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ТЕМАТИЧЕСКИЙ РЕФЕРАТИВНЫЙ СБОРНИК № 29-1

“Photonics Device Design Principles”
(«Принципы проектирования приборов фотоники»)

Журнальные публикации

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"Urban design, urban simulation, and the need for computational tools"

In this paper, we discuss the need for increased research into the development of sophisticated but easy-to-use simulation and analysis tools that can be used by urban designers to guide the development of urban design projects. We also present the current status of a research project under development by computational designers at Skidmore, Owings, and Merrill Limited Liability Partnership, an architecture and urban design firm, to address this need within the profession. The practice of urban design has historically incorporated relatively little performance-based mathematical rigor within the processes of designing cities. Instead, there are a number of codified and uncodified design theories, principles, and assumptions that are adopted or proposed by talented senior designers according to intuitions developed after encountering numerous examples of successful and unsuccessful urban design strategies. With the development of a reliable set of simulation and analysis tools, many of these urban design theories, principles, and assumptions could be evaluated for effectiveness with much greater certainty than is currently possible, bringing a higher level of rational and rigor to the practice of urban design. [J1]

"Theoretical study of carbon-nanotube-based gas pressure sensors"

We investigate microwave absorption properties of carbon nanotubes under different gas pressures, using a combination of fluid and perturbation theories. We demonstrate that microwave absorption of the system shifts toward high frequency with increasing gas pressure. A linear relationship between resonant frequency shift and gas pressure is also found. The model is useful for designing carbon nanotubes based gas pressure sensors. The change in microwave absorption of the carbon nanotubes due to exposure of different gas pressures is utilized as the principle of this gas sensor. The presented model has also great potential for different types of nanomaterials applications. [J2]

"A Simple Wide-Range Noise Thermometer With DC SQUID Readout for Operation Down to 10 mK"

The design and performance of a compact and easy-to-build thermometer for the temperature range of 10 mK-4.2 K, which is wide enough to cover the entire temperature range of a typical dilution refrigerator, are described here. A commercial low-T_{c}dc superconducting quantum interference device (SQUID) is used to measure the thermal current noise of a resistor, i.e., an insulated copper wire, that scales linearly with the temperature, as expected from the Nyquist formula. Although, in principle, this thermometer is a primary thermometer, its performance was evaluated as a secondary thermometer. The relative precision of the temperature, which is independent of the temperature, was estimated at 0.4% in a measuring time of 130 s, in good agreement with the expectations. The accuracy evaluated from the comparison with other calibrated thermometers (i.e., superconducting reference point (SRP), cerium magnesium nitrate, and germanium) on different temperature ranges is better than 2% between 10 mK and 4.2 K. If only the SRP thermometer is considered for the comparison in the temperature range of 20-207 mK, the accuracy improves to 1%. The calibrations performed with a single fixed point have a typical accuracy value of about 1%. [J3]

"Limiting performance analysis of cascaded interband/intersubband thermophotovoltaic devices"

This work addresses the question of how much electrical power can in principle be extracted from heat radiation via the combined use of interband and intersubband photodetection as a way to overcome the fundamental limitations of existing thermophotovoltaic devices using mature InP-based technology. Very efficient coverage of the incident radiation spectrum and optimal current matching can be achieved using multiple quantum-cascade structures monolithically integrated with a p-njunction by taking advantage of their intrinsic cascading scheme, spectral agility, and design flexibility. Numerical simulations indicate that this approach can effectively double the present state-of-the-art in thermophotovoltaic output electrical power. [J4]

"Application-based NGN QoE controller"

In this article, a specification and testbed implementation results of an application-based QoE controller are presented, proposing a solution for objective and context-aware end-to-end QoE control in the NGN networks. The proposed solution bases on standardized NGN service enabler operation principles that allows for efficient in-service QoE estimation and optimization. QoE control is accomplished through context-based QoE modeling, the principal role of which is to provide a detailed description of the circumstances, under which the communication is established and by which the end-user's QoE is affected. Implementation results and findings confirm feasibility and efficient design of the QoE controller proposal as well as full compliance with the requirements for its deployment into real-world NGN environments. [J5]

"In Search of Perceptually Salient Groupings"

Finding meaningful groupings of image primitives has been a long-standing problem in computer vision. This paper studies how salient groupings can be produced using established theories in the field of visual perception alone. The major contribution is a novel definition of the Gestalt principle of Prдgnanz, based upon Koffka's definition that image descriptions should be both stable and simple. Our method is global in the sense that it operates over all primitives in an image at once. It works regardless of the type of image primitives and is generally independent of image properties such as intensity, color, and texture. A novel experiment is designed to quantitatively evaluate the groupings outputs by our method, which takes human disagreement into account and is generic to outputs of any grouper. We also demonstrate the value of our method in an image segmentation application and quantitatively show that segmentations deliver promising results when benchmarked using the Berkeley Segmentation Dataset (BSDS). [J6]

"Efficient Parallel Computation of Molecular Potential Energy Surfaces for the Study of Light-Induced Transition Dynamics in Multiple Coordinates"

The conformational dynamics of molecules that arise due to light-induced transitions are critically important in many biochemical reactions, and therefore dictate the functionality of many types of biological sensors. Therefore, researchers of biological science and biological-inspired technology often need to prescribe the molecular geometry of the stable states and the associated transition trajectories that occur as a result of external excitation, e.g., light-induced transitions from the ground state to the excited states. The traditional approach to study this type of phenomenology is to limit the number of varying molecular coordinates to one or a few due to the considerable computational expense of the required physically modeling required for generating an accurate physical model for analysis. While the conformational dynamics for some types of simple molecules (e.g., retinal) are known to be adequately described by one or few numbers of molecular coordinates, light-induced transitions in arbitrarily complex molecules can be expected to involve the influence of multiple coordinates, and their influence can be expected to vary as a function of time. The research reported here will address the development of parallel computational algorithms that allow for the highly efficient study of molecular conformational dynamics over multiple numbers of multidimensional energy surfaces. Here, the goal is the development of a simulation tool that is capable of: constructing physically accurate multidimensional potential energy surfaces (i.e., from first-principle physical modeling codes); deriving the natural trajectories to local minima within individual surfaces; and that allows for dynamics human interfacing for specifying the transition between energy surfaces and the number of coordinates to be used for the optimization within a particular energy surface. As will be illustrated, this type of physics-based simulation tool will allow researchers to efficiently explore--the light-induced conformation dynamics associated with complex biomolecules, and therefore, be a useful tool for the design of biological-sensing processes in the future. [J7]

"The transport properties of D- sigma -A molecules: A strikingly opposite directional rectification"

We design the A-R rectifier based on the D-sigma -Amolecules to examine the rectifying performances by the first-principles method. The calculated results show that the electronic structures for all of our systems perfectly match the A-R rectifier, as expected, but their rectifying direction is very strikingly opposite and working mechanism is completely different. This behavior can be rationalized through an asymmetrical shift of molecular levels under bias of different polarities, which is because of always-existing intrinsic asymmetrical coupling effects of molecular levels to electrodes. Detailed analysis demonstrates that the rectifying direction induced by this mechanism is always in opposition to that induced by the A-R mechanism. [J8]

"Relational Attribute Integrated Matching Analysis (RAIMA): A Framework for the Design of Self-Adaptive Egocentric Social Networks"

An emerging research in pervasive computing is the inference of social context to facilitate and mediate communications among proximate people. Understanding users' needs through information reasoning and

leveraging principles of social networks play an important role in the emergence of innovative computer-mediated social networks. This paper introduces a generic social networking framework for the analysis and visualization of mobile and spontaneous social networks. The proposed framework is capable of analyzing social scores in order to provide decision support to users in the form of egocentric social graphs. As part of the framework, we introduce a matching algorithm that its efficiency is compared to commonly used "Stable Marriage Matching" algorithms in opportunistic social networks. We show the performance of the algorithm as social profile attributes increase in a network. [J9]

"Tailoring magnetic properties in Mn4 molecules: A way to develop single-molecule magnets"

Distorted cubane Mn4+Mn3+3single-molecule magnets (SMMs) having the general chemical formula [Mn4+Mn3+3(mu 3-L2-)3(mu 3-X-)(OAc)-3(dbm)-3] (L = O; X = various; dbmH = dibenzoyl-methane), have been studied using first-principles calculations. It was shown in our previous paper that the ferrimagnetic structure of Mn4+Mn3+3SMMs is dominated by the pi type hybridization between the dz2orbitals at the three high-spin Mn3+ions and the t2gorbitals at the Mn4+ion. This result allows us to predict that the ferrimagnetic structure of Mn4+Mn3+3molecules will be the most stable with the Mn4+-(mu 3-L2-)-Mn3+angle alpha ≈ 90°, while synthesized Mn4+Mn3+3molecules have alpha ≈ 95°. To design new Mn4+Mn3+3molecules having a much more stable ferrimagnetic state, one following approach is suggested: Controlling the Mn4+-(mu 3-L2-)-Mn3+exchange pathways by rational variations in ligands to strengthen the hybridization between Mn ions. By employed N-based ligands to form the Mn4+-(mu 3-L2-)-Mn3+exchange pathways, new distorted cubane Mn4+Mn3+3molecules with alpha ≈ 90° have been designed. These molecules have the Mn4+-Mn3+exchange coupling of about 2.5 times stronger than that of the synthesized Mn4+Mn3+3molecules. These results should facilitate--the rational synthesis of new SMMs. [J10]

"Influence of surface energy on the stiffness of nanosprings"

When the cross-sectional size of structural elements reduces to nanometers, surface effects become quite important in their mechanical behaviors. In this letter, a theoretical model is proposed to account for surface effects through both surface energy and core-shell model. Through the principle of minimum potential energy, a refined analytical solution is derived for the stiffness of nanosprings. It is shown that surface energy evidently affects the stiffness of nanosprings. The present model provides an efficient tool to analyze the mechanical performance of various nanosized helixes and is also helpful to design nanospring-based devices. [J11]

"Size effects on formation energies and electronic structures of oxygen and zinc vacancies in ZnO nanowires: A first-principles study"

We investigated the energetic, structural, and electronic properties of neutral O and Zn vacancies in ZnO nanowires with different sizes based on the first-principles calculations using density functional theory. We found that for ZnO nanowire with an O vacancy on the surface the formation energy is not sensitive to the size change. The presence of the surface O vacancy results in the formation of the metal-metal bonds. From the band structure analysis, we predicted that the optical property relating to the O vacancy can be strongly altered with decreasing the nanowire diameter. Moreover, there is a large structural deformation on the surface in the presence of Zn vacancy. The formation of a Zn vacancy in the ZnO nanowire with diameter of 16.4 E is more favorable than in those with smaller diameters. Furthermore, the O vacancy is nonmagnetic, whereas the Zn vacancy is spin-polarized with a magnetic moment of 2.0 mu Bon the surface. Our results are helpful for understanding these defects in ZnO nanowires and thus useful for nanodevice design. [J12]

"Principles and promise of Fabry-Perot resonators at terahertz frequencies"

