## "Development of acetylene-stabilized diode laser frequency standards"

Two semiconductor laser frequency standards for 1.55 μm telecommunications applications have been developed, based on Doppler-free 13C2H2spectra. Preliminary results on frequency stability, reproducibility and systematic effects will be presented. [C1768]

## "Effect of wavelet denoising on time-frequency and time-scale analysis of quadrature embolic Doppler signals"

Early and accurate detection of emboli is important for monitoring of preventive therapy in stroke-prone patients. One of the problems in detection of emboli is the identification of an embolic signal caused by very small emboli. The amplitude of the embolic signal may be so small that advanced processing methods are required to distinguish these signals from Doppler signals arising from red blood cells. Time-frequency and time-scale analysis have been widely used in analysis and detection of embolic signals. In this study we use wavelet denoising to improve analysis and detection of embolic signals. Results demonstrate that considerable improvements can be achieved by wavelet denoising. [C1769]

## "Perfect modeling and simulation of measured spatio-temporal wireless channels"

Various types of spatial channel sounders have been developed with the aim to measure and to investigate the propagation characteristics of spatio-temporal wideband mobile radio channels in typical macrocell, microcell, and picocell environments. After postprocessing the collected data, one usually presents the measured channel characteristics in the form of a so-called delay-Doppler power spectral density (PSD) and a delay-angle PSD. A problem is then to find an analytical channel model and/or a simulation model with the property that both the delay-Doppler PSD and the delay-angle PSD of the model approximate as close as possible the corresponding measured system functions. It will be shown in this paper that an exact and general solution to this problem always exists if the measured system functions are consistent. The proposed fundamental procedure is introduced as the perfect channel modeling approach. [C1770]

## "Array antenna assisted adaptive modulation scheme for fast fading environment"

Although adaptive modulation is an efficient technique capable of establishing high bit-rate digital transmission in a fading environment, it is sensitive to fast time-variation of the channel state because of difficulty in tracking the channel state. In order to solve this problem, the paper proposes a new array antenna assisted adaptive modulation scheme for fast fading environments. The proposed scheme employs an array antenna-based Doppler spread compensator in order to reduce the time variation. Computer simulation results show that the proposed scheme can drastically improve the bit error rate and throughput performances for the region in which the maximum Doppler frequency, normalized with respect to the packet length, is up to 0.1. [C1771]

## "Essential degrees of freedom in time and frequency selective MIMO channels"

A key to reliable communication is a fundamental understanding of the interaction between the signal space and the channel. In time- and frequency-selective MIMO channels this interaction happens in time, frequency and space. We propose a four-dimensional Karhunen-Loeve-like Fourier series representation for space-time channels that captures the essence of such interaction and exposes the intrinsic degrees of freedom in the channel. The four dimensions are: time, frequency and the two spatial dimensions at the transmitter and receiver. The key signal space parameters are the signaling duration, bandwidth and the two array apertures. The corresponding channel parameters are the delay, Doppler and the two angular spreads associated with the scattering environment. The representation induces a virtual partitioning of propagation paths in time, frequency and space that reveals their contribution to channel capacity and diversity. It also exposes fundamental

dependencies between time, frequency and space thereby revealing the essential independent degrees of freedom in the channel. [C1772]

## "Nonlinear cyclotron resonance of rare-earth semimetals"

The cyclotron resonance is the best way to determine the effective masses of conductors and it is interesting to compare them with other effective masses determined by the de Haas oscillations. According to Kohn's theorem, they are not necessarily coincident with each other because an electron-electron correlation in the strongly correlated electron systems contributes to only the case of the de Haas oscillations. This argument has been studied in the case of organic conductors. On the other hand, it has been difficult to observe the cyclotron resonance absorption in rare-earth semimetals due to necessity of high frequency equipment, high magnetic field, very low temperature and high quality specimen. We have succeeded in observing cyclotron resonance in some rare-earth monopnictide compounds RX (R=rare earth atom, X=pnictgen atom) with NaCl type crystal structure and discussed the relationship between two kinds of masses of these materials. As reference materials, nonmagnetic LaSb and PrSb were also studied. In these cases, we have found new nonlinear resonance lines in addition to the normal cyclotron resonance whose resonance frequencies are linear with respect to magnetic field intensity. We ascribe this effect to the Doppler shift caused by coupling of cyclotron motion of carriers with the Alfven wave propagating in the material. [C1773]

## "Generation of high-frequency radiation in bi-modal electrodynamic system filled by asymmetric multilayer heterostructure"

A method of direct transformation of a video pulse into a radio pulse in a microstrip transmission line (TL) filled with a nonlinear medium on the basis of a multilayer heterostructure (MLHS) with asymmetric barriers (AlAs/n-GaAs/AlxGa1-xAs/n+GaAs/AlAs)Nhas been suggested by A.M. Belyantsev and A.B. Kozyrev (Int. J. Inf. and MM Waves, vol. 18, p. 1169, 1997). The mechanism for the transformation is the electromagnetic shock-wave (EMSW) front instability towards the forward wave running in synchronism with it. In this paper, we study the special features of the direct transformation of a video pulse into a radio pulse in a bi-modal electrodynamic system of the coupled TL type with different types of dispersion allowing backward wave propagation. [C1774]

## "Platelet activation and free emboli formation in flow past mechanical heart valves-numerical and in vivo studies"

Numerical studies, in vitro and in vivo measurements were conducted, aimed at quantifying free emboli formation and procoagulant properties of platelets induced by flow past mechanical heart valves (MHV). 2D and 3D pulsatile turbulent flow simulations were conducted past a St. Jude Medical MHV in the aortic position, to study the effects of MHV implantation on valve thrombogenicity. Shear stress histories of platelets along turbulent trajectories exposed the platelets to elevated shear stresses around the leaflets, leading them to entrapment within the shed vortices formed in the wake of the valve. In vitro platelet studies were conducted in a model of left ventricular assist device (LVAD), using an innovative platelet activity state (PAS) assay. The platelet activation significantly increased as a function of the recirculation time past the valve, and as compared to controls. Transcranial Doppler (TCD) measurements were conducted in the carotid artery of sheep with implanted MHV, showing a marked increase in the number of HITS (high intensity transient signals) signifying the passage of free emboli generated by the valve. The HITS were analyzed to distinguish between gaseous and thrombi emboli. Finally, PAS measurements were conducted with sheep platelets, showing marked increase of platelet activation after valve implantation. [C1775]

## "A feasibility study of using hybrid collimation for nuclear environment"

This paper presents a feasibility of a gamma ray imager using combined electronic and mechanical collimation methods. This detector is based on the use of a multiple pinhole collimator, a position sensitive scintillation detector with Anger logic readout. A pixelated semiconductor detector, located between the collimator and the scintillation detector, is used as a scattering detector. For gamma rays scattered in the first detector and then stopped in the second detector, an image can also be built up based on the joint probability of their passing through the collimator and failing into a broadened conical surface, defined by the detected Compton scattering event. Since these events have a much smaller angular uncertainty, they provide more information content per photon compared with using solely the mechanical or electronic collimation. Therefore, the overall image quality can be improved. This feasibility study adapted a theoretical approach, based on analysing the resolution-variance trade-off in images reconstructed using Maximum a priori (MAP) algorithm. The effect of factors. such as the detector configuration, Doppler broadening and collimator configuration are studied. The results showed that the combined collimation leads to a significant improvement in image quality at energy range below 300keV. However, due to the mask penetration, the performance of such a detector configuration is worse than a

standard Compton camera at above this energy. [C1776]

## "A model of platelet concentration sampling in arterial flow"

Platelet aggregation and accumulation are two major components of blood clotting: the normal hemostasis that maintains vascular integrity, and the pathological thrombosis that is the cause of heart attacks and strokes. The main goal of the research is to develop a computational model of platelet accumulation, with which we can predict the thrombus growth, reduce the vascular graft failure and control the thrombosis risk in patients. Platelet margination, which is defined as the enrichment at the near-wall region, is measured using local sampling experiments. A 3D computational fluid dynamics (CFD) model based on the fluid mechanics is developed to design the experiment for medium size artery at physiological conditions. The model predicts the sample velocity required to sample platelet concentration from the near-wall zone, as the function of the bifurcation geometry and main tube flow conditions. The experiments verify the published Laser Doppler measurements of platelet margination in long 3 mm tubes at the normal shear rate. At normal arterial length, margination exists but is reduced. When pulsatility is included, the effect is reduced further. The near wall platelet count was a factor of 1.28 to 1.9 times the average platelet count. [C1777]

## "Underwater acoustic MIMO channel capacity"

The underwater acoustic channel is rich in multipath scattering, making it a promising environment for the application of MIMO communications. However, for typical underwater communications channels, there are difficulties associated with the large fractional bandwidths, significant Doppler dispersion and latencies measured in seconds. We use simulated and experimental data to estimate the channel capacity for typical shallow water MIMO channels, and motivate particular beamforming algorithms which cope with the difficult acoustic environment. [C1778]

## "Wave tank modelling of strong modulation of radar backscatter due to long waves"

Modulation of radar backscatter due to long wind waves for Ka-band radar has been studied in wave tank experiments at different wind velocities and fetches. The modulation transfer function (MTF) was analysed, and it is shown that the mechanisms of tilt modulation, hydrodynamic straining and modulation of wind stress strongly underestimate the effect when compared with experiment. Radar Doppler shifts were measured and they were shown to be larger than those, connected with free gravity-capillary Bragg waves, and smaller than for bound waves, generated by decimetre-scale dominant wind waves and propagating with their phase velocities. It is shown that the contribution of the bound waves in the short wind-wave spectrum, estimated from the measured Doppler shifts is significant so that these waves can give strong modulation of radar backscatter [C1779]

## "Acousto-electromagnetic interaction in the detection of buried objects"

An analytical study of electromagnetic scattering from a dielectric cylinder buried beneath an acoustically excited interface is presented. The solution utilizes the spectral (plane-wave) representation of the fields and accounts for all the multiple interactions between the interface and the buried cylinder. First order coefficients from the small perturbation method are used for computation of the scattered fields from the rough surface. Results show that the illumination area should be made close to the size of the buried object of interest to reduce the interference caused by the rough surface [C1780]

## "Multi-frequency radar Doppler spectrum measurements of cirrus clouds"

Improved remote sensing of cirrus cloud particle size and ice mass content is important for validating and improving cloud microphysical models used in climate research. Previous radar studies have shown that cloud particle size can be derived from non-Rayleigh scattering effects at 95 GHz (W-band) using dual-frequency radar. Typically, non-Rayleigh scattering is quantified by comparing 95 GHz Doppler spectra moments to those collected at a second lower frequency such as 35 GHz (Ka-band). The ratio of 95 GHz reflectivity to that at the lower frequency is referred to as the dual wavelength ratio (DWR). Scattering models relate DWR to median volume diameter or some other characteristic size parameter. However, analysis of full Doppler spectrum measurements collected at 33 GHz and 95 GHz reveals additional information from which vertical air motion and parameters of the particle size-velocity relationship can be retrieved. During 2000, the U.S. Department of Energy Atmospheric Radiation (DOE-ARM) Program sponsored the 2000 Cloud Intensive Operations Period (2000 Cloud IOP). A number of unique remote and in situsensors participated in the IOP, including the University of Massachusetts dual-frequency Cloud Profiling Radar System (CPRS). CPRS operates simultaneously at 33 GHz and 95 GHz through a single one-metre-diameter dielectric lens antenna, which ensures beam co-location. Both the Ka-band and W-band recorded fast Fourier transform measurements of the full Doppler spectrum at vertical incidence [C1781]

## "Lidar applications in regional air quality studies"

During air quality studies in the United States, NOAA's Environmental Technology Laboratory (ETL) deployed three lidars to improve characterization of the regional environment. An airborne ozone DIAL system mapped out 3-dimensional profiles of ozone and aerosol, enabling tracking of urban plumes, identification of the residual layer, and specification of ozone production efficiency and dispersion associated with power plant plumes. At surface sites, Doppler and ozone DIAL systems characterized the time evolution of wind profiles, turbulence, vertical mixing, horizontal transport from low level flows, and effects of transient events such as gust front passages. The lidar information greatly complemented observations from airborne and surface in situ sensors, and will be critical for improving understanding and modeling of regional air quality events [C1782]

## "The latest development of high resolution imaging for forward looking SAR with multiple receiving antennas"

The paper provides some new developments based on the azimuth synthetic and compressing method to achieve a high azimuth resolution and unambiguous image for forward-looking SAR (F-SAR) with multiple receiving antennas. The first point of the new development is addressed on how to select and optimize the reference functions for azimuth compression. The second new point is addressed on how to configure the parameters such as wavelength and the distances between the receiving antennas. And the effect of these parameters to the practical implementation of F-SAR system will be also discussed. The third point is addressed on the methods to fuse the data from different receiving antennas for solving the left/right azimuth ambiguity [C1783]