Fabry-Perot resonators have tremendous potential to enhance the sensitivity of spectroscopic systems at terahertz (THz) frequencies. Increasing sensitivity will be of benefit in compensating for the relatively low power of current high resolution continuous wave THz radiation techniques, and to fully express the potential of THz spectroscopy as source power increases. Improved sensitivities, and thus scanning speeds, will allow detailed studies of the complex vibration-rotation-tunneling dynamics that large molecules show at THz wavelengths, and will be especially important in studying more elusive, transient species such as those present in planetary atmospheres and the interstellar medium. Coupling radiation into the cavity presents unique challenges at THz frequencies, however, meaning that the cavity configurations common in neighboring frequency domains cannot simply be translated. Instead, novel constructions are needed. Here we present a resonator design in which wire-grid polarizers serve as the input and output coupling mirrors. Using this configuration, Q-factors of a few times 105are achieved near 0.3 THz. To aid future investigations, the parameter space that limits the quality of the cavity is explored and paths to improved performance highlighted. Lastly, the performance of polarizer cavity-based Fourier transform (FT) THz spectrometers is discussed, in particular those design optimizations that

should allow for the construction of THz instrumentation that rivals and eventually surpasses the sensitivities achieved with modern FT-microwave cavity spectrometers. [J13]

"An improved single crystal adsorption calorimeter for determining gas adsorption and reaction energies on complex model catalysts"

A new ultrahigh vacuum microcalorimeter for measuring heats of adsorption and adsorption-induced surface reactions on complex single crystal-based model surfaces is described. It has been specifically designed to study the interaction of gaseous molecules with well-defined model catalysts consisting of metal nanoparticles supported on single crystal surfaces or epitaxial thin oxide films grown on single crystals. The detection principle is based on the previously described measurement of the temperature rise upon adsorption of gaseous molecules by use of a pyroelectric polymer ribbon, which is brought into mechanical/thermal contact with the back side of the thin single crystal. The instrument includes (i) a preparation chamber providing the required equipment to prepare supported model catalysts involving well-defined nanoparticles on clean single crystal surfaces and to characterize them using surface analysis techniques and in situ reflectivity measurements and (ii) the adsorption/reaction chamber containing a molecular beam, a pyroelectric heat detector, and calibration tools for determining the absolute reactant fluxes and adsorption heats. The molecular beam is produced by a differentially pumped source based on a multichannel array capable of providing variable fluxes of both high and low vapor pressure gaseous molecules in the range of 0.005-1.5 Ч 1015molecules cm-2 s-1and is modulated by means of the computer-controlled chopper with the shortest pulse length of 150 ms. The calorimetric measurements of adsorption and reaction heats can be performed in a broad temperature range from 100 to 300 K. A novel vibrational isolation method for the pyroelectric detector is introduced for the reduction of acoustic noise. The detector shows a pulse-to-pulse standard deviation ≤15 nJ when heat pulses in the range of 190-3600 nJ are applied to the sample surface with a chopped laser. Particu--larly for CO adsorption on Pt(111), the energy input of 15 nJ (or 120 nJ cm-2) corresponds to the detection limit for adsorption of less than 1.5 Ч 1012CO molecules cm-2or less than 0.1% of the monolayer coverage (with respect to the 1.5 Ч 1015surface Pt atoms cm-2). The absolute accuracy in energy is within 7%-9%. As a test of the new calorimeter, the adsorption heats of CO on Pt(111) at different temperatures were measured and compared to previously obtained calorimetric data at 300 K. [J14]

"Experimental facility for two- and three-dimensional ultrafast electron beam x-ray computed tomography"

An experimental facility is described, which has been designed to perform ultrafast two-dimensional (2D) and three-dimensional (3D) electron beam computed tomographies. As a novelty, a specially designed transparent target enables tomography with no axial offset for 2D imaging and high axial resolution 3D imaging employing the cone-beam tomography principles. The imaging speed is 10 000 frames per second for planar scanning and more than 1000 frames per second for 3D imaging. The facility serves a broad spectrum of potential applications; primarily, the study of multiphase flows, but also in principle nondestructive testing or small animal imaging. In order to demonstrate the aptitude for these applications, static phantom experiments at a frame rate of 2000 frames per second were performed. Resulting spatial resolution was found to be 1.2 mm and better for a reduced temporal resolution. [J15]

"Metamagnetic phase transformation in Mn 50 Ni 37 In 10 Co 3 polycrystalline alloy"

This letter reports on an alloy design of Mn50Ni37In10Co3based on the principle of Mn-Mn ferromagnetic coupling via Co doping. The alloy is shown to exhibit a metamagnetic martensitic transformation and a high saturation magnetization of 118 emu/g in its austenitic state. The transformation generates a large magnetization difference of 89 emu/g, more than 200% of what is reported in the literature for similar alloys. A complete magnetic field induced martensitic transformation was achieved at 170 K. Such a high magnetization difference provides a strong driving force for magnetic-field-induced transformation, making this material a promising candidate for magnetic actuation applications. [J16]

"Pseudo-Hermitian Hamiltonian Formalism of Electromagnetic Wave Propagation in a Dielectric Medium-Application to the Nonorthogonal Coupled-Mode Theory"

We develop a generalized formalism for describing the propagation of an electromagnetic wave along the z-direction of a dielectric medium. The derivation is achieved by casting the 2-D transverse part of the Maxwell equations in a Schrodinger-like form whose Hamiltonian is identified to be pseudo-Hermitian. The developed formalism is combined with the variational principle to derive a set of nonorthogonal coupled-mode theory which is slightly different from that derived using the same variational principle but with the 3-D Maxwell equations. By showing that the 3-D variational approach suffers from a mode-expansion incompatibility issue that is absent in

our 2-D case, we conclude that our nonorthogonal coupled-mode theory is more rigorous. Owing to the complexity of the second-order error of the propagation constant as revealed by further analysis, it is found that our nonorthogonal coupled-mode theory may not necessarily be more accurate in practice. The developed pseudo-Hermitian formalism may provide a good framework for the analysis and design of various integrated optical devices. [J17]

"A novel target-type low pressure drop bidirectional optoelectronic air flow sensor for infant artificial ventilation: Measurement principle and static calibration"

An optoelectronic target-type volumetric air flow-rate transducer for bidirectional measurements is presented. The sensor is composed of a T-shaped target and two nominally identical LED-photodiode couples which are operated in differential mode. The sensitive surfaces of the photodiodes are differentially shadowed by the deflection of the target, which in turn depends on the gas flow-rate. The principle of operation is described in mathematical terms and the design parameters have been optimized in order to obtain the highest sensitivity along with minimal pressure drop and reduced dimensions. The sensor is placed in a 20 mm diameter hose and was tested with air flow-rate in the typical temperature range of mechanical ventilation between 20 and 40 °C. The theoretical model was validated through experiments carried out in the volumetric flow range from -7.0 to +7.0 l min-1. The nonlinear behavior allows sensitivities equal to 0.6 V l-1min for flow rates ranging from -2.0 to +2.0 l min-1, equal to 2.0 V l-1min for flow rates ranging from -3.0 to -2.0 l min-1and from +2.0 to +3.0 l min-1, up to 5.7 V l-1min at higher flow rates ranging from -7.0 to -3.0 l min-1and from +3.0 to +7.0 l min-1. The linear range extends from 3.0 to 7.0 l min-1with constant sensitivity equal to 5.7 V l-1min. The sensor is able to detect a flow-rate equal to 1.0 l min-1with a sensitivity of about 400 mV l-1min. The differential nature of the output minimizes the influence of the LEDs' power supply variations and allows to obtain a repeatability in the order of 3% of full scale output. The small pressure drop produced by the sensor placed in-line the fluid stream, of about 2.4 Pa at 7 l min-1, corresponds to a negligible fluid dynamic resistance lower than 0.34 Pa l-1min. [J18]

"Nanoradian angular stabilization of x-ray optical components"

An x-ray free-electron laser oscillator (XFELO) has been recently proposed [K. Kim etal, Phys. Rev. Lett. 100, 244802 (2008)]. Angular orientation and position in space of Bragg mirrors of the XFELO optical cavity must be continuously adjusted to compensate for the instabilities and maximize the output intensity. An angular stability of about 10 nrad (rms) is required [K. Kim and Y. Shvyd'ko, Phys. Rev. ST Accel. Beams 12, 030703 (2009)]. To approach this goal, a feedback loop based on a null-detection principle was designed and used for stabilization of a high-energy-resolution x-ray monochromator (Delta E/E 4Ч10-8, E=23.7keV) and a high-heat-load monochromator. Angular stability of about 13 nrad (rms) has been demonstrated for x-ray optical elements of the monochromators. [J19]

"Natural constructal emergence of vascular design with turbulent flow"

Here, we show that vascular design emerges naturally when a volume is bathed by a single stream in turbulent flow. The stream enters the volume, spreads itself to bathe the volume, and then reconstitutes itself as a single stream before it exits the volume. We show that in the pursuit of a smaller global flow resistance and larger volumes, the flow architecture changes stepwise from a stack of identical elements bathed in parallel flow (like a deck of cards) to progressively more complex structures configured as trees matched canopy to canopy. The transition from one architecture to the next occurs at a precise volume size, which is identified. Each transition marks a decrease in the rate at which the global flow resistance increases with the volume size. This decrease accelerates as the volume size increases. The emergence of such vasculatures for turbulent flow is compared with the corresponding phenomenon when the flow is laminar. To predict this design generation phenomenon is essential to being able to scale up the designs of complex flow structures, from small scale models to life size models. The constructal law is a bridge between the principles of physics and biology. [J20]

"Integration of complementary circuits and two-dimensional electron gas in a Si/SiGe heterostructure"

We have realized complementary devices on an undoped Si/SiGe substrate where both two-dimensional electrons and holes can be induced capacitively. The design of the heterostructure and the fabrication process are reported. Magnetotransport measurements show that the induced two-dimensional electron gas exhibits the quantum Hall effect characteristics. A p-channel field-effect transistor is characterized and the operation of an inverter is demonstrated. The proof-of-principle experiment shows the feasibility of integrating complementary logic circuits with quantum devices. [J21]

"Immersive Multiplayer Games With Tangible and Physical Interaction"

In this paper, we present a new immersive multiplayer game system developed for two different environments, namely, virtual reality (VR) and augmented reality (AR). To evaluate our system, we developed three game applications-a first-person-shooter game (for VR and AR environments, respectively) and a sword game (for the AR environment). Our immersive system provides an intuitive way for users to interact with the VR or AR world by physically moving around the real world and aiming freely with tangible objects. This encourages physical interaction between players as they compete or collaborate with other players. Evaluation of our system consists of users' subjective opinions and their objective performances. Our design principles and evaluation results can be applied to similar immersive game applications based on AR/VR. [J22]

"Three-electrode self-actuating self-sensing quartz cantilever: Design, analysis, and experimental verification"