## "Evaluation of the potential cartographic accuracy of Radarsat and JERS-1 data"

Synthetic aperture radar images reveal geometric distortions, which are caused by different sources. The aim of this study is to quantify the geometric quality of some of these images-SGF product type (path image), standard beam mode, beam positions S2 and S3 Radarsat and JERS-1 level 2.1 images, acquired in the region of Ariquemes-RO. A set of control points were acquired by using a GPS receiver in the area of study and differentially corrected. The planimetric and altimetric errors of these points are about 1,11 and 2,19 meters, respectively. These points were used as ground truth and compared with geometric properties (linear distances and angles) measured over the images. The uncorrected images presented relative scale and rotation errors of about 2 pixels. The images were geometrically corrected (geocoded and ortho-rectified) and had their geometric characteristics analyzed. The reduction of the relative scale and rotation errors obtained with the processes of geometric correction of the images were of 1/3 of pixel (4,17 meters). Visual inspection of an overlay of the SAR images and a GPS collected road network indicated a reasonable degree of coincidence. Results obtained with the calculation of the absolute accuracy of the geocoded and ortho-rectified images showed errors of absolute localization smaller than a pixel, varying from 5,42 meters to 12,24 meters to geocoded images and from 5,62 meters to 11,72 meters to the ortho-rectified ones. The images with viewing angles ranging from 24° in the near range to 31° in the far range (Radarsat S2), 30° in the near range to 37° in the far range (Radarsat S3) and 32° in the near range to 38° in the far range (JERS-1), acquired in regions with moderate altimetric variation (the area of study presents altimetric variations from 100 to 376 meters), presented geometric errors acceptable for mapping at 1:40000, 1:25000 or 1:20000 scales depending on the class of the mapping product to be obtained [C1784]

## "Laser Doppler vibrometer-based anti-personnel mine detection"

Acoustic-to-seismic (A/S) coupling has been used successfully to locate anti-tank (AT) mines with a high probability of detection and a low false alarm rate. Due to the generally smaller size and large variability in the shapes and sizes of anti-personnel (AP) mines, AP mine detection is more challenging than AT mine detection. This paper discusses the analysis results of A/S coupling mine detection data for AP mines collected using a laser Doppler vibrometer-based mine detection system at test minefields during two years. Important data features indicating the presence of a mine include the ratio of the velocity magnitude of the ground surface over and away from the target, and the presence of wave-like or scattering phenomena. The analysis reveals the relationship between the wavelength of the excitation and the target size as well as between the scanning spatial resolution and the target size and shape [C1785]

## "Blind identification and equalization of CDMA time-varying dispersive channels in multipath-Doppler domain"

We have developed a discrete-time canonical model of CDMA time-varying (TV) channels based on canonical

samples of the channel's spreading function in the multipath-Doppler domain. With this model, we propose a new two-stage blind identification and equalization algorithm based on the second-order statistics (SOS) of the observations. The ideal single-input multi-output (SIMO) model is equivalent to an additive Gaussian noisy (AGN) SIMO model so as to cancel the error propagation effects of this two-stage method. Compared with the subspace method, this new algorithm needs much less computation of the input correlation of the equivalent multi-input single-output (MISO) model. Simulations demonstrate the effectiveness of the algorithm [C1786]

## "Total arterial compliance is a major determinant of peak oxygen uptake"

Total arterial compliance (TAC), defined as dV/dP, is a major component of the arterial system. A decreased TAC increases left ventricular load and has a detrimental effect on coronary perfusion. We sought to assess the influence of TAC on the functional reserve (VO2max). 14 patients (mean age 64±14y) with known or suspected coronary artery disease and 11 controls (34±5y) underwent supine bicycle exercise echocardiography. The audio Doppler signal output of the echocardiographic machine was digitized with a customized hardware and software interface simultaneously with carotid tonometry and ECG. TAC at rest was calculated by the pulse-pressure method (PPM). By step-wise forward multivariate analysis, independent predictors of VO2max were: patient vs. control status, peak exercise cardiac output and TAC. The described PC-based acquisition system for tonometry and Doppler signals permits the assessment of ventricular function and arterial biomechanics [C1787]

## "Optimization of waveform and detection threshold for target tracking in clutter"

We formulate an optimization problem to obtain the combined sequence of waveform parameters (pulse amplitudes and lengths, and FM sweep rates) and detection thresholds for optimal target tracking in clutter. The optimal combined sequence minimizes a tracking performance index under a set of parameter constraints. The performance index can include the probability of track loss and the estimation accuracy. The effect of the false alarms and clutter interferences is taken into account in quantifying the performance index. A measurement model is developed based on the resolution cell in the delay-Doppler plane for a Gaussian pulse. Numerical experiments were performed to solve the optimization problem for several example problems [C1788]

## "Suppressed ambiguity in range by phase-coded waveforms"

In Doppler radar for surveillance and remote sensing, the ambiguities in range/Doppler are usually solved by varying the pulse repetition frequency. In this paper, two alternative methods are discussed based on phase-coding and orthogonal waveforms. The first one distributes a phase code over a pulse sequence with only one phase step per pulse. The received pulses are correlated with the phase code sequence, and by varying the delay of the phase code, the subintervals in range are scanned and reflector responses outside the focused range interval become highly suppressed. The alternative method that was studied applies a set of near-orthogonal phase codes, which modulate the pulses transmitted. In the receiver, the different subintervals in range are scanned, or detected in parallel, by correlating the signal from the scene by the delayed code sequence of the pulse transmitted. Because orthogonal codes are used, a strong suppression is achieved for signals originating outside the focused subinterval in range [C1789]

## "Ultrasound mediated transfection of HT29 colorectal cancer cells in vitro: preliminary results"

HT29 human colorectal cancer cells, from an immortal cell line, were grown to confluence on four 11 mm coverslips in minimal essential culture medium using 60 mm culture dishes. One dish was kept as a control. Following washing with serum-free medium, 1 mg of fluorescein isothiocyanate (FITC) conjugated with bovine serum albumin (BSA) was added to the remaining three dishes. FITC-BSA was added to dish 2. Sterile gas-filled microspheres (average diameter 3 μm) were added to dishes 3 and 4, in an approximate ratio of 230 microspheres to each cell. Dish 4 was aseptically insonated using 2.5 MHz pulsed wave diagnostic spectral Doppler ultrasound for 5 minutes. All cultures were then on-grown for a further 24 hours in minimal essential culture medium. Subsequently they were washed and dried with methanol, mounted using DPX medium and microscopically viewed. Dishes one, two and three showed low levels of background fluorescence, while dish four showed strong cellular fluorescence. The presence of microspheres during insonation facilitates the non-lethal entry of a large molecule (FITC conjugated BSA) into HT29 colorectal cancer cells. [C1790]

## "The effects of marine fouling on the performance of a single-point acoustic Doppler current sensor mounted on a TABS-II spar buoy"

Following the successful results of an experiment conducted during June and July, 2000 to determine how a single-point, acoustic Doppler current sensor would perform on a TABS-II spar buoy, a second experiment was conducted to determine the effects of marine fouling on the sensor. The TABS-II spar buoy is one of two types of spar buoys used by the Geochemical and Environmental Research Group (GERG) to monitor and report near

real-time surface currents, in support of oil spill response and trajectory modeling for the Texas General Land Office in Austin, Texas. An Aanderaa DCS3500R Doppler current sensor was mounted on a TABS-II spar buoy and moored at a location approximately 22 nmi southwest of Galveston, Texas in 19 in of water. The mooring remained in place from June 1 to December 15, 2000 during which time it reported hourly near-surface current components and temperature via satellite telephone to GERG's office in College Station. On November 15, 2000 a second TABS-II spar buoy, equipped with a clean, calibrated, Marsh-McBirney, Inc., (MMI) Model 585 electromagnetic sensor, was deployed 200 in downcoast of the DCS3500R-equipped buoy. A 600-kHz RD Instruments directional-wave ADCP was mounted on the bottom between them in an upward-looking configuration. On November 15, 2000, prior to deployment of the MMI-equipped buoy and the ADCP wave meter, the DCS3500R-equipped buoy was recovered to remove marine growth from the hull and mooring. Barnacle growth on the DCS3500R was extensive, covering the entire sensor and cable [C1791]

## "The use of sinusoidal frequency modulated pulses for low-Doppler detection"

This paper describes in-water testing of the reverberation gain achievable with broadband, Doppler sensitive sinusoidal frequency modulated (SFM) transmissions. Theoretical predictions via the Q-function are compared to experimental results in shallow water using static and moving sonar platforms. The coherence of target echoes is examined through the use of an echo-repeater [C1792]

## "Effects of temporal and vertical variability of echo amplitude on ADCP selection and performance"

Measurement of ocean currents using acoustic Doppler current profilers (ADCPs) depends on the presence of scatterers throughout the water column to create a backscattered signal whose Doppler shift can be measured. An insufficiency of scatterers results in missing or unreliable data, or reduced profiling range. ADCP echo amplitude data collected from rig-based downward looking ADCP systems over the past decade at numerous sites in the Gulf of Mexico and elsewhere, and using a variety of ADCP types and frequencies, consistently display a characteristic pattern of diel (24-hour) echo amplitude variability. This is attributed to vertical migration of biological organisms-namely the tendency of some species to reside closer to the surface during the night and further from the surface during daylight hours. In the uppermost region of the water column, nighttime profiles show higher echo amplitudes than daytime profiles, indicating a greater presence of scatterers in the surface layer at night. Daytime profiles show stronger echo amplitude signals in a deeper layer, indicating greater biological presence at these depths during the day. The transition between the nighttime and daytime scatterer positions is linked to sunrise and sunset, and is remarkably rapid, occurring over hundreds of metres of the upper ocean within an hour or so. Furthermore, both daytime and nighttime signals show a strong peak in echo amplitude in the 365 m to 425 m (1200 ft to 1400 ft) range, indicating a strong and consistent scattering layer there. A minimum in echo amplitude occurs at shallower depths, in the 215 m to 365 m (700 ft to 1200 ft) range. The minimum in echo amplitude can result in signal drop-outs and poor quality ADCP current data, limiting the effective range of a surface-mounted downward looking ADCP. Narrowband ADCPs are generally more tolerant of lower scattering intensity than are the broadband type, and rarely lose data in the minimum layer. The echo amplitude patterns presented in this paper are evident in data from narrowband and broadband instruments operating at 38 kHz and 75 kHz, deployed from drill rigs, drill ships, and deepwater moorings in the Gulf of Mexico for more than 10 years. Due to the universality of these scattering profile features, consideration should be given to selection of the most appropriate ADCP operating mode where maximum range is desired, especially for mission-critical measurement programs in the oil industry [C1793]

## "Suppression of impulsive noise in active acoustic time series"

Echolocation in shallow water is often characterized by spurious detections generated by impulsive noise processes and heavy tailed boundary reverberation. Persistent echos with durations commensurate with the transmitted pulse length that are delay/Doppler consistent over several interrogations are best detected and left to subsequent classifier stages. Random transient events in the time series increase the false alarm rate but can be suppressed by preprocessing the data stream with a non-linear filter. A simple preprocessor consisting of a linear predictor with a thresholded nonlinearity suppresses sporadic impulse-like events without affecting longer duration echos. The preprocessor is tested with two heavy tailed time series. The first is a reverberation process generated by a Rayleigh mixture model that simulates recorded high frequency in-water data. A linear FM echo signal is added and it is shown that the preprocessor restores nearly all of the matched filter ROC performance of the uncontaminated time series. The second noise process is a variable kurtosis mixture that simulates transient ambient noise events and is generated by combining Gaussian noise with a random impulsive time series [C1794]

## "Adaptive radar clutter suppression"

The clutter return presents a severe problem in target detection for radar systems. Conventional radar systems assume the clutter is stationary, with energy concentrated in the low frequency domain. To minimize the effect of clutter, radar systems use a fixed high pass filter (HPF) to eliminate the clutter. When the target Doppler frequency is below the cutoff frequency of the high pass filter, or the clutter energy does not concentrate on the low frequency domain, the performance of radar system is severely degraded. This paper proposes an adaptive clutter suppression scheme. This scheme provides more efficient clutter suppression for non-stationary clutter and provides the ability to detect a slow moving target. The computer simulation is presented to compare the performance of this adaptive clutter suppression technique and the fixed clutter suppression filter [C1795]

## "Equalization and coding for coherent communication in the ASIMOV vertical link"

This paper analyzes the performance of a coherent modem designed for high-speed vertical transmission at 30 kbit/s from an underwater vehicle to a surface craft. Hardware and power constraints require the modem to be based on a single fixed-point DSP, thus restricting the choice of signal processing algorithms for real-time operation. Under these conditions, high data rates can only be achieved with very favourable communication channels that result from the particular geometric configuration. Channel delay and Doppler spreads under different sea states are characterized using at-sea data collected during the ASIMOV 2000 mission. Several algorithms are tested for adaptation of the equalizer at the receiver, and it is found that simple LMS-type algorithms perform almost as well as more complex alternatives that are known to have superior convergence and tracking properties. The system also includes signal-space coding blocks that are used to lower the error rate without paying in bandwidth or transmitted power. The error probabilities of coded and uncoded modulation are estimated and compared, confirming that coding provides a real, albeit small, performance gain [C1796]

## "Rapid estimation of the range-Doppler scattering function"

Under wide sense stationary uncorrelated scattering (WSSUS) conditions, the signal spreading due to a random channel may be described by the scattering function (SF). In an active acoustic system, the received signal is modeled as the superposition of delayed and Doppler spread replicas of the transmitted waveform. The SF completely describes the second-order statistics of a WSSUS channel and can be considered a density function that characterizes the average spread in delay and Doppler experienced by an input signal as it passes through the channel. The SF and its measurement will be reviewed. An estimator is proposed based on a two-dimensional autoregressive (AR) model for the scattering function. In order to implement this estimator we derive the minimum mean square error estimator of the time-varying frequency response of a linear channel. Unlike conventional Fourier methods the AR approach does not suffer from the usual convolutional smoothing due to the signal ambiguity function. Simulation results are given [C1797]