We present a novel quartz cantilever for frequency-modulation atomic force microscopy (FM-AFM) which has three electrodes: an actuating electrode, a sensing electrode, and a ground electrode. By applying an ac signal on the actuating electrode, the cantilever is set to vibrate. If the frequency of actuation voltage closely matches one of the characteristic frequencies of the cantilever, a sharp resonance should be observed. The vibration of the cantilever in turn generates a current on the sensing electrode. The arrangement of the electrodes is such that the cross-talk capacitance between the actuating electrode and the sensing electrode is less than 10-16F, thus the direct coupling is negligible. To verify the principle, a number of samples were made. Direct measurements with a Nanosurf easyPPL controller and detector showed that for each cantilever, one or more vibrational modes can be excited and detected. Using classical theory of elasticity, it is shown that such novel cantilevers with proper dimensions can provide optimized performance and sensitivity in FM-AFM with very simple electronics. [J23]

"Transformation Electromagnetics: An Overview of the Theory and Applications"

The recently introduced transformation-electromagnetics techniques provide a new methodology for designing devices that possess novel wave-material interaction properties. They are based on the form invariance of Maxwell's equations under coordinate transformations. These methods provide an extremely versatile set of design tools that employ spatial-coordinate transformations, where the compression and dilation of space in different coordinate directions are interpreted as appropriate scalings of the material parameters. The most famous transformation-optics device is the cloak of invisibility. However, a wide variety of other devices are also possible, such as field concentrators, polarization rotators, beam splitters, beam collimators, and flat lenses. In this paper, an overview of transformation-electromagnetics device design techniques is presented. The paper begins by introducing the underlying design principle behind transformation electromagnetics. Several novel transformation-based device designs are then summarized, starting with electromagnetic cloaks that have spherical shell or cylindrical annular shapes, More general cloaking designs of noncircular annular geometries are treated, and the application of cloaking to RF/microwave antenna shielding is also discussed. Following this, device designs that employ transformations that have discontinuities .on the domain boundary are presented. Unlike those used for cloaks, this type of transformation is capable of modifying the fields outside of the device. Examples of this type of transformation-electromagnetics device are presented, which include flat near-field and far-field focusing lenses, wave collimators for embedded sources (e.g., antennas), polarization splitters and rotators, and right-angle beam benders. [J24]

"GPS Landing System Reference Antenna"

The GPS landing system (GLS) is a reality today, and will undoubtedly become the workhorse system in the future. GPS aircraft navigation is currently utilized for aircraft en-route, terminal, and initial-approach navigation. It is expected that in 2009, a Category I GPS landing system will start its initial phase of a worldwide deployment. The ARL-1900 antenna was designed specifically to satisfy the stringent requirements for the Category I, II, and III GPS landing system reference-receiver stations. A difficult problem for a Category I, II, and III GPS landing systems is the mitigation of ground-reflected multipath effects. The antenna must provide coverage of the upper hemisphere while suppressing ground-reflected multipath. In addition, the antenna must operate at the L1, L2, and L5 GPS frequencies, have right-hand circular polarization, and ideally have constant carrier and code (group) delay throughout the coverage region. Over a period of 15 years, BAE Systems has developed the ARL-1900 antenna, a unique antenna with near-ideal performance that satisfies the stringent requirements for a Category I, II, and III GPS landing systems. This paper reviews the requirements for a GPS landing system reference antenna, presents the design principles for the ARL-1900 antenna, describes its implementation, and presents performance data. [J25]

"Evolutionary Cross-Domain Discriminative Hessian Eigenmaps"

Is it possible to train a learning model to separate tigers from elks when we have 1) labeled samples of leopard and zebra and 2) unlabelled samples of tiger and elk at hand? Cross-domain learning algorithms can be used to solve the above problem. However, existing cross-domain algorithms cannot be applied for dimension reduction, which plays a key role in computer vision tasks, e.g., face recognition and web image annotation. This paper envisions the cross-domain discriminative dimension reduction to provide an effective solution for cross-domain dimension reduction. In particular, we propose the cross-domain discriminative Hessian Eigenmaps or CDHE for short. CDHE connects training and test samples by minimizing the quadratic distance between the distribution of the training set and that of the test set. Therefore, a common subspace for data representation can be well preserved. Furthermore, we basically expect the discriminative information used to separate leopards and zebra can be shared to separate tigers and elks, and thus we have a chance to duly address the above question. Margin maximization principle is adopted in CDHE so the discriminative information for separating different classes (e.g., leopard and zebra here) can be well preserved. Finally, CDHE encodes the local geometry of each training class (e.g., leopard and zebra here) in the local tangent space which is locally isometric to the data manifold and thus CDHE preserves the intraclass local geometry. The objective function of CDHE is not convex, so the gradient descent strategy can only find a local optimal solution. In this paper, we carefully design an evolutionary search strategy to find a better solution of CDHE. Experimental evidence on both synthetic and real word image datasets demonstrates the effectiveness of CDHE for cross-domain web image annotation and face recognition. [J26]

"Measuring D(d,p)T fusion reactant energy spectra with Doppler shifted fusion products"

Deuterium fusion reactant energy spectra have been measured using a diagnostic that records the Doppler shift imparted to charged particle fusion products of the D(d,p)T reaction by the center-of-mass velocity of the deuterium reactants. This diagnostic, known as the fusion ion Doppler shift diagnostic (FIDO) measures fast deuterium energy spectra in the inertial electrostatic confinement (IEC) experiment at the University of Wisconsin-Madison {Santarius etal [Fusion Sci. Technol. 47, 1238 (2005)]}, a device to confine high energy light ions in a spherically symmetric, electrostatic potential well. This article details the first measurements of the fusion reactant energy spectra in an IEC device as well as the design and principles of operation of the FIDO diagnostic. Scaling of reactant energy spectra with a variety of experimental parameters have been explored. [J27]

"Hollow Cathode Effect in Cold Cathode Fluorescent Lamps: A Review"

Various efforts within the cold cathode fluorescent lamp (CCFL) industry are underway to decrease costs and increase electrode performance. In order to understand the impact that the choice of gas mixtures and pressures, cathode shape and material might have on the lamp's operation requires a knowledge of the underlying principles governing the glow discharge. We present a review of the literature on the hollow cathode effect and glow discharges, which has particular relevance to the design of CCFL lamp electrodes used in liquid crystal displays. We show that industry-wide standard gas pressures and electrode designs cannot operate in the hollow cathode regime. [J28]

"Quantum-dot-array diffraction grating with single order diffraction property for soft x-ray region"

A gold transmission grating is used routinely to disperse the x-ray spectrum at the Z soft x-ray facility to measure the spectrum and temporal history of the absolute soft x-ray power emitted from z-pinch and hohlraum radiation sources. A quantum-dot-array diffraction grating (QDADG) of 250 lines/mm for soft x-ray is designed and fabricated for the first time according to the principle of binary sinusoidal transmission grating. The diffraction efficiencies of the grating are measured in the 150-300 eV photon energy range on the Beamline 3W1B of Beijing Synchrotron Radiation Facility. This article describes the basic concept and calibration techniques and presents calibration results. It is shown that the 250 lines/mm QDADG can be used to disperse light without higher-order diffractions in soft x-ray range, and the diffraction efficiencies of this grating are nearly constant (about 25%), which is beneficial in the spectrum analysis. [J29]

"An electrostatic autoresonant ion trap mass spectrometer"

A new method for ion extraction from an anharmonic electrostatic trap is introduced. Anharmonicity is a common feature of electrostatic traps which can be used for small scale spatial confinement of ions, and this feature is also necessary for autoresonant ion extraction. With the aid of ion trajectory simulations, novel autoresonant trap mass spectrometers (ART-MSs) have been designed based on these very simple principles. A mass resolution 60is demonstrated for the prototypes discussed here. We report also on the pressure dependencies, and the (mV) rf field strength dependencies of the ART-MS sensitivity. Importantly the new MS designs do not require heavy magnets, tight manufacturing tolerances, introduction of buffer gases, high power rf sources, nor

complicated electronics. The designs described here are very inexpensive to implement relative to other instruments, and can be easily miniaturized. Possible applications are discussed. [J30]

"Note: A combined aerodynamic lens/ambient pressure x-ray photoelectron spectroscopy experiment for the on-stream investigation of aerosol surfaces"

We discuss a new approach for the measurement of the surfaces of free aerosol particles with diameters from 50 to 1000 nm. Particles in this size range have significant influence on the heterogeneous chemistry in the atmosphere and affect human health. Interfacing an aerodynamic lens to an ambient pressure x-ray photoelectron spectrometer permits measurement of the surface chemical composition of unsupported aerosol particles in real time. We discuss the basic considerations for the design of such an instrument, its current limitations and potentials for improvement. Results from a proof-of-principle experiment on silicon oxide particles with average diameters of 270 nm are shown. [J31]

"Bulk acoustic wave filters synthesis and optimization for multi-standard communication terminals"

This article presents a design methodology for bulk acoustic wave (BAW) filters. First, an overview of BAW physical principles, BAW filter synthesis, and the modified Butterworth-van Dyke model are addressed. Next, design and optimization methodology is presented and applied to a mixed ladder-lattice BAW bandpass filter for the Universal Mobile Telecommunications System (UMTS) TX-band at 1.95 GHz and to ladder and lattice BAW bandpass filters for the DCS1800 TX-band at 1.75 GHz. In each case, BAW filters are based on AlN resonators. UMTS filter is designed with conventional molybdenum electrodes whereas DCS filters electrodes are made with innovative iridium. [J32]

"Three-Dimensional Pareto-Optimal Design of Inductive Superconducting Fault Current Limiters"

The inductive-type superconducting fault current limiters (LSFCLs) mainly consist of a primary copper coil, a secondary complete or partial superconductor cylinder, and a closed or open magnetic iron core. Satisfactory performance of such device significantly depends on optimal selection of its employed materials and construction dimensions, as well as its electrical, thermal, and magnetic parameters. Therefore, it is very important to identify a comprehensive model describing the LSFCL behavior in a power system prior to its fabrication. When a fault occurs, the dynamic model should essentially characterize the overall phenomena to compare the simulation results by varying LSFCL parameters to maximize the merits of a fault current limiter while minimizing its drawbacks during the normal state. The principle object of this paper is to achieve a feasible and full penetrative approach in 3-D alignments, i.e., a Pareto-optimal design of LSFCLs by means of multicriteria decision-making techniques after defining the LSFCL model in a power system CAD/electromagnetic transients including dc environment. [J33]

"Design of transparent cloaks with arbitrarily inner and outer boundaries"

In this paper, the efficient transformation optics method has been utilized to design and analyze two-dimensional (2D) transparent cloaks, structures that can physically protect the devices inside but do not affect their electrical performances at all. The general and explicit expressions for the material parameters of the transformed space are derived. 2D transparent cloaks with arbitrarily conformal and nonconformal inner and outer boundaries and those working in gradually changing background and layered media are designed. Full-wave simulations combined with the Huygens' principle are applied to validate the transparency of the cloaks. The simulation results under different circumstances demonstrate that the proposed method is correct and efficient. The work introduced here makes important progress in the theoretical design of the transparent cloak and expands the application of the transformation optics method. [J34]

"Compound Phase-Shifted Fiber Bragg Structures as Intrinsic Magnetic Field Sensors"

We report on the simulation and characterisation of compound phase-shifted fiber Bragg structures for use as novel in-fiber magneto-optical point sensors. Through simulation we show that the Faraday rotation spectra of phase-shifted gratings can be tailored by tuning the ratio of substructure lengths. A design process for tailoring the magneto-optical spectrum is illustrated, and it is shown that a general optimum structure exists for producing a region of total reflection incorporating magneto-optical Faraday rotation that is enhanced both in strength and spectral width. A practical optical fiber system that exploits the proposed distributed feedback (DFB) structures to enable novel all-fiber sensors for the dual measurement of magnetic field strength and temperature is described in detail, and the sensor response is simulated. The study is supported by laboratory fabrication of the proposed fiber DFB structures which demonstrates the principle of enhancement in terms of tailored group delay spectra and highlights practical issues for sensor packaging. [J35]

"Understanding Online Interruption-Based Advertising: Impacts of Exposure Timing, Advertising Intent, and Brand Image"

Interruption-based advertising has gained prominence in the online channel. Yet, little attention has been paid to deriving design principles and conceptualizations for online interruption-based advertising. This paper examines three novel design factors related to this phenomenon, namely, exposure timing, advertising intent, and brand image. Exposure timing pertains to the time by which the advertisement (ad) is launched within a website. Advertising intent refers to the explicitness of ad content in portraying the desire to induce purchase behavior. Brand image relates to consumers' overall perceptions of the advertised brand. In a laboratory experiment, participants were exposed to pop-up ads that were operationalized based on these three design considerations. Results reveal three two-way interactions among the study constructs. Online interruption-based ads shown in the predecisional shopping phase are more effective when their contents are designed with implicit advertising intent compared to explicit intent. Brand image is found to moderate the effects of advertising intent on consumer's purchase intention. Participants' responses also show that ads promoting weak brands with less favorable image tend to enjoy higher purchase intention when shown in the predecisional phase compared with the postdecisional phase. Theoretical and practical implications together with suggestions for future research are discussed. [J36]

"IMT-advanced relay standards [JWiMAX/LTE Update]"

There are two candidates for IMT-Advanced (4G) standards, LTE-Advanced by 3GPP and 802.16m by IEEE. This article focuses on relay architectures in 16m and LTE-A, and discusses design principles and trade-offs leading to decisions in each standards group. Basically, 16m relay and LTE-A Release 10 relay are very similar technologies where the relay is essentially an orthogonal frequency-division multiple access base station with a wireless backhaul link. However, some open issues, such as mobility, power saving, multihop architecture, transparent relaying, multi-arrier transmission, and cooperative transmission, are still left as challenges for engineers and researchers. This article provides insights to both relay standards that could be helpful for readers to fully comprehend practical ways of incorporating relays into 4G wireless broadband networks. [J37]

"An approach to modeling and control of QoE in next generation networks [JNext Generation Telco IT Architectures]"

In this article an approach to QoE modeling and QoE assurance is presented. Employing objective end-to-end QoE modeling, a QoE estimation algorithm is proposed and applied to a service enabler of an NGN SDE to provide a QoE assurance service. The proposed QoE model is context-aware and comprises a comprehensive set of quality-related parameters available throughout various information factories of the NGN, accessible by employing standardized procedures within the NGN SDE. Design principles, methodology, as well as simulation results and comparative analyses are given. A QoE assurance service solution is presented as a use case proposal that operates as a proactive in-service QoE controller, followed by results of a real-world laboratory implementation. [J38]

"Voltage Surge Protection Circuit for Superconducting Bias Coil"

In some circumstances, a superconducting dc magnetizing coil with a magnetic core may be subject to a large induced voltage surge due to coupling with other coils or a sudden break/close of its circuit. For instance, the superconducting bias coil in a saturated iron-core type fault current limiter may experience a huge induced voltage when a short-circuit fault takes place in the power grid. These events may result in damage of the coil or other elements in the circuit. Therefore, it is important to have a measure for protecting the superconducting coil from large voltage surges. We designed a circuit configuration that is capable of suppressing voltage surges on the dc superconducting coil and has no adverse effect on the coil's normal magnetizing capacity. Experiments were carried out to verify the validity of the design. In this paper, we introduce the protective circuitry and its work principle. We also report the experimental results which are in a good agreement with theoretical calculations. [J39]

"Design of Axial and Radial Flux HTS Permanent Magnet Synchronous Motor's Rotor"

Most of superconducting motors use the superconducting coils as the excitation coils which are located in the rotor. But its cool system is complex and the cool temperature is lower than 60 K. A novel axial-radial flux HTS (high temperature superconducting) motor is presented with the liquid nitrogen cool, its armature winding in stator is superconducting coils, the excitation winding in cover is superconducting coils, permanent magnets is located in the rotor. Its cool system is simple, and easy to implement. But the electromagnetic parameters are required to ensure the armature current can flow in the winding with low voltage. Through the prototype test with

the copper winding instead of the superconducting winding, a novel rotor structure fit for the HTS motor with superconducting armature winding is presented. [J40]

"Charge carrier separation induced by intrinsic surface strain in pristine ZnO nanowires"

We predict by first-principles calculations a spontaneous charge carrier separation mechanism in pristine [0001]-oriented ZnO nanowires. We find that the shrinking strain induced by surface reconstruction causes electrons and holes to separate and move toward the core and surface region, respectively. Such separation can be enhanced by axially applied tensile strain as a result of the enhancement of surface strain induced by the Poisson effect, and be suppressed by compressive axial strain. Similar carrier separations are found in IIB-sulfides. This intrinsic charge separation and tensile strain induced enhancement are expected to shed light on solar cell designs. [J41]

"Tensile properties of helical auxetic structures: A numerical study"

This paper discusses a helical auxetic structure which has a diverse range of practical applications. The mechanical properties of the system can be determined by particular combinations of geometry and component material properties; finite element analysis is used to investigate the static behavior of these structures under tension. Modeling criteria are determined and design issues are discussed. A description of the different strain-dependent mechanical phases is provided. It is shown that the stiffnesses of the component fibers and the initial helical wrap angle are critical design parameters, and that strain-dependent changes in cross-section must be taken into consideration: we observe that the structures exhibit nonlinear behavior due to nonzero component Poisson's ratios. Negative Poisson's ratios for the helical structures as low as -5 are shown. While we focus here on the structure as a yarn our findings are, in principle, scaleable. [J42]

"Contact mechanisms and design principles for (Schottky and Ohmic) metal contacts to semiconductor nanowires"

Contact mechanisms and design principles for (Ohmic and Schottky) metal (M) contacts to semiconductor nanowires (NWs) have been studied. The NWs have been assumed to be cylindrical. A unified model has been developed for the contacts. The model takes into consideration the amorphicity of the M/NW interface structure, the diameter dependence of the energy band gap, the barrier height modulation, and the fluctuations in both the barrier height and the applied bias. While the fluctuations in the barrier height are assumed to involve band tails, the fluctuations in applied bias are assumed to involve tiny Gaussian peaks. Several different features of the Ohmic and the Schottky contacts have been addressed. These include temperature and dimension dependencies of the current-voltage characteristics, the influence of the M/NW interface on the contact characteristics, the relationship between the barrier height and the ideality factor, and the barrier height reduction as a function of temperature. The model appears to be very general. It seems to explain all experimental results available to date in the literature. The calculated results are almost always in good correspondence with the experimental results. The study seemingly demonstrates an alternative to the doping dependence of the Ohmic contacts. It elucidates the fundamental physics underlying M/NW contacts. It highlights means to yield low-resistivity Ohmic contacts by thermionic emission. It describes design criteria for both Ohmic and Schottky contacts. The design criteria for Ohmic contacts tend to address the long-term reliability concerns for devices. They explain also the behavior of both good and bad Ohmic contacts. All these may be the most striking attributes of the study. These attributes explain why Schottky contacts to NWs, with proper gate modulation, may act also as Schottky barrier transistors. [J43]

"A breathing rate sensor with plastic optical fiber"

A breathing rate sensor has been developed using plastic optical fiber and the test results are presented in this letter. The principle of coupling loss was used in designing this sensor to take advantage of the large core size of plastic optic fiber. The sensor was placed near the nostril to determine the rate of breathing as air was exhaled. The results demonstrated the ability to quantify the breathing rate and monitor different breathing patterns up to a resolution of 1 breath/s (1 Hz). [J44]

"Simulation of junctionless Si nanowire transistors with 3 nm gate length"

Inspired by recent experimental realizations and theoretical simulations of thin silicon nanowire-based devices, we perform proof-of-concept simulations of junctionless gated Si nanowire transistors. Based on first-principles, our primary predictions are that Si-based transistors are physically possible without major changes in design philosophy at scales of 1nmwire diameter and 3nmgate length, and that the junctionless transistor avoids potentially serious difficulties affecting junctioned channels at these length scales. We also present investigations into atomic-level design factors such as dopant positioning and concentration. [J45]

"Design of HTS Coil for Magnetic Driving Spacecraft"

An experiment testbed aiming to demonstrate the principle of the magnetic driving (MD) spacecrafts was successfully constructed in 2008. Orthogonal Bi2223 coils provide magnetic fields to attract, repel and rotate two 50 kg vehicles in an air pressured platform. Technique details of the testbed in association with the coil design and fabrication are briefly introduced. More details focused on two conceptual designs, which support the use of MD in the future space missions. First, the acceleration between two vehicles, which is a main parameter to evaluate the efficiency of MD is calculated. An optimal coil radius is obtained for such structure that Bi2223 coils are cooled by a passive radiative cooler whose weight is approximately proportional to the coil radius. Second, an active-passive shielding system (APSS) is proposed to protect the onboard instruments which are sensitive to the magnetic field. The basic unit of the APSS is closed HTS coils, which can resist flux variation. The shielding ability of the APSS is discussed by using both theoretical and Finite Element Analysis. [J46]

"A super resolution metalens with phase compensation mechanism"

We propose a metalens consisting of a metamaterial slab that can support the propagation of waves with high wave vectors and a nonperiodic plasmonic waveguide coupler atop that can provide phase compensation and wave vector matching. The principle of the metalens is analyzed and numerically verified. We show that the metalens not only can achieve super resolution focusing but also has the fundamental properties of a conventional optical lens, such as Fourier transform and imaging. The proposed metalens may offer exceptional opportunities for optical system design and information processing. [J47]

"A new traveling wave ultrasonic motor using thick ring stator with nested PZT excitation"