## "The relative salience of auditory motion cues"

The relative salience of auditory motion cues was measured in a series of four experiments. In the first three experiments, all combinations of three different auditory motion cues (intensity changes, Doppler frequency shifts and interaural time delays) were presented at various source trajectories, parallel to the listener's frontal plane. In the first experiment, the velocity of the source was varied from 7.5 to 100 miles per hour and the point of closest passing was varied from 1 to 100 meters. In the second experiment, the angular position of the source always moved from minus 30 degrees to plus 30 degrees and the minimal distance of the path was varied. In the third experiment, the simulated velocity was fixed at 33 miles per hour for all stimuli. The results of these experiments show that monaural acoustic cues of intensity and Doppler frequency changes had the greatest effect on the listeners' judgments of perceived velocity. The binaural cue of interaural time delays had little effect on the velocity judgments. The results also show that the distance traveled by the source was found to be a more salient velocity cue than actual sound source velocity. A fourth experiment was conducted to measure speed estimates of actual moving automotive sounds via dummy-head recordings. Actual sounds were estimated to travel at greater velocities than were simulated sounds, especially when the sounds were far away from the listener [C1798]

## "A new algorithm to calculate the reference image of ship targets for ATR using ISAR"

This paper develops a new algorithm to calculate the reference inverse synthetic aperture radar (ISAR) images of candidate targets for ship target recognition. To make reference images, cross range aids defined by the target's unknown angle velocity vector must be estimated for projection of reflectivity on the candidate targets to the range-Doppler plane. To estimate cross range axis, we extract the centerline and the Doppler width of the ship target from the observed ISAR image. By using these information and the relation between the direction vector of the straight line in the space and the ISAR image formulated in this paper, the cross range vector can be estimated for each candidate target. The effectiveness of the proposed algorithm is evaluated by using

simulated targets [C1799]

## "A blind multichannel DFE receiver for precoded OQPSK signal transmission in shallow water"

We apply a special modulation format derived from offset quadri-phase shift keying (OQPSK) to digital transmission and propose a novel practical multichannel receiver architecture for its demodulation. The receiver is based on the standard adaptive decision feed-back equalizer (DFE) which is extended so that both its multichannel feed-forward section and the feedback section operate fractionally spaced. We therefore introduce a new decision rule that exploits the structural properties of this signal type and allows the adaptive filters to be updated twice per symbol. This also enables the receiver to operate in a completely self-recovering, or 'blind' manner. To compensate for Doppler effects, explicit non-data-aided timing recovery and decision-directed carrier recovery is performed. To demonstrate the performance of the proposed system, the receiver is applied to experimental data for acoustic communication in shallow water where the information signal is both emitted by a fixed and a moving source [C1800]

## "Basin-scale acoustic communication: a feasibility study using tomography m-sequences"

Tomography transmissions made over a 3250 km path in the North Pacific as part of the Acoustic Thermometry of Ocean Climate (ATOC) program are analyzed as data communications signals in order to estimate the rate and reliability of very long range undersea telemetry. The ATOC tomography signal is a phase-encoded maximal-length shift-register sequence transmitted at 37.5 symbols per second using a 75 Hz carrier. It may be interpreted as a BPSK data signal at 37.5 bits per second, or as a direct sequence spread spectrum signal with a spreading rate 1023 (the m-sequence period) and a resulting data rate of 1 bit every 27 seconds. The multipath arrivals observed at the receiver span nearly 8 seconds, with the majority of the energy occupying the last two seconds. The data are processed using an adaptive multi-channel decision feedback equalizer with integrated phase tracking and Doppler compensation. Equalization of the signal on one hydrophone is sufficient to extract the low-rate spread spectrum modulation, while joint use of all twenty hydrophone channels provides near symbol-rate communications. The excellent results may be attributed to the short term stability (several minutes) of the deep-ocean sound channel at low frequencies [C1801]

## "Energy and delay constrained power control for file transfers over fading channels"

We consider binary (on/off) power control strategies for transferring fixed size files (packets) over fading channels under constraints on transmit energy and transmission delay. The goal is to maximize the probability of successfully transferring the entire file. Three delay constrained scenarios are considered: infinite delay, an average delay constraint and a strict delay constraint. In the case of infinite delay tolerance, the optimal policy results in transmission only at the best channel state. It is observed that the probability of successful transfer is much higher under average delay constraints than for a strict delay constraint. In both average and strict delay constrained cases, the probabilities of success are seen increasing as the Doppler frequency increases [C1802]

## "The mine detection system coupled with a compact tandem accelerator"

We have been developing a mine detection system coupled with a 1 MV compact tandem accelerator. This system will consist of a compact high current tandem accelerator, a target system, a detection system, a power generator system and a transportation system for mine field applications. The tandem accelerator is designed to accelerate protons with energies of 1.75 MeV up to a 10 mA beam current. We have developed a new mine detection method for a scattered 9.17 MeV gamma-ray produced from the 14N(γ,γ)14N photo-resonant reaction. The incident gamma-rays are produced by a 1.75 MeV proton beam bombarding at a 13C target. A new detection method is described which separates the scattered gamma-rays from the 13C target gamma-rays to within a 0.1% energy resolution using the Doppler effect from the nucleus recoil mechanism [C1803]

## "Robust channel estimation using the hybrid particle filter"

Mobile wireless channels are subject to multipath with potentially large Doppler spreads. Previous joint channel and delay estimation algorithms, based for example on the extended Kalman filter (EKF), are subject to divergence. We present a hybrid particle filter (HPF), also called the particle extended Kalman filter (PEKF) for delay/channel estimation in direct-sequence CDMA applications. The PEKF uses a sampling technique to update the nonlinear delay state variables, combined with Kalman filters to track the linear channel coefficients. Initial simulation results indicate the ability of the PEKF to track delays and channels with large Doppler spreads on the order of 1Ч10-3/T, where 1/T is the symbol rate [C1804]

## "Increasing the availability of medium data rates at high latitude HF channels"

At high latitudes, HF communications at medium data rates (1200-2400 bps) suffer from low availability because of ionospheric disturbances. The problem is that the channel exhibits large Doppler spread, delay spread and/or auroral absorption, not necessarily at the same time. If one can choose among different waveforms at each data rate, the maximum tolerable Doppler spread and delay spread can be increased (without increasing the maximum tolerable spreading factor). We have used DAMSON measurements to analyse the increase in availability that can be achieved using such a scheme. The largest improvement found is: at 2400(1200) bps the availability is 28(57)% using one waveform, and 35(68)% using 3 waveforms. [C1805]

## "Diversity techniques for rotorcraft wireless communications"

Transmitted and received signals involving rotorcrafts are subject to inter-modulations caused by the rotor blades. The statistical characteristics of the wireless communication link between a rotorcraft transmitter and a receiver on the ground are developed. Both the scattering and Doppler effects of the rotating blades on the impairment of frequency modulated frequency hopping signals are considered. The channel model includes the near-field wave propagation between the transmitter antenna and the scattering blades. The channel model is used to examine the performance of different diversity techniques, namely, the transmitter diversity, multicarrier frequency hopping (MCFH) and the fast frequency hopping (FFH), in view of the antenna polarization and relative strength of the direct path and the scattering component from the rotating blades. [C1806]

## "Numerical simulation of nonlinear effects in high power ultrasound applications"

An extension of a recently developed simulation scheme for the calculation of nonlinear wave propagation in thermo-viscous fluid media is presented. Based on the nonlinear wave equation derived by Kuznetsov, the nonlinear pressure field is calculated by means of a finite element formulation. Furthermore, generated mean acoustic force densities can be obtained. Considering real-live high intensity sources which involve pressure amplitudes of up to 100 MPa and higher, significant differences between linear and nonlinear calculations are exhibited, resulting in force density changes up to 4 order of magnitudes. Plane wave applications as well as plane piston sources are used in these investigations. Streaming velocity calculations based on the streaming forces of plane piston sources are also presented. As an application of our calculation scheme a high intensity focusing pulse source, as used in medical applications, with a peak pressure amplitude of approx. 80 MPa is presented [C1807]

## "Dynamic color Doppler extended field of view imaging"

A new method for generating dynamic color Doppler extended field of view (EFOV) images is presented. The method derives an ECG waveform from the spatial average of Doppler velocity data from a series of co-planar ultrasonic images acquired by translating the probe in the azimuth direction. Translation and rotation parameters between successive images are estimated using speckle correlation of the B-mode data. The images corresponding to the same phase of the synthetic ECG are then combined using, these, motion parameters to form a color Doppler EFOV image. A series of these color Doppler EFOV images are generated corresponding, to, different cardiac phases. These images are then played back in a continuous loop over the B-mode EFOV image [C1808]

## "Wireless transmissions in multipath environments benefit from direct sequence spread spectrum techniques"

Presents recent radio communications research work carried out by LETI (Laboratoire d'Electronique, de Technologie et d'Instrumentation), which is a laboratory belonging to the French Atomic Energy Commission. At the outset, a team from the LETI was involved in a programme to develop robot intervention in hostile environments. One of the first problems to be solved was to find a reliable and robust radio modulation technique for multi-path environments. In this type of situation, conventional radio solutions are unsuccessful and provide only extremely low data rates. The performance of wireless transmissions is much poorer than conventional communications using cables and they have to cope with a transmission channel that is subject to much more interference. In particular, multi-path transmission of radio waves leads to interference phenomena such as widening of the channel impulse response, fading and Doppler noise, which reduce the quality of the transmission. A novel reception structure, implementing direct-sequence spread-spectrum techniques combined with a diversity system, actually benefits from the multi-path phenomena which usually damage conventional radio transmissions. The first receivers developed were based on a surface acoustic wave filter and were subsequently replaced by dedicated digital circuits that perform all the base band processing. The resulting flexibility has made the design of CDMA and high-data-rate wireless systems possible. This research has potential applications in a wide variety of areas, e.g. video surveillance and track-to-train communications in underground systems and factory communications for machine synchronisation [C1809]

## "High frame rate tissue Doppler imaging"

In tissue Doppler and strain rate imaging of the heart, a high frame rate is necessary to capture the rapid relaxations and contractions of the myocardium. Previously, the Doppler and tissue B-mode images have been calculated from different pulse transmissions. To improve the temporal resolution, we present a new acquisition technique where the Doppler based images are calculated from the same pulse transmissions as the tissue B-mode images. By constructing the image from 10-15 transmit beams, frame rates above 300 frames/second are possible when imaging the heart. To get adequate spatial resolution, the small number of transmit beams limits the width of the image, but the image is wide enough to cover a heart wall, i.e. the interventricular septum. The Doppler pulse repetition frequency equals the frame rate and is relatively low. Tissue velocity estimates calculated from these data therefore suffer from aliasing. However, we present a robust technique that corrects the aliased velocities. A significant advantage of the new technique is the continuous stream of data with constant sampling intervals. Doppler spectra and sound signals can thus be calculated at arbitrary points in the 2D image [C1810]

## "Radial distribution of the Doppler power from porcine blood over a pulsatile flow cycle"

The Doppler power from porcine blood in a mock flow loop was observed to vary spatially and temporally during a pulsatile cycle. It was found to decrease with shear rate under steady flow, except near the center of the tube where other mechanisms such as radial distribution of the rouleaux across the tube might be involved. The Doppler power varied with stroke rate at the center of the tube in a way of such that the peak of the Doppler power was closer to the peak systole from 20 to 60 beats/min (BPM) and the power and velocity peaks coincided at 60 BPM. The coincidence of the Doppler power peak with the flow peak may be speculated to result from the aggregation enhanced by acceleration and the dynamic interactions of the rouleaux during a cycle. The 'black hole' phenomenon was observed over portions of the flow cycle. All these complex variations across the tube over a cycle are thought to be due to red cell aggregation, which can be affected by shear rate, acceleration, and radial position [C1811]

## "Spectral Doppler flow velocity and Doppler angle estimations for small vessel by large sample volume"

In this paper, we present a Doppler angle and flow velocity estimation method for small vessels by using a large sample volume length. We use the mode frequency, fd, and the -3 dB maximum frequency, to calculate the Doppler angle and flow velocity while keeping the sample volume length larger than the beam path length across the blood vessel. We have successfully implemented this approach in a clinical ultrasound system for measuring a constant and pulsatile flow generated by a UHDC flow phantom in a 4 mm polyethylene tube between 50° and 80° Doppler angle. The standard deviation of the estimated flow velocity is 3.4 cm/s (about 11%) for a constant flow with 23.8 cm/s flow velocity, and is 6 cm/s (about 15%) for a pulsatile flow with 35.8 cm/s peak flow velocity [C1812]

## "AEW radar multi-channel joint CFAR detection of hovering helicopters"

We developed a constant false alarm rate (CFAR) strategy for detecting the blade echo-signal of a hovering helicopter with phased array airborne early warning (AEW) radar, which is based on the time-space cascaded adaptive processing approach (TSA) and "multi-Doppler channels joint detection" technique. The configuration of detector is given, the performance of the detector is analyzed, and the feasibility and effectiveness are verified with computer simulations [C1813]

## "2D-OS-CFAR detector for cloud clutter suppression"

The problems of CFAR processing are investigated by means of real cloud clutter data. Based on FFT processing techniques, a comparison of cloud clutter suppressing performance is made between CAGO-CFAR detectors, 3D-CLUTTER MAP-CFAR detectors and MX-OS-CFAR detectors. A new robust 2D-OS-CFAR detector is developed to resolve existent problems, with CFAR processing on a two-dimensional R-Fd (range-Doppler frequency) plane in place of the conventional one-dimensional range. Order statistics are used to estimate clutter amplitude at the same time. The processing results of real cloud clutter and target simulation signals have verified excellent performances of the 2D-OS-CFAR detector [C1814]

## "On suppressing azimuth ambiguities of synthetic aperture radar by three filters"

This paper proposes a method for suppressing the azimuth ambiguities of synthetic aperture radar (SAR). This method is based on the discrete time domain model of the echo signal. In addition to the usual matched filter

used by image reconstruction of SAR, other two filters are used to get responses which have the same shapes as the responses of the first ambiguities. After the outputs of the latter two filters are subtracted from that of the matched filter, we can get a response nearly free of the first ambiguities. Simulation shows that this method is effective. This method is helpful in improving SAR image quality and relaxing the constraints of the pulse repetition frequency (PRF) in SAR system design [C1815]

## "Analysis and experimental results on sparse-array synthetic impulse and aperture radar"

Sparse-array synthetic impulse and aperture radar (SIAR) is a new concept of 4D radar, based on the use of a transmit array, simultaneously radiating a set of orthogonal waveforms, and of a reception array, delivering sampled signals to a processing equipment, dedicated to Doppler filtering, time-space beamforming (including a transmitting beam and a receiving beam by calculation), and target extraction, thus, it can isotropically radiate. This radar adopt sparse arrays to improve its angle resolution. This paper introduces the principle of the SIAR, discusses some questions (including optimization of the frequency coding of the transmitting signal. to eliminate the coupling effects between distance and angles, a low-range-sidelobe technique based on frequency-coding agility among these frequencies and application of large time-bandwidth signals) and presents a description of the experiment system. Finally, some experiment results are given. Moreover, the strong agreement observed on both experiment and theoretical results [C1816]

## "An overview of spatial channel models used in smart antenna system analysis"

Smart antennas have become a promising technology for future mobile communication systems. They can effectively improve the performance of mobile communication systems. With smart antennas, channel modeling is an important issue for the design and performance analysis. In this article, we review some fundamental channel models that combine the time and spatial properties of mobile channels. Although channel models in which the parameters are based on measurement might be more closed to the real channel, we only discuss those models that completely or partially employ theoretical analyses. This is because the data obtained form measurement should only be applied to the associated environments and cannot be generalized [C1817]

## "A comparison the WWER-1000 reactor neutron power change processes for different variants of (Th,U,Pu)O2 fuel loading with Doppler effect taken in account"

This report gives the results of a numerical simulation of the reactor's neutron power changes process, which are caused by fixed changes of reactivity. We make a comparison of the reactor power changes when changes of reactivity were the same but in the active core different types of fuel were replaced. The cases of standard UO2 fuel using mixed (Th,U)O2fuel was examined [C1818]

## "The study on Doppler centroid estimation in DBS imaging"

Doppler centroid estimation is one of the most important steps in Doppler beam sharpen (DBS) imaging of airborne pulse Doppler radar. Two improved Doppler centroid estimation techniques are proposed. They are called the weighted pattern match technique (WPMT) and curve fitting iterative technique (CFIT) respectively. These new algorithms avoid the effects of non-homogeneous scene and random fluctuation of echoes. The precision of the estimation is improved significantly. The processing results of raw radar data prove their effectivity [C1819]

## "Application of 4th-order spectrum slice in Doppler information processing of OTH radar"

In the application of high frequency ground wave over-the-horizon radar systems, a new method is presented to extract the range and Doppler information from the radar echo. The paper is based on higher-order statistics (HOS). It only requires calculating the slice of higher-order statistics, and eliminates the calculation of multi-dimensional Fourier transforms. Therefore it requires less computational complexity. At the same time, because higher order statistics can greatly suppress the additive Gaussian noise, it possesses improved performance. For comparison purposes, some simulations, adopting the new method and the classical power spectrum estimation respectively, are introduced. The results show that the new method can effectively extract the range and velocity information of a moving object [C1820]

## "Correction of migration through resolution cell in ISAR imaging"

A simple ISAR range-Doppler algorithm is applicable to steadily small flying target. However, for a maneuvering target the assumption is not satisfied, as the Doppler frequency has a time variation property. Actually, to obtain the cross-range resolution of dozens of centimeters for the large-scale or medium targets especially for the S or L wave band, where the wavelength is not shorter, the migration through the resolution cell (MTRC) would occur

on both fringes of the ISAR imaging. The reason for this migration through the resolution cell is discussed, and a compensating algorithm is proposed. Simulated data and real data prove that this method is effective [C1821]

## "Investigation on low-angle tracking technique for HRR radar"

Accurate tracking of targets flying at low altitudes above a smooth surface is difficult because of the multipath propagation effects. In order to address this problem, a new method for eliminating the effects of specular components on the performance of radar low-angle tracking is presented. Using stepped frequency high range resolution (HRR) radar, one can obtain the target range profile from applying inverse fast Fourier transforms (IFFT) to the target echoes. By auto-correlation of target range profile, the path difference between the target and its specula can also be extracted, hence, the target altitude is estimated. The results of simulation and a range profile obtained from a stepped-frequency ultra-wideband trail radar (using 4GHz bandwidth) are also discussed [C1822]

## "Adaptive beamforming for Doppler signal"

A small number of samples and system errors can degrade the performance of adaptive arrays, particularly when the input signal-to-noise ratio (SNR) is large. A direct signal cancellation method to estimate the interference-noise covariance matrix which increases the SINR by using the desired signal Doppler information is proposed. It has the advantages of eliminating the problem of signal cancellation, a good beam pattern with the properties of low sidelobe level and fast convergence, which are confirmed by computer simulations [C1823]

## "Joint estimation of Doppler and multipath time delay of overlapping echoes for LFM pulse radar"

A new method for estimating the Doppler and multipath time delay of the overlapping linear-frequency modulated (LFM) signal returned echoes for pulse radar by using only one period pulse signal is presented. First, the Doppler frequency is estimated by the Wigner-Hough transform. Then, a reference signal is reconstructed using prior knowledge of the transmitted signal and the frequency parameters. Finally, using the property that the Wigner-Ville distribution can separate each echo from the overlapping echoes in the time-frequency plane, the multipath time delay is obtained by a so-called "modified time-frequency correlation function" proposed in this paper. The proposed method is characterized by the stronger robustness against additive Gaussian noise and the lower computational cost [C1824]

## "UV Rayleigh lidar system for accurate temperature profiling of the troposphere"

A compact and efficient ultraviolet lidar system is designed and developed to measure the temperature profile in the troposphere. The Doppler broadened Rayleigh-Brillouin scattering is detected with two etalon filters. The Mie scattering noise effect is reduced by a proper signal processing method. High temperature sensitivity is expected in this scheme [C1825]

## "Time and frequency synchronization of orthogonal frequency division multiple access systems"

We propose a non-data aided synchronization algorithm for orthogonal frequency division multiple access systems. The method is applied to both quasisynchronous and asynchronous systems. The proposed algorithm does not require the transmission of training sequences or of repeated symbols and, differently from all available methods, our frequency estimator has performance independent of the channel zero locations. We provide an analytic expression for the variance of the frequency offset estimator and then we validate our theoretical findings with simulation results [C1826]

## "A novel OFDM adaptive antenna array for delayed signal and Doppler-shifted signal suppression"

It is well known that OFDM scheme is robust to frequency selective fading in wireless channels. However, once delayed signals beyond the guard interval and Doppler-shifted signals are introduced in the channel, inter-subcarrier interference and inter-symbol interference give a severe degradation in the transmission performance. This paper proposes a novel OFDM adaptive antenna array which can suppress both delayed signals and Doppler-shifted signals. The proposed adaptive antenna array has a simple structure and by forcing virtual subcarrier outputs to be zero, it can steer its nulls toward incoming Doppler-shifted signals, even when they have no time delay. Computer simulation results show its excellent performance, for a case where four signals are incident on an eight-element circular array, such as one signal with no time delay, one Doppler-shifted signal with no time delay, one Doppler-shift signal with time delay within the guard interval, and one signal with time delay beyond the guard interval [C1827]

## "Discriminant functions and decision tree induction techniques for antenatal fetal risk assessment"

This study concentrates on the comparison of the discriminant functions and the decision tree induction techniques in antepartum fetal evaluation. These classification techniques are applied to antenatal fetal risk assessment problem and the performances, the computational complexities and the importance of each technique in terms of diagnostic clues are observed. The task is to investigate the Doppler ultrasound measurements of umbilical artery (UA) to relate the health conditions of fetuses using discriminant functions such as linear discriminant functions (LDF), multilayer perceptron (MLP), decision trees (C4.5, CART) and neural trees. We use the following UA blood flow velocity waveforms: pulsatility index (PI), resistance index (RI) and systolic/diastolic ratio (S/D) in terms of weeks (week index: WI as a normalized value) to decide if there is any hypoxia suspicion. It is observed that the performances of MLP and CART are better but C4.5 defines understandable diagnostic clues. On the other hand, the time complexity of LDF and C4.5 are become favorable. Experiments support that C4.5, MLP, CART and neural trees are favorable medical aids to physicians during intensive surveillance of fetuses. With the limited number of indices, we obtain a specificity and sensitivity of 100% and 93% with these decision techniques [C1828]

## "Adaptive modulation with imperfect channel information in OFDM"

Adaptive modulation in OFDM is a means by which the OFDM transmitter adapts the subchannel bit and power allocation to the amplitude response of the frequency selective channel for improved performance in high data rate wireless communications. Previous studies demonstrating the performance gains of adaptive modulation have assumed the availability of perfect channel state information. This paper examines the impact on performance of an adaptive OFDM system due to imperfect channel information arising from realistic channel estimators and time-varying channels. The latter is of particular relevance to mobile wireless applications, for which OFDM has received much attention. The performance of a typical channel estimator is found to be sufficient to justify the use of adaptive modulation in wireless OFDM systems, but in mobile situations the effect of outdated channel information in the presence of quickly time-varying channels can be significant. The use of channel prediction is shown to mitigate the impact of outdated channel information and improve performance when the Doppler spread, or mobile velocity, is high [C1829]

## "Statistical analysis of the received signal over multipath fading channels via generalization of shot-noise"

This paper is a continuation of a companion paper, in which multipath fading channels (MFC) are formulated as generalizations of the shot-noise analysis in investigating the statistical properties of wireless channels and their responses to different signals. These include second-order statistics, generalizations of Campbell's theorem and central-limit theorems. An application of the results to wide-sense-stationary-uncorrelated-scattering (WSSUS) channels reveals the effects of the rate of the counting process in shaping the power delay profile and Doppler spread of the channel [C1830]

## "Validation of theoretical GPS multipath bias characteristics"

Although GPS multipath error envelopes have been well-explored both mathematically and in hardware environments, the range biases caused by Doppler-shifted multipath pulling on the GPS receiver tracking loops have long remained the target of purely analytical discussion. This paper examines the effect of so-called fast-fading multipath on GPS code phase tracking performance and proposes a test method for isolating system range biases in an off-the-shelf receiver. The biases, which may be on the order of several meters, are based on the use of a noncoherent delay-lock loop (NCDLL) in the receiver's code tracking structure. In addition, existing models show a complete elimination of these bias errors in the presence of fast-fading multipath if a coherent delay-lock loop (CDLL) architecture is employed in the receiver. Bench data shows the existing theoretical model to be incomplete and a revised model is presented in order to explain the observed results [C1831]

## "Performance analysis of GMSK with CSDD and CSDDD scheme in land mobile to mobile channel with random frequency shifts and CCI"

In land mobile to mobile (LMM) channel, random frequency shifts (RFSs) may be introduced into the carrier frequency as a result of the Doppler effect due to the motion of transmitter (Tx) and receiver (Rx). Hagras et al. (2000) showed that the performance of center sampling differential detection (CSDD) in an LMM channel yields poor performance in the presence of RFSs. The main object of this paper is to study the performance of center sampling double differential detection (CSDDD) scheme introduced in Abdelkader and Fred (1986) in an LMM channel and compare its performance with the CSDD scheme. The performance of the CSDD and CSDDD schemes are analyzed in a two path Rayleigh fading channel taking into account frequency selective fading

(FSF), RFS, intersymbol interference (ISI), Doppler frequency shift, cochannel interference (CCI), and additive white Gaussian noise (AWGN). It is shown that the CSDDD scheme in the LMM channel has the potential to compact the effect of RFS and its performance is better than the CSDD scheme when RFSs are introduced into the carrier [C1832]

## "M-DPSK detection, channel estimation and power control in LEO satellite communications"

Differential detection of phase-shift keying signals entails the ability to establish a stable phase reference based on previous symbol(s). In low bit-rate communications strongly affected by Doppler effect, like those making use of non-geostationary satellites, significant carrier phase drifts may occur within the symbol interval; thus, large irreducible error floors result if the Doppler frequency shift (DFS) is not estimated and subtracted. We propose a state-space based receiver for M-DPSK signals in transmissions affected by fast fading and DFS, which evaluates the multiplicative distortion (amplitude and phase) of the baseband signal and uses those estimates to track the frequency offset. In addition, the proposed receiver can estimate the power of the line-of-sight component and the Rician fading parameter K which allow to monitor the transmission quality and control the transmitted power in adaptive systems. Simulations presented for 4-DPSK show that the performance of the new receiver is superior to that of conventional receivers in the presence of large DFS, exhibiting substantially lower error floors [C1833]

## "A Markov chain and quadrature amplitude modulation fading based statistical discrete time model for multi-WSSUS multipath channel"

The computation of the tap gains of the discrete time representation of a slowly time varying multipath channel is investigated. The simplest nondegenerate class of processes which exhibits uncorrelated depressiveness in the time delay and Doppler shifts is known as the “wide sense stationary uncorrelated scattering”, (WSSUS) model introduced by Bello (1963). The channel is assumed to be locally WSSUS. Our model presence the quadrature modulation fading simulators (MMFS) form. Assumptions on the multiplicative noise are made to follow Clarke's (1968) model for flat fading. An extension to multipath is provided by utilizing several fading simulators in conjunction with variable gains and time delays. The multipath extended Clarke's model resembles QMFS. However, the multiplicative coefficients are claimed to be Rayleigh distributed (extension to Ricean is easily deduced). The result is a closed form solution for tap gains, this was possible by the use of operator commuting with an error bound of 6fDT2. An extension to large area analysis where WSSUS assumption cannot be in force is made possible through the use of a Markov chain. Finally, further comments and figure results are displayed [C1834]