To avoid the disadvantages of conventional traveling wave ultrasonic motorsГ‚Вїlower efficiency PZT working mode of d31, fragility of the PZT element under strong excitation, fatigue of the adhesive layer under harsh environmental conditions, and low volume of the PZT material in the stator- a new type of traveling wave ultrasonic motor is presented in this paper. Here we implement the stator by nesting 64 PZT stacks in 64 slots specifically cut in a thick metal ring and 64 block springs nested within another 64 slots to produce preloading on the PZT stacks. In this new design, the d33 mode of the PZT is used to excite the flexural vibrations of the stator, and fragility of the PZT ceramics and fatigue of the adhesive layer are no longer an issue. The working principle, FEM simulation, fabrication, and performance measurements of a prototype motor were demonstrated to validate the proposed ideas. Typical output of the prototype motor is no-load speed of 15 rpm and maximum torque of 7.96 NГ‚Вїm. Further improvement will potentially enhance its features by increasing the accuracy in fabrication and adopting appropriate frictional material into the interface between the stator and the rotor. [J48]

"Enabling suspension-based biochemical assays with digital magnetic microtags"

Microarrays and suspension-based technologies have attracted significant interest over the past decade with applications in medical diagnostics and biochemical multiplexed assays. However, the throughput of microarrays will always be limited by the array density and the slow kinetics, while the suspension (or bead)-based technologies are currently limited by the number of distinct codes the beads can carry. A novel digital magnetic tagging technology based on magnetic tags that can be used as encoded microcarriers for biomolecular probes, is presented here. The highly disruptive platform technology can provide a very large number of unique codes, enabling a high degree of multiplexing. The design principles of a novel magnetic laboratory-on-a-chip device comprising microfluidic channels with embedded magnetic tunneling magnetoresistive sensors are also discussed. [J49]

"Spectroscopic Calibration Correlation of Field and Lab-Sized Fluorescence LIDAR Systems"

A method has been developed to correlate spectral signatures obtained with various fluorescence LIght Detection And Ranging (LIDAR) systems. A calibrated fluorescence reference target was used to calibrate the spectral response of the LIDAR transmitter channels and obtain their transfer functions. Two LIDAR systems have been spectrally characterized, and corrected signatures for two bioaerosols are presented. The first LIDAR system is the Standoff Integrated Bioserosol Active Hyperspectral Detection field LIDAR developed by Defence R&D Canada. This standoff system uses a 351-nm pulsed laser in a monoaxial design. The second system is a lab-sized aerosol chamber designed to characterize fluorescent aerosols under controlled environmental conditions. The chamber was designed according to classical short-range biaxial LIDAR principles, with the purpose of duplicating the results obtained with field LIDAR systems. Aerosols generated within the chamber are probed by a 355-nm pulsed laser, and autofluorescence spectra are measured with a spectrometer and an intensified charge-coupled device camera. This chamber is used to collect the reference spectra of various fluorescing aerosols and simulants of biological agents. One of the main objectives in using this chamber is to produce and

compile a library of instrument-free fluorescing spectra that can be transferred to other LIDAR-based bioaerosol sensors with known optical transfer functions. [J50]

"IEEE Ultrasonics, Ferroelectrics and Frequency Control Society-Elected administrative committee"

To avoid the disadvantages of conventional traveling wave ultrasonic motorsГ,Вїlower efficiency PZT working mode of d31, fragility of the PZT element under strong excitation, fatigue of the adhesive layer under harsh environmental conditions, and low volume of the PZT material in the stator- a new type of traveling wave ultrasonic motor is presented in this paper. Here we implement the stator by nesting 64 PZT stacks in 64 slots specifically cut in a thick metal ring and 64 block springs nested within another 64 slots to produce preloading on the PZT stacks. In this new design, the d33mode of the PZT is used to excite the flexural vibrations of the stator, and fragility of the PZT ceramics and fatigue of the adhesive layer are no longer an issue. The working principle, FEM simulation, fabrication, and performance measurements of a prototype motor were demonstrated to validate the proposed ideas. Typical output of the prototype motor is no-load speed of 15 rpm and maximum torque of 7.96 NГ,В·m. Further improvement will potentially enhance its features by increasing the accuracy in fabrication and adopting appropriate frictional material into the interface between the stator and the rotor. [J51]

"Immunomagnetic reduction assay using high-T c superconducting-quantum-interference-device-based magnetosusceptometry"

Via immunomagnetic reduction assay, biomolecules can be quantitatively detected with aid of biofunctionalized magnetic nanoparticles, which are used as labeling markers for specific biomolecules. To achieve ultra-high sensitivity in detecting biomolecules, superconducting quantum interference device (SQUID) is a promising candidate to act as a sensor to the magnetic signal related to the concentration of detected biomolecules. In the past, we developed a single channel SQUID-based magnetosusceptometry. In order to increase the detection through-put, multichannel SQUID-based magnetosusceptometry is developed. In this work, the design and working principle of four-channel SQUID-based magnetosusceptometry are introduced. Using utilizing scanning technology, four samples can be simultaneously logged into the SQUID-based magnetosusceptometry. Notably, only single SQUID magnetometer is used in the magnetosusceptometry. The precision and sensitivity in detecting biomolecules using the four-channel SQUID-based magnetosusceptometry are investigated. [J52]

"Passive magnetic field cancellation device by multiple high-Tc superconducting coils"

A passive magnetic field cancellation device (PMFCD) is designed. The PMFCD could automatically cancel the field as an active cancellation system did; however it requires no power sources and feedback systems. The capability of the PMFCD is based on the principle that a closed loop can resist flux variation and keep the flux constant inside. The closed loop in the PMFCD is formed by connecting two pairs of high temperature superconductor Helmholtz coils with different radii in series. More important thing is that the ratio of the radius and the turn number between the coils has to satisfy a number of conditions, with which 100% cancellation can be reached. Theoretical methods to obtain the turn number ratio and radius ratio are the major part of the paper. Numerical simulation was followed, aiming to evaluate field distribution under a cancellation state and correct the theoretical values. [J53]

"A rotating-compensator based reflectance difference spectrometer for fast spectroscopic measurements"

We present a new type of reflectance difference (RD) spectrometer for fast spectroscopic measurements based on a rotating-compensator (RC) design. The instrument uses a 1024 element Si photodiode linear array for simultaneous multiwavelength detection. High quality RD spectra covering a spectral range from 1.5 to 4.5 eV can be acquired within a few seconds. A detailed description of the working principle, the instrumentation, and the algorithms used for data collection and reduction is presented, followed by a discussion of errors introduced by lamp instability and optical imperfections of the compensator. Finally, to demonstrate the performance of the new RCRD spectrometer, we illustrate its application for the in situ, real-time monitoring of the initial stages of organic thin film growth of para-sexiphenyl (p-6P)on the Cu(110)-(2Ч1)Osurface. [J54]

"Donor-donor binding in In 2 O 3 : Engineering shallow donor levels"

Using first-principles band structure methods, we investigate the interactions between different donors in In2O3. Through the formation energy and transition energy level calculations, we find that an oxygen-vacancy creates a deep donor level, while an indium-interstitial or a tin-dopant induces a shallow donor level. The coupling between these donor levels gives rise to even shallower donor levels and leads to a significant reduction in their formation energies. Based on the analysis of the PBE0-corrected band structure and the molecular-orbital

bonding diagram, we demonstrate these effects of donor-donor binding. In addition, total energy calculations show that these defect pairs tend to be more stable with respect to the isolated defects due to their negative binding energies. Thus, we may design shallow donor levels to enhance the electrical conductivity via the donor-donor binding. [J55]

"Input impedance matching of acoustic transducers operating at off-resonant frequencies"

The input impedance matching technique of acoustic transducers at off-resonant frequencies is reported. It uses an inherent impedance property of transducers and thus does not need an external electric matching circuit or extra acoustic matching section. The input electrical equivalent circuit includes a radiation component and a dielectric capacitor. The radiation component consists of a radiation resistance and a radiation reactance. The total reactance is the sum of the radiation reactance and the dielectric capacitive reactance. This reactance becomes zero at two frequencies where the impedance is real. The transducer size can be properly chosen so that the impedance at one of the zero-crossing frequencies is close to 50 Ω, the output impedance of signal generators. At this off-resonant operating frequency, the reflection coefficient of the transducer is minimized without using any matching circuit. Other than the size, the impedance can also be fine tuned by adjusting the thickness of material that bonds the transducer plate to the substrates. The acoustic impedance of the substrate and that of the bonding material can also be used as design elements in the transducer structure to achieve better transducer matching. Lead titanate piezoelectric plates were bonded on Lucite, liquid crystal polymer (LCP), and bismuth (Bi) substrates to produce various transducer structures. Their input impedance was simulated using a transducer model and compared with measured values to illustrate the matching principle. [J56]

"Phase transition study of integrated circuit chip power supplying based on ferroelectric ceramic"

We introduce the tin-modified and niobium-modified lead zirconate titanate ferroelectric ceramics as a micropower supplying source for integrated circuit chip. The ferroelectric ceramic phase transition under transverse shock wave compression can release the depolarization energy to the external storage capacitor. The porous microstructure ferroelectric ceramic micropower-generator is capable of generating low output voltage pulses with amplitudes 50.3 V and with transferred energy 1.12 mJ, and supplying integrated circuit chip with micropower sources. Theoretical calculations are conducted based on circuit analysis law, principle of dynamic high pressure, and shock wave physics, and the calculated response matches well with experimental data. [J57]

"Novel multi-layer polymer-metal structures for use in ultrasonic transducer impedance matching and backing absorber applications"

This paper presents a novel design principle for designing multilayer polymer-metal structures which are well suited for front surface impedance conversion (matching) and for back surface acoustic absorption. It is shown that a polymer layer with an outer metal layer, when loaded by a low impedance propagation medium, acts as an efficient impedance converter. The resulting impedance seen at the inner polymer surface is increased and the structure provides the same performance as a traditional quarter-wavelength matching layer. Experimental evidence is also shown for a double-matching scheme for a lead zirconate titanate (PZT) transducer using an inner polymer-metal multilayer and an outer polymer quarter-wavelength layer, resulting in a 55% bandwidth at 2.6 MHz with air backing. Also, it is theoretically shown that multiple layers of a lossy polymer adhesive-metal structure produce low propagation velocity and high absorption. Experimental proof of this ultrasonic multilayer backing absorber is provided. Design theories based on both a simplified mass and spring model and a rigorous one-dimensional wave model have been developed and show fair agreement. [J58]

"A novel laser wavelength meter based on the measurement of synthetic wavelength"

The accuracy of the current wavelength meter using optical interferometry is limited by the numbers of fringe counted. To solve this problem, a novel laser wavelength meter based on the measurement of synthetic wavelength is proposed. The unknown wavelength is obtained by measuring the value of synthetic wavelength produced by the unknown and reference wavelengths, and half of this value corresponds to 2pi variation of the phase difference between the interference signals of the unknown and reference wavelengths. The optical configuration of the wavelength meter is designed and the measurement principle is analyzed theoretically. To verify its feasibility, three helium-neon lasers' wavelengths were determined experimentally, and a relative uncertainty on the unknown wavelength of the order of 10-8was realized. Accuracy analysis shows that this wavelength meter has the advantage of high accuracy when the unknown wavelength is around the standard laser wavelength recommended by CIPM. [J59]

"Operation Request Gatekeeper: A software system for remote access control of diagnostic

instruments in fusion experiments"