## "Channel estimation algorithms for third generation W-CDMA communication systems"

Three approaches for channel estimation are proposed and analyzed for third generation (3G) wideband code division multiple access (W-CDMA) communication systems. The down link (DL) channel estimation schemes researched use time multiplexed pilot-data symbols, code multiplexed common pilot channel (CPICH), and combine the channel estimate results from these two into an approach which is called combined channel estimation (CCE). For channel estimates using time multiplexed pilot-data symbols, we propose a new algorithm called iterative multi-slot averaged linear interpolation (IMALI). These methods are modeled and analyzed by means of computer simulations under a multipath Rayleigh fading channel and compared to the ideal channel estimation result. IMALI and CCE schemes show improvement in channel estimation accuracy and BER performance for high Doppler frequency [C1835]

## "Detection and estimation of embolic Doppler signals using discrete wavelet transform"

Almost any system for the detection of asymptomatic circulating emboli by Doppler ultrasound employs the fast Fourier Transform (FFT). However, the FFT is not ideally suited to study short-lived embolic signals. The wavelet transform (WT) is an optimized way of analyzing short-lived signals and performs better than the FFT in some respects. We propose a detection method based on the discrete wavelet transform (DWT) and study some parameters, which might be useful for describing embolic signals. We used 2 independent data sets, comprising 100 low intensity embolic signals, 100 various type of artifacts and 100 Doppler speckle. After applying the DWT to the data, several parameters were evaluated. The threshold values used for both data sets were optimized using the first data set. 98 out of 100 embolic signals were detected as embolic signals for the first data set. 95 out of 100 embolic signals were detected for the second data set when the same threshold values were used [C1836]

## "Space-time-frequency multiuser detection over fast-fading multipath channels for synchronous DS-CDMA systems"

RAKE receivers suffer degradation in performance under fast fading due to errors in channel state estimation. The wide-sense stationary uncorrelated scatterer channel model lends itself to time-frequency canonical representation, and provides additional diversity in the frequency axis. Using the joint spatial-multipath-Doppler diversity model based on this canonical representation with multiple antennas, we first develop linear space-time-frequency multiuser detectors based on decorrelating and MMSE interference suppression techniques and further present nonlinear space-time-frequency decision-driven multiuser detectors based on interference cancellation ideas to operate over the fast-fading multipath synchronous CDMA channels. Simulation results based on realistic fast-fading assumptions demonstrate that the nonlinear detectors present improved bit-error-rate performance over the linear detectors and all proposed detectors exhibit significant resistance to the near-far effect [C1837]

## "Array antenna assisted adaptive modulation in a fast fading channel"

This paper proposes a new adaptive modulation scheme, which is robust to a fast time-variation of Rayleigh fading. Adaptive modulation, which chooses an appropriate modulation format according to the instantaneous carrier-to-noise power ratio (CNR) of the fading channel, is an efficient technique capable of improving the transmission performance in a multipath fading channel. However, in a fast fading channel environment, the performance improvement will drastically be reduced. When CNR varies during the transmission burst, the transmission often fails since the modulation format chosen at the beginning of the burst to obtain the required bit error rate (BER) does not satisfy the required BER at the end of the burst. In order to overcome this problem, we propose a new adaptive modulation scheme, which employs the array antenna based Doppler spread compensator. Computer simulation results show the proposed adaptive modulation scheme drastically improves the packet error rate and throughput performance in fast fading environment [C1838]

## "A four-parameter quadratic distribution"

Quadratic distributions such as time-frequency distributions and ambiguity functions have many useful applications. In some cases it is desirable to have a quadratic distribution of more than two variables. Using the technique of applying operators to variables, general quadratic distributions of more than two variables can be developed. We use this technique to develop a four-parameter quadratic distribution that includes variables of time, frequency, lag, and Doppler effect. A general distribution is first developed and some of the mathematical properties are discussed. The distribution is then applied to the improvement of an adaptive time-frequency distribution. An example signal is shown to evaluate the performance of the technique [C1839]

## "Quasi-static antenna array processing for rapidly time-varying channels"

This paper explores the use of quasi-static frequency-domain antenna combining weights for multi-user (e.g., SDMA) or multi-stream (e.g., MIMO) communication systems operating in rapidly time-varying frequency-selective channels. By implementing combining weights that are constant across a time slot but are updated from slot-to-slot (i.e., "quasi-static"), great computational complexity savings can be realized compared to calculating new weights at each data block within a time slot. The quasi-static weights are computed by first modeling, the time-varying channel for each user as the superposition of multiple time-invariant channels, called Doppler channels. The weights are then calculated based on all users' Doppler channels. These new weights work by using some of the degrees of freedom of the antenna array to suppress time variations as well as multiple access interference. Despite being fixed across a time slot, these weights can equalize and suppress SDMA interference even when the channel varies significantly over the slot. Simulation results show the effectiveness of these weights for equalization and interference suppression [C1840]

## "Spectral moment estimation for weather radars using a whitening transformation on oversampled data"

A method for estimation of Doppler spectral moments on pulsed weather radars is presented. This scheme operates on oversampled echoes in range; that is samples of in-phase and quadrature phase components are taken at a rate several times larger than the reciprocal of the transmitted pulse length. The aforementioned radar variables are estimated by suitably combining weighted averages of these oversampled signals in range with the usual processing of samples (spaced at pulse repetition time) at a fixed range location. The weights in range are chosen such that the oversampled signals become uncorrelated and consequently the variance of the estimates decreases significantly. Because the estimates' errors are inversely proportional to the volume scanning times, it follows that storms can be surveyed much faster than it is possible with current processing methods, or equivalently, for the current volume scanning time, the accuracy of the estimates can be greatly improved [C1841]

## "Optimal time-frequency signaling for rapidly time-varying channels"

We introduce a new signaling scheme for time- and frequency-selective channels that is a generalization of multi-carrier code division multiple access (MC-CDMA) signaling used in slowly time-varying channels. The Fourier basis functions used in conventional MC-CDMA systems encounter temporal distortion in rapidly time-varying channels resulting in degraded performance. The proposed scheme transmits the data over a set of orthonormal time-frequency basis functions whose time-frequency support is matched to the coherence time and bandwidth of the channel. The time-frequency signaling scheme approximately diagonalizes the time-varying multipath channel and each basis function encounters flat Rayleigh fading. We derive an optimal choice of basis parameters that yield the most accurate diagonalization for given multipath and Doppler spreads of the channel. The proposed system fully exploits the diversity afforded by the channel and delivers improved performance in rapidly time-varying channels in contrast to degraded performance of existing systems under such conditions [C1842]

## "Chirped-OFDM for transmissions over time-varying channels with linear delay/Doppler spreading"

In this work we show that the optimal digital communication strategy for transmissions over time-varying channels with spread function maximally concentrated along a line of the delay-Doppler domain consists in multiplexing the input symbol block with an IFFT, as in OFDM, and modulating the IFFT output with a chirp signal whose sweep rate is matched to the channel. We show how to allocate the transmit power optimally across the chirped subcarriers, derive the limits of applicability of the proposed chirped-OFDM scheme and compute the resulting BER curves [C1843]

## "Active integrated antennas using the direct-conversion detection"

Two active integrated antennas are implemented to act as direct-conversion receivers. These active antennas can be applied for Doppler frequency detection, I&Q demodulation and direction finding [C1844]

## "Demonstration of single-sided Compton scatter tomography in fan beams with an HPGe array"

An instrument is demonstrated whereby radiographic images of a sample's electron density are compiled from the information encoded in the energy spectra of gamma rays backscattered from one side of the sample. Nondestructive inspection of aluminum airframes is the application of interest, so it is assumed that access is restricted to only one surface of the object under inspection. Use of energy coding allows imaging in a fan beam rather than independent interrogation of individual volume elements. The Multiplexed Compton Scatter Tomograph (MCST) instrument consists of an array of planar high-purity germanium detectors, a set of fan beam collimators, and a Cd109radionuclide source. Instrument signals are converted to electron density images using a penalized weighted least squares image reconstruction algorithm coupled with a deterministic system model that includes effects of finite source and detector size, detector resolution and efficiency, attenuation, and Doppler broadening. The Doppler broadening, resulting from the momentum distribution of bound electrons, is significant at the energies used here. The proof-of-principle instrument is demonstrated on some aluminum samples. In an 8-mm thick sample with a 4 mm void in its center, contrast recovery of 90% is achieved. In a 10-mm thick sample with a 3 rum void at the back, about 85% of the contrast is recovered. [C1845]

## "Angular error in ultrasound Doppler tissue velocities and its influence on the derived variable peak systolic strain"

When recording velocities using ultrasound Doppler, the obtained velocities are always a projection of the true velocities onto the direction from the recording point towards the transducer. In this study we have marked up lines in sequences of ultrasound images of the heart showing the direction of the original velocity. Doing this, it is possible to calculate the original velocity in the marked direction. Both the recorded and corrected velocities have been used for calculating strain, in order to compare the two. Apical ultrasound images have been recorded on a sample of 18 normal individuals. The corrected velocities are on the average less than 5% higher than the recorded ones, and the effect on the derived variable strain is even less, so we suggest that the correction can be omitted when recording tissue velocities through an apical window. [C1846]

## "Spectroscopic investigations of a ferroelectric plasma cathode"

Results of spectroscopic investigations of the plasma formed on the surface of a ferroelectric cathode under the application of a driving pulse are presented. It was shown that light emission from the excited ions and neutral atoms of materials of the front electrode and the ferroelectric ceramics (Cu, Pb, Sr, Ba, Ti, and H) appears within the first 50 ns after the beginning of the driving pulse. By analyzing of the Doppler broadening of the observed spectral line profiles, it was found that the temperature of ions and neutral atoms is ≤0.8 eV. The analysis of the

Stark broadening of the Hαand Hβspectral lines showed the absence of a high (>1 kV/cm) electric field, which could be developed at the surface of the ferroelectric due to the appearance of noncompensated polarization charges. The same Stark analysis showed that the plasma density does not exceed 1013cm-3. By comparison of the obtained relative intensities of the Hαand Hβspectral line intensities and results of collision radiative modeling the plasma electron temperature was found to be 3 eV. [C1847]

## "Three-Compton telescope: theory, simulations, and performance"

The advent of highly segmented gamma ray detectors with good energy resolution has made a new class of gamma ray detectors possible. These instruments record the positions and energies of each individual gamma-ray interaction with high precision. Analysis of the individual interactions can provide energy and directional information, even for events with only partial energy deposition. Advantages over traditional gamma ray detectors include enhanced efficiency, background rejection, gamma ray imaging, and sensitivity to polarization. Consider those gamma rays that interact three or more times in the detector. The energy of the gamma ray that initiated one of these events is uniquely determined by measuring the energies of the first two interactions, and the scatter angle of the second interaction. The precision of this measurement is limited by the energy and position resolution of the detector, but also from Doppler broadening that results from the scattering off of bound electrons in the detector. It is also essential to correctly sequence the first three interactions. The importance of Doppler broadening is greater in higher Z-materials, thus silicon becomes a good choice for the detector material. We discuss performance and simulations of the multiple Compton telescope. [C1848]

## "Vascular adaptations to transverse aortic banding in mice"

Transverse aortic banding in mice generates pressure overload, but cardiac hypertrophy is variable, and the effects on peripheral hemodynamics are unknown. The purpose was to characterize and model carotid and aortic blood flow patterns in banded mice using noninvasive Doppler methods. In 15 normal mice a 27-gauge needle was sutured against the transverse aorta and then removed. In 6 sham-operated mice the suture was not tied. A Doppler probe was used to measure right (R) and left (L) carotid artery (CA), aortic, and mitral blood velocity 1 day later. At 7 days the heart-weight/body-weight ratio (HW/BW) was measured. Mean aortic, mitral, and carotid velocities were similar in sham and banded mice, but peak RCA/LCA velocities were much higher in banded mice and were highly correlated to HW/BW. An esophageal Doppler probe detected high jet velocity and distal vorticity. We conclude that mice compensate for the band by increasing RCA resistance and compliance and decreasing LCA resistance to maintain normal cerebral perfusion. Velocity signals measured within one day and fitted to a lumped-parameter arterial model to estimate the pressure drop can predict the amount of cardiac hypertrophy at one week. [C1849]

## "Etiology of decubitus ulcers using an animal model-a comparison of blood flow measurement method between point analysis and two-dimensional analysis"

The purpose of this study has been to clarify the effect of sustained compression on skin surface blood flow at the edema stage and flare in the initial phase of decubitus ulcer formation with the use of rabbit ears. Experimental protocol is compared between point analysis and two-dimensional analysis. For the point analysis, a laser Doppler perfusion monitoring probe is contacted with the skin surface continuously. For two-dimensional analysis, the scanning probe is not contacted with skin. The experimental phases are divided as follows: 1) initial (pre-compression), 2) edema, 3) compression and 4) release from compression. For the the point analysis, the blood flow rate has been measured continuously on a point from the initial phase to release from the compression phase. When the two protocols were compared, similar blood flow changes were observed. From results of two-dimensional analysis, during the compression phase and during release from compression, the blood flow rate in the peripheral part of the compressed area was found to change proportionately to the applied compressive load. [C1850]

## "Comparison of near infrared spectroscopy (NIRS) signal quantitation by multilinear regression and neural networks"

Signal quantitation in most near infrared-spectroscopy (NIRS) instruments is achieved through solving simultaneous equations or multiple regression analysis. The aim of this study was to compare NIRS signal quantitation by conventional multiple regression to artificial neural networks. Sixteen adult sheep were used in the study of the effects of changes in cerebral blood flow and metabolism through induction of seizures, ischemia, and hypercapnia. NIRS-derived signal attenuation for relative blood volume (BV) and oxygen desaturation (DESAT) were compared to simultaneous blood flow values measured by laser Doppler flowmetry and venous oxygen-saturation (SVO2) determined from direct blood gas analysis. The regression for flow provided a zero p-value, a variance S=17.57 and F statistic=50.49. The residuals vs. fits plots suggest that the

current model would underestimate values below the mean and overestimate those above the mean. An improved regression model for SvO2provided a zero p-value, a variance S=14.1 and F statistic=4.26. Two different neural networks were implemented for flow and oxygen saturation. Both networks "tracked" their values closely and with low cycle errors. Neural networks are powerful tools for evaluation of rapidly changing, variable environments. [C1851]

## "Analysis of effects of nonuniform beam profile on Doppler power spectrum and mean velocity"

Summary form only received as follows: In this paper we present a detailed simulation method to estimate the accuracy of Doppler power spectrum and mean blood velocity, using real CW Doppler transducers with twin-crystal arrangement. The method is based on dividing the sample volume into small cells using the statistics of the total power of Doppler spectrum with the same Doppler shift frequency, and from total power, which predicts errors in the mean blood velocity. Results show that the Doppler angle, vessel depth, and sample volume length are not sensitive functions for both the Doppler power spectrum and error in the mean blood velocity. However vessel diameter, displacement distance and blood velocity profiles have significant effects. Finally, comparisons between simulation and experiment results illustrated a good agreement for parabolic flow profile. These results will contribute to an improved understanding of Doppler power spectrum and error in mean blood velocity in medical ultrasound diagnostics. [C1852]

## "Effect of contrast on systolic myocardial ultrasound color-Doppler velocity"

Intravenously distributed ultrasound contrast increases echoes from the normally low echogenic bloodpool and myocardial perfusion imaging is developing. However the microspheres used are potential endothelial stimulators as well as nonlinear scatterers. Tissue Doppler is developed to detect velocities of myocardial motion, which are in the same range as perfusion flow velocities. The effect of contrast is not evaluated. We performed echocardiography in 12 patients with ischemic heart disease before and immediately after a slow intravenous infusion of 27 ml Optison®using color myocardial Doppler imaging (GE Vingmed systemV). Longitudinal basal systolic velocities and their integrals were analyzed in digitally stored cineloops. Peak mean velocity increased 10% by contrast from mean 5.2 ± 1.8 (SD) to 5.7 ± 2.3 cm/s (p=0.02, confidence interval 2-16%) but integral did not change (0.8 ± 0.4 cm). Contrast has no effect on blood pressure or heart rate in used dose. It is therefore of interest to further evaluate if this increase in velocity; a) is a methodological effect that may be used to detect contrast within myocardium (and thereby perfusion/blood volume), or b) is secondary to increased flow and motion caused by endothelial and vascular effects from the contrast microspheres. Either have important methodological, physiological and clinical impact. [C1853]

## "Performance analysis of digital second order delay locked loops for direct sequence spread spectrum systems with Doppler shift and A/D quantization"

The non-coherent second-order digital delay locked loop with Doppler shift present is analyzed. The analysis is unique on two counts. First, the effects of the loop A/D quantization on the loop performance, which have been neglected previously, are examined. Second, MTLL (mean time to lose lock) and MSE (mean square error) are evaluated more accurately than by previous methods. Numerical results show that: (1) the number of quantization levels significantly alters the loop behavior, including the lock-in range, transient responses, MTLL and MSE; and (2) the traditional analysis based on Gaussian approximation may result in a large error in performance evaluation when the A/D quantization is taken into account [C1854]

## "M-DPSK receiver for Doppler-shift mobile communications"

Differential detection of phase-shift keying signals entails the ability to establish a phase reference based on previous symbol(s). In communications strongly affected by the Doppler effect, like those involving non-geostationary satellites, the carrier phase drift within the symbol interval may be significant; thus, a better strategy than averaging the phase over previous symbols is to continuously estimate it along the corresponding interval. We propose a receiver for M-DPSK signals in channels affected by fast fading and Doppler frequency shift. A bank of stochastic nonlinear filters estimates the carrier phase drift and the fading vector, which are modeled as stochastic processes within the symbol interval; a key algorithm driven by the filters' outputs estimates the carrier offset frequency, which is considered a constant parameter in each estimation interval (corresponding to at least two-symbol intervals). Simulations with 4-DPSK show that the receiver performs much better than conventional differential phase detectors; it exhibits short convergence times, being able to cope with large Doppler frequency shifts [C1855]

## "The directional diversity of HF signals received over high latitude paths and the possibility of improved data throughput by means of spatial filtering"

The high latitude ionosphere is a disturbed region containing irregularities which may be regarded as providing a rough reflecting surface for obliquely propagating HF radio waves. Signals associated with each propagation mode may arrive at the receiver over a range of angles in both azimuth and in elevation. In addition, ionospheric movements at the reflection points impose Doppler shifts and Doppler spreads onto the signal. Various researchers have been engaged in an experimental programme of channel sounding over high latitude paths with the DAMSON pulse compression sounder (Davies and Cannon 1993). The system allows signal strength, time-of-flight, time dispersion due to multipath propagation and frequency dispersion Doppler spread and Doppler shift to be measured over point-to-point communications paths. All of these parameters are of great importance to the design and operation of HF communications equipment in the high latitude regions. It is suggested here that signals may be combined from two or more antennas in such a way as to, in effect, steer beam(s) or null(s) in the directional sensitivity pattern of the receiver antenna so as to exploit the directional diversity of the incident signals in order to reduce the delay and Doppler spreads. Such a technique is potentially important for increasing the data throughput of communications systems employing modern, high speed modems operating within the high latitude environment [C1856]

## "Time-frequency decorrelating decision-feedback multiuser detector over fast-fading multipath channels for synchronous DS-CDMA systems"

RAKE receivers suffer degradation in performance under fast fading due to errors in channel state estimation. The wide-sense stationary uncorrelated scatterer channel model lends itself to a time-frequency canonical representation, and provides additional diversity in the frequency axis. Using the joint multipath-Doppler diversity model based on this canonical representation, we propose a nonlinear time-frequency decorrelating decision-feedback multiuser detector for synchronous CDMA which utilizes decisions of the stronger users when forming the decisions for the weaker ones. Analytical and simulation results based on realistic fast-fading assumptions demonstrate that the proposed decision-feedback multiuser detector promises substantially improved bit-error-rate performance compared to the time-frequency decorrelating multiuser detector for the weaker users, while the error probability of the weakest user approaches the single-user bound as the interferers grow stronger. The proposed detector exhibits strong resistance to the near-far effect for all users and the time complexity per bit is linear in the number of users [C1857]

## "Best management of FM waveform by a missile-borne pulsed Doppler radar during high-manoeuvring target tracking in strong clutter environment"

Referring to the application of missile-borne pulsed Doppler radars, the use of a radiofrequency HPRF-FM seeker, having a monopulse tracking processing, is considered in scenarios with a low altitude flying high-manoeuvring target. During target tracking the seeker has to solve the situations when the clutter signal occupies the target frequency positions and tracking can be lost. The algorithm that is presented shows how to dynamically choose an optimum FM factor, so to reduce clutter disturbing effects and to maintain a stable target tracking [C1858]

## "Effects of internal clutter motion on STAP in a heterogeneous environment"

Clutter is typically modeled as stationary (i.e., zero Doppler shift) scatter from the surface. Thus for ground-based systems the clutter is contained at zero Doppler while airborne systems will observe clutter spread in Doppler due to platform motion (i.e., the classic angle-Doppler clutter `ridge'). However, motion internal to the background clutter of vegetation, etc., will result in the clutter having non-zero bandwidth. This effect, generally referred to as internal or intrinsic clutter motion, will tend to increase the rank of the clutter in the space-time adaptive processing (STAP) covariance matrix. We examine the effect of this phenomenon on STAP. We consider the effects of a heterogeneous environment and provide examples based on site-specific terrain data that illustrate the impact on STAP performance [C1859]

## "Bistatic STAP performance analysis in radar applications"

We consider the performance of several space-time adaptive processing (STAP) algorithms in a bistatic airborne radar application. Specific consideration is given to the effect of bistatic clutter spectral dispersion on covariance estimation and the algorithm's resulting clutter rejection capability. Our prime research focus emphasizes adaptive processing methods capable of high performance with efficient utilization of training data requiring no spectral compensation for dispersion mitigation; i.e., methods capable of operation with training data from radar range cells located in close proximity to the primary range test cell. Algorithm performance is assessed using the output signal-to-interference-plus-noise ratio (SINR) compared to that of the matched filter with known covariance [C1860]

## "Signal processing of ground penetrating radar using super resolution technique"

Ground penetrating radar (GPR) using electromagnetic pulse requires high resolution due to its narrow bandwidth nature. The rising requirement for high resolution lead to specific demands for improved prediction methods, all requiring many aspects to be examined. The application of the super resolution method MUSIC (multiple signal classification) algorithm and FFT (fast Fourier transform) are examined. The combined processing method (CPM) of the time domain response of MUSIC and IFFT (inverse fast Fourier transform) is proposed for signal processing of GPR for the first time. Simulation and experimental results show that CPM has both higher resolution and higher receiving signal level than other conventional signal processing methods [C1861]

## "Performance comparison of fast-scan GMTI/STAP architectures"

This paper presents a study on multibeam radar architectures to provide wide-area fast-scan ground moving target indicator (GMTI) coverage. The minimum dwell time of a GMTI radar system is often determined by the Doppler processor. The revisit rate can be lowered, while still meeting dwell time constraints, by using multibeam techniques to cover more area in each dwell. The two multibeam techniques examined here are: (1) to spoil the transmit beam with a quadratic phase and digitally beamform on receive; and (2) to break each transmitted pulse into sub-pulses each with different center frequencies, pointed in different directions, and to beamform in the corresponding direction on receive. Space time adaptive processing (STAP) is used with these GMTI architectures to mitigate main beam clutter and to enhance detection of targets in severe interference environments. The antenna sub-arraying, used for beamforming and STAP, generates grating lobes in the receive pattern in multibeam systems. This can degrade performance because grating lobes cannot be suppressed in more than one direction at a time. Two different antenna designs are studied to determine the effect of grating lobes for each of the above fast-scan architectures; non-overlapping (contiguous) sub-arrays and 75 percent overlapping sub-arrays which allows greater control of grating lobes at the cost of greater array complexity. This paper presents signal-to-interference ratio loss (SIRL), probability of detection (P d) and minimum detectable velocity (mdv) for each system. A narrowband interference source is swept in angle to determine system performance degradation due to the grating lobes [C1862]

## "MIMO measurement and joint M-D parameter estimation of mobile radio channels"

We describe a measurement and parameter identification procedure for the mobile radio propagation channel which includes the azimuth directions of the propagating waves at both link ends, elevation at the base station, time delay, and Doppler shift. The measurement is based on a broadband, real-time multiple-input-multiple-output radio channel sounder. At the mobile station a circular uniform beam array (CUBA) is used which covers 360° viewing angle whereas at the base station a uniform rectangular array (URA) is deployed. We derive the underlying data model and propose a multidimensional joint parameter estimation procedure from measurements which is based on the M-D ESPRIT algorithm. The resolution of coherent paths by subspace smoothing and the reduction of measurement errors by device calibration procedures is addressed [C1863]

## "Laser light scattering diagnostic for measurement of flow velocity in vicinity of propagating shock waves"

A laser light scattering diagnostic for measurement of dynamic flow velocity at a point is described. The instrument is being developed for use in the study of propagating shock waves and detonation waves in pulse detonation engines under development at the NASA Glenn Research Center (GRC). The approach uses a Fabry-Perot interferometer to measure the Doppler shift of laser light scattered from small (submicron) particles in the flow. The high-speed detection system required to resolve the transient response as a shock wave crosses the probe volume uses fast response photodetectors and a PC based data acquisition system. Preliminary results of measurements made in the GRC Mach 4, 10Ч25 cm supersonic wind tunnel are presented. Spontaneous condensation of water vapor in the flow is used as seed. The tunnel is supplied with continuous air flow at up to 45 psia; the flow is exhausted into the GRC laboratory-wide altitude exhaust system at pressures down to 0.3 psia [C1864]

## "Optimum element arrangement of adaptive arrays for SDMA considering angular spread and Doppler effect"

Frequency reuse is one of the most important issues facing future mobile communication systems because many users will utilize mobile communication services that have limited frequency resources. Space division multiple access (SDMA), which applies adaptive arrays to base stations, is a promising technique to increase the channel capacity. To actualize SDMA, the optimum element arrangement of adaptive arrays must be clarified as

well as other design parameters in RF and digital signal processing blocks. We reported that the average squared spatial correlation (ASSC) is useful in designing the element arrangement of the adaptive arrays for SDMA when incoming waves are plane waves. In this paper, we derive the conditions that minimize the ASSC by extending the formula presented by Takatori, Nishimori and Hori (see Proceeding of 2000 VTC-Fall, Boston, vol.1, p.150-156, 2000). Moreover, the influences of the angular spread and Doppler effect are investigated by computer simulation and a design chart of the element arrangement for a three-element circular array is presented [C1865]