Tokamak diagnostic settings are repeatedly modified to meet the changing needs of each experiment. Enabling the remote diagnostic control has significant challenges due to security and efficiency requirements. The Operation Request Gatekeeper (ORG) is a software system that addresses the challenges of remotely but securely submitting modification requests. The ORG provides a framework for screening all the requests before they enter the secure machine zone and are executed by performing user authentication and authorization, grammar validation, and validity checks. A prototype ORG was developed for the ITER CODAC that satisfies their initial requirements for remote request submission and has been tested with remote control of the KSTAR Plasma Control System. This paper describes the software design principles and implementation of ORG as well as worldwide test results. [J60]

"Field Stabilization of the Iseult/Inumac Magnet Operating in Driven Mode"

A neuroscience research center with very high field MRI equipments was opened in November 2006 by the CEA life sciences division. Three MRI systems operating at 3, 7 and 17 T have been already installed. One of the imaging systems will require a 11.75 T magnet with a 900 mm warm bore. The large aperture and high field strength of this magnet provide a substantial engineering challenge compared to the largest MRI systems ever built. This magnet is being developed within an ambitious R&D program, Iseult, whose focus is high field MRI. Traditional MRI magnet design principles are not readily applicable and thus concepts taken from high energy physics or fusion experiments, namely the Tore Supra tokamak magnet system, will be used. The coil will be made of a niobium-titanium conductor cooled by a He II bath at 1.8 K, permanently connected to a cryoplant. Due to its design the magnet will be operated in a non-persistent mode. As the field stability needed for MRI imaging requires a field drift of less than 0.05 ppm/h, it is hardly feasible to directly transpose these requirements in the power supply specification. Two existing solutions developed for other applications have been selected: one using a semi-persistent mode, and the other using a short-circuited superconducting coil in the inner bore. In order to make a decision on experimental basis, an ambitious R&D field stability program has been set-up based on magnet prototypes, high field test facility (Seht, a 44 H and 8 T magnet with a warm bore to 600 mm). We will present development and experimental results of the two stabilization solutions. In conclusion, the stability solution selected for the Iseult magnet is given. [J61]

"Comparison of three current sources for single-electrode capacitance measurement"

The capacitance of a single electrode is usually measured by injecting a current to the electrode and measuring the resultant voltage on the electrode. In this case, a voltage-controlled current source with a high bandwidth is needed because the impedance is inversely proportional to the excitation frequency. In this design note, three different current sources are discussed: (1) the Howland current source, (2) a modified Howland current source, and (3) a dual op-amp current source. The principle and dynamic performances are presented and compared. Simulation and experimental results show that although the Howland current source has the lowest (i.e., worst) output impedance, its output is the most stable among the three current sources when the frequency changes. Therefore, it is suitable for single-electrode capacitance measurement. Initial tests have proven the feasibility of single-electrode capacitance sensor with the Howland current source. [J62]

"Polarization-Insensitive Variable Optical Attenuator and Wavelength Blocker Using Liquid Crystal Polarization Gratings"

We demonstrate a variable optical attenuator (VOA) based on liquid crystal polarization gratings (LCPGs), which eliminates the need for complex polarization management found in competing LC technologies. We then configure the VOA as a multi-channel wavelength blocker resulting in a simple, compact architecture with high performance and low cost. Together with a dual fiber collimator, relay lenses, a diffraction grating, a quarter wave plate, and a mirror we achieve optical attenuation of ~50 dB with minimal polarization dependent loss (≤ 0.3 dB) and insertion loss (≤ 2.5 dB). The device also manifests competitive wavelength flatness (≤ 0.35 dB variation), response times (~ 40 ms), and temperature dependent loss (≥ 47 dB maximum attenuation up to 85°C). We describe the principle of operation, explain the fabrication process and optimization challenges, and finally present the system design and experimental results for a four-channel, 100 GHz wavelength blocker in the C-band. [J63]

"Cavity Enhanced Internal Photoemission Effect in Silicon Photodiode for Sub-Bandgap Detection"

In this paper, a new approach for the near infrared sub-bandgap detection in Si-based devices is investigated. In particular, the design, the realization and the characterization of a back illuminated silicon resonant cavity enhanced Schottky photodetectors, working at 1.55 μm, are reported. The photodetectors are constituted by Fabry-Perot microcavity incorporating a Schottky diode. The working principle is based on the internal

photoemission effect enhanced by cavity effect. Performances devices in terms of responsivity, free spectral range, finesse and estimated bandwidth are reported. [J64]

"A Comprehensive Approach to Image Spam Detection: From Server to Client Solution"

Image spam is a type of e-mail spam that embeds spam text content into graphical images to bypass traditional text-based e-mail spam filters. To effectively detect image spam, it is desirable to leverage image content analysis technologies. However, most previous works of image spam detection focus on filtering the image spam on the client side. We propose a more desirable comprehensive solution which embraces both server-side filtering and client-side detection to effectively mitigate image spam. On the server side, we present a nonnegative sparsity induced similarity measure for cluster analysis of spam images to filter the attack activities of spammers and fast trace back the spam sources. On the client side, we employ the principle of active learning where the learner guides the users to label as few images as possible while maximizing the classification accuracy. The server-side filtering identifies large image clusters as suspicious spam sources and further analysis can be performed to identify the real sources and block them from the beginning. For those spam images which survived the server-side filter, our active learner on the client side will further guide the users to interactively and efficiently filter them out. Our experiments on an image spam data-set collected from the e-mail server of our department demonstrate the efficacy of the proposed comprehensive solution. [J65]

"End-group effects on negative differential resistance and rectifying performance of a polyyne-based molecular wire"

Based on first-principles approach, the end-group effects on negative differential resistance (NDR) and rectifying performance of polyyne-based molecular wires are investigated. The NDR behaviors are observed when the polyyne is attached to asymmetric (-NO2and -NH2) or symmetric (double -S) end groups, and rectifying performance emerges with the presence of asymmetric groups. The analysis on microscopic nature reveals the intrinsic origin of these phenomena. Our results show the possibility of a multifunctional molecular device design simultaneously with NDR and rectifying performances by using a technology of capping certain end groups to polyyne. [J66]

"Nonlinear electrical properties of Si three-terminal junction devices"

This letter reports on the realization and characterization of silicon three-terminal junction devices made in a silicon-on-insulator wafer. Room temperature electrical measurements show that the fabricated devices exhibit pronounced nonlinear electrical properties inherent to ballistic electron transport in a three-terminal ballistic junction (TBJ) device. The results show that room temperature functional TBJ devices can be realized in a semiconductor material other than high-mobility III-V semiconductor heterostructures and provide a simple design principle for compact silicon devices in nanoelectronics. [J67]

"Using a model-driven architecture for technology-independent scenario configuration in networking testbeds"

Networking testbeds are a key tool to design and experiment with new protocols, architectures, and services being proposed for future networks. The scenario-based configuration approach is a state-of-the-art testbed configuration mechanism that maximizes productivity in reconfigurable testbeds. However, commonly used scenario specification languages are highly coupled with the underlying testbed technologies. This fact precludes either the reusability of scenarios among different testbeds, or experimentation with complex test scenarios implemented over federated infrastructures proposed in projects like GENI, which comprise a combination of heterogeneous testbeds. In this article these issues are addressed by proposing a novel technology-independent scenario-based testbed configuration management architecture based on model-driven architecture principles. Our proposal takes into account general applicability and extensibility requirements, as well as seamless integration with existing testbeds. Furthermore, it has been experimentally validated with tests performed on actual testbeds. [J68]

"Performance enhancement of terahertz metamaterials on ultrathin substrates for sensing applications"

We design, fabricate, and characterize split-ring resonator (SRR) based planar terahertz metamaterials (MMs) on ultrathin silicon nitride substrates for biosensing applications. Proof-of-principle demonstration of increased sensitivity in thin substrate SRR-MMs is shown by detection of doped and undoped protein thin films (silk fibroin) of various thicknesses and by monitoring transmission changes using terahertz time-domain spectroscopy. SRR-MMs fabricated on thin film substrates show significantly better performance than identical SRR-MMs fabricated

on bulk silicon substrates paving the way for improved biological and chemical sensing applications. [J69]

"Finite element analysis and design of cubic high-pressure anvils based on the principle of lateral support"

This article theoretically investigates the lateral support on cubic high-pressure anvil using finite element analysis. The results show that to gain the same chamber pressure, the value of system oil pressure can be decreased by reducing the lateral support area and the anvils' lifetime is extended when the lateral support area grows. The optimal lateral support area to maximize anvils' lifetime is 27.96 cm2. Furthermore, the chamber pressure will increase by about 6.99% when the value of lateral support area reduces from 33.16 to 27.96 cm2under same hydraulic rams. Our simulation results have been verified by many high-pressure synthesis experiments and illustrated by breakage of anvils. [J70]

"Reflections of ions in electrostatic analyzers: A case study with New Horizons/Solar Wind Around Pluto"

Electrostatic analyzers (ESAs), in various forms, are used to measure plasma in a range of applications. In this article, we describe how ions reflect from the interior surfaces of an ESA, the detection of which constitutes a fundamentally nonideal response of ESAs. We demonstrate this effect by comparing laboratory data from a real ESA-based space instrument, the Solar Wind Around Pluto (SWAP) instrument, aboard the NASA New Horizons spacecraft, to results from a model based on quantum mechanical simulations of particles reflected from the instrument's surfaces combined with simulations of particle trajectories through the instrument's applied electrostatic fields. Thus, we show, for the first time, how reflected ions in ESAs lead to nonideal effects that have important implications for understanding the data returned by these instruments, as well as for designing new low-background ESA-based instruments. Specifically, we show that the response of SWAP widens considerably below a level of 10-3of the peak response. Thus, a direct measurement of a plasma distribution with SWAP will have an energy-dependent background on the order of ≤10-3of the peak of the signal due to that distribution. We predict that this order of magnitude estimate for the background applies to a large number of ESA-based instruments because ESAs operate using a common principle. However, the exact shape of the energy-dependent response will be different for different instruments. The principle of operation is that ions outside the ideal range of energy-per-charge are deflected into the walls of the ESA. Therefore, we propose that a new design paradigm is necessary to mitigate the effect of ion reflections and thus accurately and directly measure the energy spectrum of a plasma using ESAs. In this article, we build a framework for minimizing the effect of ion reflections in the design of new ESAs. Through the u--se of existing computer simulation software, a design team can use our method to quantify the amount of reflections in their instrument and iteratively change design parameters before fabrication, conserving resources. A possible direction for the new design paradigm is having nonsolid walls of the ESA, already used in some applications. [J71]

"Current-Steering Digital-to-Analog Converters: Functional Specifications, Design Basics, and Behavioral Modeling"

Functional specifications and design basics for current-steering digital-to-analog converters (DACs) are covered. An outline of digital-to-analog conversion principles, together with fundamental current-steering DAC architectures, are briefly explained. A generalized design flow for DACs and design basics for current-steering architectures, together with a universal SIMULINK®-based behavioral model useful for the block-level simulation of a current-steering DAC, are described. [J72]

"Phenomenological quantum description of the ultrafast response of arrayed waveguide gratings"