## "Spectroscopic measurements of spherically convergent beam fusion"

Spherically convergent beam fusion (SCBF) is a scheme for accelerating ions, which are generated between electrodes by a glow discharge, toward the spherical center and giving rise to fusion reactions. The SCBF device is very simple and compact unlike other fusion devices. Therefore, it is applicable to a portable neutron source. However, the detailed mechanism of SCBF has not been made clear yet. The experimental device is made of 45 cm diameter and 31 cm high stainless steel cylindrical chamber, in which a spherical mesh-type anode of 30 cm diameter is installed. An open spherical grid cathode of 7 cm diameter is set at the center of the spherical anode. The system is maintained at a constant pressure of 0.6 to 55 mTorr by feeding discharge gas through a leak valve. The visible and ultraviolet emission from the device was investigated using hydrogen discharge. Emission, from the SCBF device is focused by a lens (f=100 mm) on an end of an optical fiber and guided to a spectrometer. The spectrometer is a Czerny-Turner type and the resolution is 0.027 nm. Effects of the discharge current and cathode voltage on emission intensities and spectrum profiles of hydrogen Balmer lines were investigated. In the case of the Star mode, the peak of emission intensities was obtained at the spherical center. The plasma core at the cathode center expanded with discharge current and shrunk with cathode voltage. All hydrogen lines were broadened with the cathode voltage. There was a good agreement between the experimental and the calculational results, and so the broadening was verified to be caused by the Doppler effect. The detailed experimental results will be presented [C1866]

## "Development of a planar three-component velocimeter using Doppler global velocimetry (DGV) and PIV"

Doppler global velocimetry (DGV) is a planar velocity measurement technique, which is based on the determination of the Doppler shift of laser light scattered off particles by using a molecular filter. Currently a pulsed Doppler global velocimeter is being constructed at the Institute of Fluid Dynamics. An out-of-plane component of each velocity vector in the laser-illuminated plane is obtained by that configuration. The experimental setup is extended so as to measure the in-plane component of those velocity vectors by using particle image velocimetry (PIV). Thus, a measurement system is being developed which is capable of obtaining three components of the velocity vectors located in a plane by using one single camera system. A velocimeter based on pulsed DGV consists of a long-pulse laser for the flow illumination, an image acquisition system and the molecular filter cell. The specifications of each single component have a major effect on the overall system performance. Therefore the technical specifications of all velocimeter components have been evaluated experimentally. Evaluation data are presented in this report. First results of calibration measurements are also shown and an outlook on upcoming steps of the system development is given [C1867]

## "3D echographic data segmentation and carotid artery turbulences mapping by Doppler velocimetry by a common approach based on calculus of variations"

The DOLPHINS project is supported in part by the 4thEuropean RTD Framework Program, and deals with echographic applications dedicated to arterial walls and plaque segmentation, plaque motion and degree of stenoses analysis. For this purpose, we have adapted geodesic active contours methods for arterial walls segmentation, to characterize stenose severity with regularized high resolution Doppler spectrum analysis by turbulences mapping from a Doppler spectral width measurement. The original contribution of our approach consists in using the same calculus of variations framework for image segmentation and Doppler velocimetry. We prove that we can, by analogy, find the equivalent mean curvature flow equation, used for geodesic active contours, for Doppler analysis by considering the complex autoregressive polynomial as a closed plane curve immersed in the oriented Euclidean plane [C1868]

## "Fundamental limits on symbol rate in frequency selective continuous fading channels"

We consider fundamental limits on the symbol rate in frequency selective continuous fading channels. We show the relationship between the upper and lower bounds on the symbol rate set by the delay spread and the Doppler frequency of the channel respectively. We assume training-based channel estimation without tracking, and coherent detection without equalization. An approximation is derived for simulating channels with small delay

spread using symbol period spaced samples. Simulation results with a two-path channel model are presented, including bit error rate (BER) and maximum throughput as functions of normalized delay spread for fixed products of delay spread and Doppler frequency. We also discuss the general implications of these results [C1869]

## "Overview of equalization schemes for space-time-coded transmission with application to EDGE"

This paper presents an overview of candidate equalization schemes for space-time-coded transmission over broadband wireless channels. Promising equalization schemes for space-time trellis and block codes are described and their pros and cons discussed. Performance results for the third-generation TDMA cellular standard EDGE are also presented [C1870]

## "Three-dimensional E-CSAR imaging of a T-72 tank and synthesis of its spotlight, stripmap and interferometric SAR reconstructions"

This paper presents the results of three-dimensional imaging of a T-72 tank using its angular azimuthal (turntable) and linear elevation synthetic aperture data at X band. This is achieved using an accurate and computationally-efficient wavefront (Fourier-based) reconstruction algorithm for elevation and circular (E-CSAR) data. The E-CSAR 3D images are then used to synthesize 2D spotlight and stripmap slant plane SAR images of the target at a desired range and squint angle. For this purpose, a procedure is introduced that incorporates the spatially-varying azimuthal and elevation Doppler signatures of individual reflectors on the target as well as the mean range, azimuth and elevation of the flight path. Results using the E-CSAR images of the T-72 tank are provided [C1871]

## "Time correlation based maximum Doppler frequency estimator for W-CDMA receiver"

Channel estimation is an important technique for compensating the signal against fading effects. Optimal channel estimation requires information of the vehicle speed or the maximum Doppler frequency. We developed a time correlation based maximum Doppler frequency estimator for the optimal channel estimation. We evaluated its performance and applied it to a CDMA RAKE receiver under a multipath fading channel. The proposed scheme can accomplish the features of a wide detection range i.e., from low Doppler frequency to 380 Hz, while achieving a low mean square estimation error of 10% under a multipath environment [C1872]

## "cdma2000: adaptive reverse link operation using Doppler estimation"

This paper looks at a way of doing adaptive power control using Doppler estimation. It looks at the performance of the reverse link (RL) of cdma2000 under various conditions for a mobile station in a vehicle. Then, it looks at various ways of Doppler estimation, and suggests a method for identifying the speed of the vehicle to control the power of the system adaptively and enhance its performance [C1873]

## "Iterative receivers for space-time block coded OFDM systems in dispersive fading channels"

We consider the design of iterative receivers for space-time block coded orthogonal frequency-division multiplexing (STBC-OFDM) systems in unknown wireless dispersive fading channels, with or without outer channel coding. First, we propose a maximum-likelihood (ML) receiver for STBC-OFDM systems based on the expectation-maximization (EM) algorithm. By assuming that the fading processes remain constant over the duration of one STBC codeword, and by exploiting the orthogonality property of the STBC as well as the OFDM modulation, we show that the EM-based receiver has a very low computational complexity, and that the initialization of the EM receiver is based on the linear minimum mean-square-error (MMSE) channel estimate for both the pilot and the data transmission. Since the actual fading processes may vary within one STBC codeword, we also analyze the effect of a modelling mismatch on the receiver performance, and show both analytically and through simulations that the performance degradation due to such a mismatch,is negligible for practical Doppler frequencies. We further propose a turbo receiver based on the maximum a posteriori (MAP)-EM algorithm for STBC-OFDM systems with outer channel coding. Compared with the previous non-iterative receiver employing a decision-directed linear channel estimator, the iterative receivers proposed here significantly improve the receiver performance and can approach the ML performance in typical wireless channels with very fast fading, at a reasonable computational complexity well suited for real-time implementations [C1874]

## "Sound field measurement through the acousto-optic effect of air by using laser Doppler velocimeter"

Sound pressure was measured by a laser Doppler velocimeter through the acousto-optic effect of air. First, the

author deduced the acousto-optic coefficient of air. Then, quantitative measurements based on the theory were demonstrated for ultrasound [C1875]

## "Time-frequency decision-driven multiuser detectors over fast-fading multipath channels for synchronous DS-CDMA systems"

RAKE receivers suffer degradation in performance under fast fading due to errors in channel state estimation. The wide-sense stationary uncorrelated scatterer channel model tends itself to time-frequency canonical representation, and provides additional diversity in the frequency axis. That is, the joint multipath-Doppler diversity model enables the development of nonlinear decision-driven time-frequency multiuser detectors based on successive interference cancellation and multistage interference cancellation ideas. Simulation results demonstrate that the proposed nonlinear decision-driven time-frequency multiuser detectors promise substantially improved bit-error-rate performance compared to previously proposed time-frequency multiuser detectors while exhibiting strong resistance to the near-far effect [C1876]

## "Implementation of grounding, bonding, shielding and power system improvements in FAA systems: reliability assessments of the terminal Doppler weather radar (TDWR)"

The safety and efficiency of the National Airspace System (NAS) is critically dependent upon the inherent reliability of the many systems required for its operation. A major impediment to reliability is the frequency at which FAA systems fail due to electrical power interruptions. These failures are most often associated with power system transients that result from the passage of thunderstorms in the vicinity of FAA facilities. In order to improve the reliability of the NAS, the FAA has developed and implemented a program to provide improved Grounding, Bonding, Shielding and Power systems (GBSP) in support of major facilities. This paper reports on the initial program effort, dealing with performance of the Terminal Doppler Weather Radar (TDWR) system and the effects of implementing the GBSP program. The program has resulted in significant improvements in reliability [C1877]

## "Physics of the interaction of pulsed magnetic fields with plasmas and relevance to applications"

Summary form only given, as follows. Spatially and temporally resolved spectroscopic measurements of the ion velocities, electron density and temperature, non-thermal electric fields, and the magnetic field evolution in a current-carrying plasma, show that ion separation occurs in which a light-ion plasma is pushed ahead of a magnetic piston while a heavy-ion plasma lags behind the magnetic piston. The velocities of the heavier ions are determined from Doppler shifts and the proton velocity is obtained using charge-exchange spectroscopy. The width of the current channel, calculated from the spatial distribution of the magnetic field, determined from Zeeman splitting of doped helium lines, is significantly broader than expected from classical diffusion. A large electron and ion heating is observed during the field penetration, as predicted theoretically. Moreover, the formation of non-thermal fast electrons, associated with the field penetration is experimentally studied. Turbulent electric fields with a 10+-2 kV/cm amplitude are inferred from Stark broadening of hydrogen and helium lines. Explanations for the observed rapid magnetic field penetration into the heavy-ion plasma in the context of EMHD theory or turbulence-induced collisionality are discussed. It is shown that the presence of the light ions in the plasma significantly modifies the dissipated-magnetic-field-energy partitioning between electrons and ions. Furthermore, understanding the dynamics of different ion species allows for improving the switch opening and coupling to various loads. Relevance to astrophysics and magnetic fusion will also be discussed [C1878]

## "Effect of axial momentum spread on radiation growth rates in a spatiotemporally gyrating electron beam"

Summary form only given, as follows. In previous work, a stability analysis was made of an electron beam propagating along and gyrating about a uniform magnetic field for the case of a spatiotemporal distribution in the phase angle of the transverse electron momentum component. A result of that work was that the beam may emit stimulated radiation at frequencies far in excess of the Doppler shifted electron cyclotron frequency. However, in that work it was assumed that the beam was cold (i.e., that the axial and transverse momentum components have definite magnitudes). In the present work, an analysis is made of the influence of a Lorentzian axial momentum spread on the stability properties of the beam. It is found that, for a sufficiently narrow momentum spread, the integral equations that relate electromagnetic field amplitude can be approximated by a set of algebraic relations, so that a dispersion relation is obtained. Numerical examples of the effect of axial momentum spread on radiation growth rates are presented [C1879]

## "Temperature dependence of the adsorption time of cesium atoms on a glass surface"

Summary form only given. Reflection spectroscopy at a dielectric/atomic vapor interface allows one to study the properties of atoms close to a surface, within a depth of the order of the optical wavelength. We report on the use of evanescent wave spectroscopy to determine the temperature dependence of the adsorption time of Cs atoms on the pyrex window of an ordinary optical cell. Saturated absorption (SA) spectroscopy in a vapor is known to be a velocity selective technique, yielding Doppler-free spectra. In the presence of velocity changing collisions, SA spectroscopy can also provide information on the velocity redistribution (the collision kernel) provided that the pumping effect has not been totally washed out in the course of the collisional process. [C1880]

## "Adaptive interleaver based on the measurement of Doppler shift in fading channel [Cvehicle speed measurement]"

An adaptive interleaver based on the measurement of Doppler shift in fading channel is presented in this paper. It is known that the combination of channel coding with interleaver can effectively correct burst errors in fading channel. An interleaver can make channel actions on symbols in one decoder block appear to be independent. In general words, the deeper the interleaver is, the better the effect is, but the longer the delay is. The depth of interleaver is much related with the fading rate, i.e., it is dependent on the correlative time of fading channel. This paper gives out an adaptive interleaver by measuring vehicular speed, i.e. Doppler shift. From measurement of the Doppler shift by calculating variation of different of estimated fading factor, one can compute optimal interleaver depth, and then select appropriate interleaver both in the transmitter and receiver. By using this method, the average delay of interleaver can be decreased effectively. This paper presents this method and computer simulation results [C1881]

## "Turbo equalization of convolutional coded and concatenated space time trellis coded systems using radial basis function aided equalizers"

A reduced-complexity radial basis function (RBF) aided neural-network based turbo equalization (TEQ) scheme is proposed for employment in a serially concatenated convolutional coded and systematic space time trellis coded (CC-SSTTC) arrangement. A two-path Rayleigh fading channel having a normalised Doppler frequency of 3.3615Ч10 -5was used. The BER performance of the RBF-CC-SSTTC(4,4) scheme employing a transmission burst consisting of 100 symbols using a space-time-trellis (STT) interleaver of at least 400 symbols and eight turbo equalization iterations was found to be similar to that of the CC-SSTTC system using a trellis-based TEQ, which attains the optimum performance. However, the Jacobian RBF based TEQ provided a complexity reduction factor of 14 [C1882]

## "Impact of the channel estimation onto the BER-performance of PSAM-OFDM systems in mobile radio channels"

Pilot symbol assisted modulation (PSAM) of the subcarriers of an OFDM system seems to be very attractive for high data rate radio systems. It is used, or will be in the near future, in broadcast systems like DVB-T and DRM. Nevertheless, for highly time- and frequency-dispersive radio channels, the channel estimation based on the interpolation between the pilot symbols in time and frequency is very critical. We derive expressions for the gross BER as a function of channel correlation and interpolation filter in time and frequency. Also adjacent channel interference due to Doppler effects is taken into account. Example results are given for the European DVB-T system, which is also a system candidate for the broadband downlink of a new platform concept to enable asymmetric IP-based mobile multimedia services. This concept is under investigation within the German research project UMT-Splus/COMCAR [C1883]

## "Analysis of the demodulation techniques for OFDM signals under correlated Rayleigh fading"

The complex channel fading process cannot be assumed constant over one OFDM symbol duration when the symbol interval is long enough. In other words, the faded samples within one OFDM symbol are not highly correlated. We propose a novel OFDM demodulation technique by multiplying the received signal with the conjugate of the channel gain at each time instant before performing FFT. The probability density function (PDF) of the multiplicative distortion is expressed as the inverse Laplace transform of its moment generating function (MGF). This allows us to calculate the bit error rate (BER) analytically. Both analytical and simulation results show that the proposed demodulation method gives better performance than the conventional demodulation method when the product of Doppler spread and sample duration (fd Ts) is small [C1884]

## "Frequency stabilization, line narrowing and modulation studies in quantum cascade lasers"

Summary form only given. Some of the applications of stabilized laser sources (mid-IR sub-Doppler

spectroscopy, precision laser ranging) require reduction of the high frequency spectral noise components, resulting in fine narrowing and an increase in the coherence length of the laser. In order to achieve this, considerable servo bandwidth is required. For this reason, the phase transfer function behavior of the laser stabilization system is crucial, time delays and inductive effects being detrimental. In this paper, we report on our latest developments in QC laser stabilization, including some elegant electronics that have alleviated a number of common control theory issues including resonances and variability in the transfer function [C1885]

## "Performance evaluation of CDMA/PRMA techniques for LEO constellations"

A CDMA/PRMA protocol is proposed for application to low Earth orbit (LEO) communication systems. The large carrier frequency shift caused by the high speed movement of satellites (Doppler effects) and the large propagation delay on the up-down link are very critical issues in LEO communications, both affecting the selection and the implementation of a suitable access technique. Extended simulation trials prove that the proposed scheme seems to be a very promising access method for the case of mixed voice/data traffic [C1886]

## "Doppler-induced unidirectional operation of a CW Raman ring laser"

Summary form only given. Lasing was recently achieved on a third-order nonlinear optical transition in gaseous hydrogen. The researchers used a highly stabilized, frequency-doubled Nd:YAG laser to pump the Q(1) vibrational Raman transition in diatomic hydrogen gas, which was substantially enhanced by a doubly-resonant high-finesse Fabry-Perot cavity (HFC). The transition was pumped with diode lasers shortly thereafter, which highlighted the usefulness of this technique for generating broadly tunable, narrow linewidth laser radiation throughout the near infrared. However, these systems utilized exclusively linear Raman laser resonators. By exploiting a Doppler-induced Raman gain anisotropy between the forward and backward directions, we demonstrate what is to our knowledge the first unidirectional Raman ring laser. We are unaware of other ring laser systems that utilize this inherent anisotropy in a predominantly homogeneous gain medium [C1887]

## "On the effect of smart antennas on error statistics and TCP performance"

We present some results on the statistics of the packet error process and on the resulting throughput of TCP when a smart antenna system is used to transmit signals from a base station to wireless users. Multiple users are assumed to be present, and the propagation environment considered includes frequency selective fading. The main results presented involve the tradeoffs between various systems parameters. It is shown that smart antennas have the potential to improve the wireless channel adequately, thereby essentially solving the performance problems which affect TCP. It is also shown that the whole complexity of these scenarios can be essentially summarized by the fading rate (Doppler frequency) and by the average packet error rate, thereby allowing the introduction of the concept of an "equivalent single-antenna system" and the scalability of the many available results for the latter case [C1888]

## "A code-aided adaptive equalizer using soft decision-directed algorithm and convolutional coding for fading channels"

We propose to use a soft decision-directed least mean square algorithm in a code-aided equalizer for fading channels. The soft-output Viterbi algorithm is used in decoding the convolutional code used. The soft output is then fed to the equalizer to adjust the tap coefficients (gains) of the equalizer. Simulation and analysis results are presented for bit error rate performance in a multipath environment for various Doppler rates (normalized Doppler rates equal to 0.001, 0.002 and 0.005, respectively). The proposed equalizer provides significant performance improvement in terms of bit error rate compared to other conventional equalization schemes [C1889]

## "Frequency shifter based on the cross Doppler effect (relativistic frequency shifter)"

We consider microwave frequency shifters based on the cross Doppler effect (CDE). We analyse the process of the change of the frequency of electromagnetic waves, falling on such a receiver, taking account of the quantum mechanical nature of the radiation. A circuit of the experimental installation for the measurement of CDE, which can be realized on the base of quasioptical engineering, is also presented [C1890]

## "Optimal receiver location for emitter tracking"

This paper describes the research work on the selection of a strategy of measurements for a receiving system. The approach is based on the feedback interconnection between two dynamical systems. First, a state estimator where the observation equation is a nonlinear map between the state variables of the target and the receiving system. This mapping depends on some external variables and on the relative position of the sensors with

respect to the target. Second, a controller of the receiving system with the objective of minimizing some functions of the covariance of the state estimation error. A detailed description of this active estimator is presented in the case of a receding horizon observation interval [C1891]

## "Effects of imperfect channel information on adaptive loading gain of OFDM"

The performance of OFDM system in mobile wireless channels can be enhanced by introducing adaptive loading schemes: information bits are distributed unequally in subchannels according to the channel frequency response. Under the assumption of perfect channel estimation, considerable gain can be achieved over the non-adaptive loading scheme for typical channels. If there are channel estimation errors in the system, the adaptive loading gain will be adversely affected in proportion to the MSE of the errors. The effect of channel mismatch due to Doppler spread is also studied. The results show that adaptive loading can preserve most of its gain even with imperfect channel information. [C1892]

## "Space-time-frequency decorrelating decision-feedback multiuser detector over fast-fading multipath channels for synchronous DS-CDMA systems"

RAKE receivers suffer degradation in performance under fast fading due to errors in channel state estimation. The wide-sense stationary uncorrelated scatterer channel model lends itself to time-frequency canonical representation, and provides additional diversity in the frequency axis. Using the joint spatial-multipath-Doppler diversity model based on this canonical representation, we propose a nonlinear space-time-frequency decorrelating decision-feedback multiuser detector for synchronous CDMA which utilizes decisions of the stronger users when forming the decisions for the weaker ones. Simulation results based on realistic fast-fading assumptions demonstrate that the proposed decorrelating decision-feedback multiuser detector promises substantially improved bit-error-rate Performance compared to space-time-frequency decorrelating multiuser detector for the weaker users, while the error probability of the weakest user approaches the single-user bound as the interferers grow stronger. The proposed detector exhibits strong resistance to the near-far effect for all users and the time-complexity-per-bit is linear in the number of users. [C1893]

## "Site independent diversity transmit power control for inter-cell site diversity in W-CDMA forward link"

This paper proposes a new fast transmit power control algorithm for forward link inter-cell site diversity, called site independent diversity transmit power control (hereafter SIDTPC) and compares the effect of decreasing the total transmit signal energy per bit-to-background noise power spectrum density ratio (Eb/N 0) of all cell sites for three methods: SIDTPC, site selection diversity transit power control (SSDT), and conventional TPC during inter-cell site diversity (hereafter CTPC) in the W-CDMA forward link. The SIDTPC method differs from SSDT in that each cell site transmits a dedicated physical channel (DPCH) with different transmit power, which is adaptively weighted according to the path loss between each cell site and a mobile station (MS), that is to say, with larger (smaller) transmit power for the cell having the smaller (larger) path loss, resulting in a decreased total transmit power similar to the SSDT method, while maintaining a superior feature which enables SIDTPC to be less sensitive to the reception errors of the control bits sent via the reverse link. Simulation results demonstrated that when the traffic ratio of voice service to data service is 1:1, the required total average transmit Eb/N0, at the average block error rate (BLER) of 10-2for 50% of MSs using the SIDTPC method is decreased by approximately 0.4 (0.5) dB and 2.0 (0.2) dB compared to those with the CTPC and SSDT methods, respectively, for Doppler frequency, fD, of 5 (80) Hz [C1894]

## "Novel fast fading compensator for OFDM using space diversity with space-domain interpolator"

This paper proposes a novel space diversity assisted OFDM receiver with Doppler spread compensator. A linear array antenna is set up on the vehicle. The proposed compensator estimates the received signal at the point that does not move with respect to the ground during the observation period. Computer simulation results show that the proposed scheme can mitigate the performance degradation due to Doppler spread. [C1895]

## "Performance of an OFDM-SDMA based system in a time-varying multi-path channel"

Significant investigation has been conducted towards combining OFDM which mitigates intersymbol interference and SDMA which improves the bandwidth efficiency. OFDM-SDMA systems need accurate channel estimation, because it is from this information that the separation of co-channel users is performed. Usually, the channel is assumed stationary because the frame duration is chosen smaller than the coherence time. However this choice limits the system efficiency. This paper discusses the performance of an OFDM-SDMA based system under a time-varying multi-path channel. The system under study uses the basic combining algorithm based on the

linear minimum mean square error (MMSE) criterion for user separation and a pilot based scheme independent from channel statistics for channel estimation. We investigate in particular the effect of the pilot subcarrier arrangement on the BER performance and deduce an optimal configuration in a channel with both delay and Doppler spread [C1896]

## "Characteristics of the rotating blade channel for FH/FM communication systems"

Transmitted and received signals from and at rotor-crafts are subject to intermodulations caused by the rotor blades which lead to significant signal distortion. We analyze the channel model underlying the communication systems that involve rotating blades. The systems are operated using slow frequency hopping (FH) with frequency modulation (FM). Of our particular concern is the very high frequency (VHF) band of 30-88 MHz [C1897]

## "Multistage channel estimation with LMS parallel interference cancellation for asynchronous DS-CDMA in frequency-selective Rayleigh channels"

We propose a multistage channel estimation method using LMS parallel interference cancellation with the assistance of periodically transmitted pilot symbols. After obtaining the channel estimates, the performance of various parallel interference methods are evaluated. RAKE reception and maximum ratio combining (MRC) are adopted. Simulation results show that the proposed channel estimation scheme for DS-CDMA system works well in frequency-selective Rayleigh fading channels with Doppler spread when the system load is not too high [C1898]

## "Time evolutionary wideband propagation channel model for user positioning in UMTS"

A new time variant wideband propagation channel model is presented for user location applications in third generation mobile environments. The model considers evolutionary angle of arrival (AOA) and evolutionary time of arrival (TOA), based on the real instantaneous relative user equipment and base station position. The channel model proposed is used also in a link level simulator (LLS) to estimate realistic delay and angle of arrival coherence time, that is, the time in which position and time delay and angle of arrival for the received signal remain almost constant. In order to increase the time integration period and consequently reduce the error in geographical positioning, the maximum coherence time has to be known in the time delay and angle estimating process. The new wideband propagation channel model will provide the delay and angle estimating process with realistic coherence time and Doppler spread. The model also provides spatial correlation matrices for different diversity base station (BS) antenna schemes and compares them with experimental results [C1899]

## "A novel method used for the performance analyzing of channel estimation in time-varying fast fading channel-equivalent channel analysis method"

In a time-varying fast fading channel, due to the influence of amplitude fading and fast phase changing, the performance of QAM system was deteriorated seriously, it is also the main reason that restrains high-dimension modulation from use in fast mobile communications. In order to solve this problem, many estimation methods were presented previously. As is known, the process of channel estimation is practically that of compensation of the channel characteristic. So, in analyzing the performance of various channel estimation methods one also analyzes the equivalent channel after compensation. The characteristics of the equivalent channel after compensation is examined in the course of equivalent channel estimation. This method named the equivalent channel analysis method is introduced. By using this method, the system performance after using channel estimation is only a function of the Doppler shift and correlative coefficient of channel, and depends on the channel estimation method. We only need to calculate the correlative coefficient of two neighbouring symbol, we can obtain the relation formula between the error probability and Doppler shift using channel estimation, so it simplifies the analysis of the system performance [C1900]

## "Delay-Doppler POCS for specular multipath"

A method is presented for resolving delay and Doppler specular multipath components using an extension of a previously developed projection onto convex sets (POCS) algorithm. To improve performance and convergence speed, a matched-filter based support constraint is incorporated into the variance of the residual constraint in the style of constrained least squares. The resulting algorithm performs well in a wide variety of delay and Doppler simulated multipath environments. Simulation results for the POCS algorithm are included along with results for matched filtering and least squares for comparative purposes. [C1901]

## "Space-time-Doppler coding over time-selective fading channels with maximum diversity and

coding gains"

We rely on a basis expansion model (BEM) for the channel, to design three space-time-Doppler (STD) codecs that enable maximum diversity gains, when block transmissions undergo time-selective fading effects. Within the constraints of each maximum-diversity design, it is also possible to achieve maximum coding gain, at least when the BEM parameters are i.i.d. The theoretical results are corroborated by simulation results and the BEM is validated. [C1902]

"Optimal blind carrier synchronization for M-PSK burst transmissions"

This paper introduces a family of blind feedforward nonlinear estimators for joint estimation of carrier phase, frequency offset and Doppler rate for burst-mode phase shift keying (PSK) transmissions. An optimal or "matched" nonlinear estimator that exhibits the smallest asymptotic variance within the family of envisaged estimators is developed. The asymptotic performance of these estimators is established in closed-form expression and compared with the Cramer-Rao lower bound for an unmodulated carrier. Finally, computer simulations are presented to corroborate the theoretical performance analysis. [C1903]

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