This work presents a detailed and quantitative quantum description of the ultrafast response of arrayed waveguide gratings (AWG) illuminated with relatively intense short pulses of light. This is achieved with no more mathematical or conceptual complexities than that required by a classical description. The presented approach is based on the phenomenological interpretation of the photon, that is, a photon is what produces a "click" in a photodetector. This phenomenological approach was combined with the application of Feynman's rules for describing interference and Bohr's correspondence principle, i.e., quantum theory should somehow converge in the limit with the classical description of the interference phenomena. This basic approach reveals that, in apparent opposition to wide-held beliefs, especially designed AWGs can be used to produce interference in conditions where the "which-path" information is available. [J73]

"Rational computational design of optimal catalytic surfaces"

Using calculations from first-principles based on density functional theory, we introduce an innovative concept for

the design of catalysts based on the tuning of the surface properties by progressive layering of thin metal films on an oxide support, where the substrate is substantially exploited as an active design element for the tuning of the reactivity of the metallic surface. We demonstrate this idea by studying the adsorption and activation properties of CO2on Pd and oxide-supported Pd thin films. [J74]

"Design considerations and propagation characteristics of channel Bragg-plasmon-coupled-waveguides"

We present a detailed design principle and propagation characteristics of channel Bragg-plasmon-coupled-waveguide. We have found that there is a significant change in the slope of the phase-velocity dispersion curve leading to an ultranarrow interaction bandwidth (765pm)and group-velocity dispersion (GVD ±4.5Ч104ps/km-nm)that is an appreciably large GVD using a waveguide mode-coupling geometry in any region of the optical spectrum. The effect of waveguide parameters such as channel width, number of bilayers, etc. on a mode-coupling mechanism is also studied with significant emphasis on the propagation loss suffered by the supermodes of the structure. The proposed waveguide exhibits sensitivity as high as 7500 nm/RIU, thereby opening a route for biochemical sensing. [J75]

"The maximum possible magnetocaloric Delta T effect"

The current boom of research activity in magnetocaloric materials science is fuelled by the expectation that new advanced refrigerants may be found whose Delta Twill significantly surpass that of gadolinium (Gd) metal (2.6-2.9 K/T). Because of this expectation, the main effort in the field has been diverted from the important issues of refrigerator design to the routine characterization of magnetic materials. Estimating the maximum adiabatic temperature change that can be achieved in principle by applying a certain magnetic field, say 1 T, is a matter of priority. In this work the problem of maximum Delta Tis approached from general principles. According to the most optimistic estimates, Delta Tcan never exceed 18K/T, the more realistic upper limit lying somewhere in high single figures. We therefore deem it most unlikely that a refrigerant much better than Gd, in respect of the Delta Tvalue, will ever be found. [J76]

"Design, simulation, and visualization of R-SPUDT devices with transverse mode suppression"

When designing narrow band resonant SPUDT devices, the excitation of undesired transverse modes may result both in extra ripple in the passband and in spurious response in the stop band. To avoid these issues, it was proposed to use an approach similar to the one used for bulk-acoustic-wave devices. The principle is to add a low-velocity region at the edge of the transducer. If this edge region is properly designed, the transducer supports a so-called piston mode, i.e., a mode having a flat transverse amplitude profile across the aperture. A P-matrix model is extended to account for transverse modes in SPUDTs. The model is used to analyze both regular and piston-mode devices. Different physical possibilities to implement the low-velocity region are investigated and compared. In particular, it was found important to design the transducer so that the acoustical sources and reflectors extend into the edge region to minimize the coupling to higher order modes. From these considerations, a new implementation for piston-mode devices is proposed and demonstrated on a GSM base station 199-MHz filter. Electrical measurements as well as acoustical wave fields measured with an optical interferometer are analyzed and compared with simulations. [J77]

"The 50 kA Superconducting Transformer for Testing ITER CC Conductors Short Sample"

To meet the specification of International Thermonuclear Experimental Reactor (ITER) Correction Coil (CC) conductors, the 50 kA superconducting transformer has been designed which allows rating of conductor samples during different operating conditions at the Institute of Plasma Physics, the Chinese Academy of Sciences (ASIPP). The superconducting transformer consists of two concentric layer-wound superconducting solenoids with the primary inside the secondary. The 50 kA secondary conductor consists of 4 turns of rectangular cable-in-conduit conductor (CICC) type used of the 0.87 mm NbTi superconductor strands. This paper describes the basic principles of superconducting transformer, the designed concept of the 50 kA superconducting transformer. [J78]

"A Systematic Approach for Radiated System-Level Verification of Unknown Sources Inside Satellites from Unit-Level Measurements"

A hybrid numerical/experimental procedure for the characterization of radiated emissions from electronic devices at the system level from measurements at the unit level is presented in this work. The procedure is based on the characterization of the device in free space, the computation of equivalent currents for the equipment, followed by computation of the radiation of the device inside the satellite using the equivalent model as the source. The

objective of this effort is to replace measurements at the system level to reduce cost. Related topics, such as numerical and experimental verification, electric and magnetic probe design, etc., are also described in the paper. [J79]

"The advanced helical generator"

A high explosive pulsed power generator called the advanced helical generator (AHG) has been designed, built, and successfully tested. The AHG incorporates design principles of voltage and current management to obtain a high current and energy gain. Its design was facilitated by the use of modern modeling tools as well as high precision manufacture. The result was a first-shot success. The AHG delivered 16 MA of current and 11 MJ of energy to a quasistatic 80 nH inductive load. A current gain of 160 times was obtained with a peak exponential rise time of 20mu s. We will describe in detail the design and testing of the AHG. [J80]

"Yellow-green light-emitting electrochemical cells with long lifetime and high efficiency"

We show that the electrochemical stability window of the constituent components in light-emitting electrochemical cells (LECs), e.g., the electrolyte, should be considered in order to minimize undesired side reactions. By designing and operating LECs in accordance with straightforward principles, we demonstrate sandwich cells that turn on fast at room temperature (2s), and which emit significant yellow-green light (100cd/m2)during 25 days of uninterrupted operation at low voltage (4V)and high power conversion efficacy (6lm/W). We further demonstrate that it is possible to attain balanced p- and n-type doping and a centered p-n junction in such planar LECs based on the conjugated polymer "superyellow." [J81]

"Design and validation of a novel bioreactor principle to combine online micro-computed tomography monitoring and mechanical loading in bone tissue engineering"

Mechanical loading plays an important role in bone remodeling in vivo and, therefore, has been suggested as a key parameter in stem cell-based engineering of bone-like tissue in vitro. However, the optimization of loading protocols during stem cell differentiation and subsequent bone-like tissue formation is challenged by multiple input factors, which are difficult to control and validate. These include the variable cellular performance of cells harvested from different patients, nonstandardized culture media components, the choice of the biomaterial forming the scaffold, and its morphology, impacting a broader validity of mechanical stimulation regimens. To standardize the cell culture of bone-like tissue constructs, we suggest the involvement of time-lapsed feedback loops. For this purpose we present a prototype bioreactor that combines online, nondestructive monitoring using micro-computed tomography and direct mechanical loading of three-dimensional tissue engineering constructs. Validation of this system showed displacement steps down to 1 mcmand cyclic sinusoidal loadings of up to 10 Hz. Load detection resolution was 0.01 N, and micro-computed tomography data were of high quality. For the first time, the developed bioreactor links time-lapsed, nondestructive, and dynamic imaging with mechanical stimulation, designed for cell culture under sterile conditions. This system is believed to substantially improve today's experimental options to study and optimize osteogenic stem cell culture and differentiation at the interface with mechanical stimulation. [J82]

"The Iseult/Inumac Whole Body 11.7 T MRI Magnet R&D Program"

A neuroscience research center with very high field MRI equipments has been opened in November 2006 by the CEA life science division. One of the imaging systems will require a 11.75 T magnet with a 900 mm warm bore. Regarding the large aperture and field strength, this magnet is a real challenge when compared to the largest MRI systems ever built, it is being developed within an ambitious R&D program, Iseult, focused on high field MRI. The conservative MRI magnet design principles are not readily applicable, other concepts taken from high energy physics or fusion experiments, namely the Tore Supra tokamak magnet system, will be used. The coil will thus be made of a niobium-titanium conductor cooled by a He II bath at 1.8 K, permanently connected to a cryoplant. Due to the high level of stored energy, about 340 MJ, and a relatively high nominal current, about 1500 A, the magnet will be operated in a non-persistent mode with a conveniently stabilized power supply. In order to take advantage of superfluid helium properties and regarding the high electromagnetic stresses on the conductors, the winding will be made of wetted double pancakes meeting the Stekly criterion for cryostability. The magnet will be actively shielded to fulfill the specifications regarding the stray field. In order to develop the magnet design on an experimental basis, an ambitious R&D program has been set-up based on magnet prototypes, high field test facility (Seht) and stability experiments. The main results from these experiments and their impact on the Iseult magnet design will be discussed. [J83]

"Ti-decorated C 60 as catalyst for hydrogen generation and storage"

First-principles calculations were carried out to study Ti-C60nanostructures as catalysts for water dissociation to

generate hydrogen and elucidate the influence of water moisture in the air on hydrogen storage capability of such systems. Our results show that both Ti atoms and dimers on C60can act as reaction centers for water dissociation with much lower energy barriers than that for water splitting in free space (5eV). After water dissociation, Ti atoms are covered with OH groups, their interaction with hydrogen is substantially reduced, and hydrogen adsorption is changed from chemisorption to physisorption. Therefore, care needs to be taken to eliminate moisture if they were designed as efficient hydrogen storage media. [J84]

"Model and Experimental Study of Permanent Magnet Vibration-to-Electrical Power Generator"

The vibration energy exists widely and is always wasted. Energy harvesting devices that convert kinetic energy into electrical energy have attracted much interest. A variety of vibration driven generators using electromagnetic principles to convert the kinetic energy into electrical energy, are being studied for powering sensors. However, the power supply is always a bottleneck problem to the development of handheld electronic equipments and some other low power electrical apparatus. In this paper, the vibration-to-electrical power generator has been designed and its magnetic field distribution has been analyzed by using Finite Element method (FEM). Then, the input-output model of the generator is built on the basis of vibration equation and law of electromagnetic induction. The calculation result has shown that output voltage of the generator depends on the amplitude, frequency and waveform of a vibration source. A generator prototype has been fabricated and tested at open-circuit and different loads, such as resistances, inductances and capacitances. The comparison of experimental result with calculating one has shown that the model can describe the input-output relation of the vibration-to-electrical power generator. [J85]

"Ionic doping effect in ZrO 2 resistive switching memory"

Oxygen vacancy (VO)plays the critical role for resistive switching in transition metal oxide resistive random access memory (RRAM). First principles calculation is performed to study the impact of metallic ion (Al, Ti, or La) doping in ZrO2on the behaviors of VO, including defect energy level and formation energy (Evf). Trivalent dopant (Al or La) significantly reduces Evf. Based on the calculated results, ZrO2-based RRAM devices are designed to control the formation of VO, and improved resistive switching uniformity is demonstrated in experiments. [J86]

"Nonferromagnetic material inserted magnetostrictive patch bonding technique for torsional modal testing of a ferromagnetic cylinder"

Torsional vibration testing requires pure torsional mode transduction. However, no reliable technique is available for exciting torsional vibrations in ferromagnetic cylinders for a relatively wide range of frequencies. A magnetostrictive patch bonding excitation method developed for nonferromagnetic cylinders, based on the magnetostrictive principle, may be considered for ferromagnetic cylinders. However, the direct bonding of a magnetostrictive patch onto a ferromagnetic cylinder fails because the applied magnetic field spreads to both the patch and the cylinder and thus generates unwanted modes of vibration such as longitudinal modes. Thus, a modified or new technique must be developed in order to concentrate the applied magnetic field mainly on the patch, while causing the patch deformation to fully transfer to the cylinder. This paper presents a modified magnetostrictive patch bonding excitation and measurement technique suitable for ferromagnetic cylinders. The key idea is to insert a nonferromagnetic material between the test cylinder and the magnetostrictive patch. Because the thickness of the material or the gap size critically affects the torsional vibration test by the magnetostrictive patch boding method, a series of numerical and experimental investigations to find the optimal gap size are conducted. Other factors affecting the developed modal testing method are also considered. The validity of the developed method is checked by comparing the experimentally obtained eigenfrequencies of a test ferromagnetic cylinder with the theoretical eigenfrequencies. [J87]

"SMES Based Dynamic Voltage Restorer for Voltage Fluctuations Compensation"

This paper presents a superconducting magnetic energy storage (SMES) based dynamic voltage restorer (DVR) to protect consumers from the grid voltage fluctuations. Due to the characteristic of high energy density and quick response, a superconducting magnet is selected as the energy storage unit to improve the compensation capability of DVR. This paper analyses the operation principle of the SMES based DVR, and designs the DVR output voltage control method. The control system mainly consists of two parts, the PWM converter controller and the DC/DC chopper controller. The PWM converter controller adopts double-loop control strategy, with an inner current regulator and an outer voltage controller. Combining the coordinated control of DC/DC chopper, the DVR can regulate output voltage accurately and quickly to compensate the system voltage fluctuations. Using MATLAB SIMULINK, the models of the SMES based DVR is established, and the simulation tests are performed to evaluate the system performance. [J88]

"Cryogenics Around the 11.7 T MRI Iseult Magnet"

As part of the Iseult/Inumac project, the development of a 500 MHz whole body MRI magnet has been launched in 2006. This magnet with a central field of 11.7 T in a warm bore of 900 mm has outstanding specifications with respect to usual MRI systems. The normal operation of this magnet will need the construction of a cryoplant able to cool its superconducting coils with pressurized HeII 1.8 K. A helium liquefier and 4.2 K/1.8 K refrigeration stage will be installed in the vicinity of the magnet. Before that, a magnet test facility (Seht-??station d'essais huit teslas??) installed at CEA/Saclay has been built in order to validate technical and control-process aspects during all operating phases: cooling down, nominal operation, quench event. The cryogenic system has been designed according to the principles foreseen for Iseult. The facility integration, commissioning, and operating results will be presented. The design of the final cryogenic installation for Iseult magnet, adapted to the facility experiences, is previously described. [J89]

"Adaptive noise-predictive maximum-likelihood (NPML) data detection for magnetic tape storage systems"

Advanced data detection will be one of the key enablers to achieving the very high areal recording densities of future tape storage systems. Departing from the partial-response maximum-likelihood (PRML)-based read channel design traditionally used in tape systems, this paper describes noise-predictive maximum-likelihood (NPML) detection, which is a technique that has been known for many years in the hard-disk-drive industry but has been introduced for the first time in the tape storage industry in IBM tape drives. In the NPML read channel design, the readback signals are conditioned prior to data detection so that their noise components are statistically decorrelated and reduced in power. This paper describes the basic principles of NPML detection and its application to tape systems in the form of a 16-state detector. It is argued that, because of the inherent variability of the recording channel characteristics in tape drives, fully adaptive NPML detection needs to be realized in order to optimize detection performance. Actual readback waveforms of data recorded on metal particulate as well as barium-ferrite particulate tape media are used to illustrate the error rate performance achieved by 16-state and 32-state NPML detectors. It is shown that, under realistic worst-case channel conditions, a 16-state NPML detector could offer an improvement in error rate after an error-correcting code of approximately two orders of magnitude. [J90]

"Camera Response Functions for Image Forensics: An Automatic Algorithm for Splicing Detection"

We present a fully automatic method to detect doctored digital images. Our method is based on a rigorous consistency checking principle of physical characteristics among different arbitrarily shaped image regions. In this paper, we specifically study the camera response function (CRF), a fundamental property in cameras mapping input irradiance to output image intensity. A test image is first automatically segmented into distinct arbitrarily shaped regions. One CRF is estimated from each region using geometric invariants from locally planar irradiance points (LPIPs). To classify a boundary segment between two regions as authentic or spliced, CRF-based cross fitting and local image features are computed and fed to statistical classifiers. Such segment level scores are further fused to infer the image level authenticity. Tests on two data sets reach performance levels of 70% precision and 70% recall, showing promising potential for real-world applications. Moreover, we examine individual features and discover the key factor in splicing detection. Our experiments show that the anomaly introduced around splicing boundaries plays the major role in detecting splicing. Such finding is important for designing effective and efficient solutions to image splicing detection. [J91]

"A Newly Developed Pulse-Type Microampere Magnetic Flux Pump"

A newly pulse-type microampere magnetic flux pump has been developed. This flux pump is used to compensate the decay of magnetic field in the high temperature superconducting (HTS) magnet coils. The superconducting joint resistance and lower n-index value induce the HTS coils could not operate in a persistent current mode. But using a flux pump would solve the problems. This paper presents the structure design and the basic principle of a newly developed pulse-type microampere magnetic flux pump. The developed flux pump has a simple structure. It is estimated that it will have low ripple and exact compensation for current. The current running in the flux pump is controlled by a pulse which is under the commands of the computer. In this way, the direction of the traveling field is easy to control. The working process of the flux pump is investigated in detail and some experiments have been performed. The results show that the new type flux pump can be regarded as a power supply providing for a persistent current because of the high pumping current. The developed flux pump is expected to be applied to the HTS magnetic resonance imaging (MRI) magnet system and nuclear magnetic resonance (NMR) magnet system. [J92]

"Turnbuckle diamond anvil cell for high-pressure measurements in a superconducting quantum interference device magnetometer"

We have developed a miniature diamond anvil cell for magnetization measurements in a widely used magnetic property measurement system commercial magnetometer built around a superconducting quantum interference device. The design of the pressure cell is based on the turnbuckle principle in which force can be created and maintained by rotating the body of the device while restricting the counterthreaded end-nuts to translational movement. The load on the opposed diamond anvils and the sample between them is generated using a hydraulic press. The load is then locked by rotating the body of the cell with respect to the end-nuts. The dimensions of the pressure cell have been optimized by use of finite element analysis. The cell is approximately a cylinder 7 mm long and 7 mm in diameter and weighs only 1.5 g. Due to its small size the cell thermalizes rapidly. It is capable of achieving pressures in excess of 10 GPa while allowing measurements to be performed with the maximum sensitivity of the magnetometer. The performance of the pressure cell is illustrated by a high pressure magnetic study of Mn3[Cr(CN)6]2·xH2OPrussian blue analog up to 10.3 GPa. [J93]

"Prototype of the Superferric Dipoles for the Super-FRS of the FAIR-Project"

The FAIR China Group (FCG), consisting of the Institute of Modern Physics (IMP Lanzhou), the Institute of Plasma Physics (ASIPP, Hefei) and the Institute of Electric Engineering (IEE, Beijing) developed and manufactured in cooperation with GSI, Germany a prototype of a superferric dipole for the Super-Fragment-Separator of the FAIR-project. The dipole magnets of the separator will have a deflection radius of 12.5 m, a field up to 1.6 T, a gap of at least 170 mm and an effective length of more than 2 meters to bend ion beams with a rigidity from 2 T ?? m up to 20 T ?? m. The magnets operate at DC mode. These requirements led to a superferric design with a yoke weight of more than 50 tons and a maximum stored energy of more than 400 kJ. The principles of yoke, coil and cryostat construction will be presented. We will also show first results of tests and measurements realized at ASIPP and at IMP. [J94]

"Development and Coil Fabrication for the LARP 3.7-m Long Nb3Sn Quadrupole"

The U.S. LHC Accelerator Research Program (LARP) has started the fabrication of 3.7-m long Nb3Sn quadrupole models. The Long Quadrupoles (LQ) are ldquoProof-of-Principlerdquo magnets which are to demonstrate that Nb3Sn technology is mature for use in high energy particle accelerators. Their design is based on the LARP Technological Quadrupole (TQ) models, developed at FNAL and LBNL, which have design gradients higher than 200 T/m and an aperture of 90 mm. The plans for the LQ R&D and a design update are presented and discussed in this paper. The challenges of fabricating long accelerator-quality Nb3Sn coils are presented together with the solutions adopted for the LQ coils (based on the TQ experience). During the fabrication and inspection of practice coils some problems were found and corrected. The fabrication at BNL and FNAL of the set of coils for the first Long Quadrupole is in progress. [J95]

"Current Limiting and Recovery Characteristics of SFCLs Using Magnetic Coupling of Two Coils"

Superconducting fault current limiters (SFCLs) using magnetic coupling of two coils can be divided into the insulated type SFCL and the non-insulated type SFCL depending on whether the two coils are insulated through one iron core or not. Among such SFCLs, the transformer type SFCL belongs to the insulated type SFCL because of its insulated two coils. On the other hand, the flux-lock type SFCL, its two coils electrically connected in parallel or series, can be classified into the non-insulated type SFCL. Basically, the structural component and the operational principle of these SFCLs rely upon the magnetic coupling of two coils, and might therefore be considered to be the same. However, there are important differences in the current limiting and the recovery characteristics of these SFCLs depending on design conditions such as the winding direction and the inductance ratio between two coils. [J96]

"Enabling collocated coexistence in IEEE 802.16 networks via perceived concurrency"

Multiple wireless interfaces (GSM, Wi-Fi, Bluetooth, FM, and GPS receiver, etc.) are being integrated into mobile devices. WiMAX, an IEEE802.16-based wireless access technology recently included in the IMT-2000 set of standards by ITU-R, will soon be added. Obstacles remain to operating these collocated radios concurrently, including interference and hardware conflicts due to congested spectrum allocation and component sharing with radio integration. In this article we provide a tutorial overview of today's solutions to enable concurrent operation of multiple collocated radios in IEEE 802.16- based wireless networks with a focus on perceived concurrency: a MAC coordination approach. We then present three general design principles-predictability, compressibility, and flexible scheduling-with examples of standard features. It is anticipated that the next-generation IEEE 802.16 standards will be enhanced with new features such as explicit service setup, asynchronous operation, and collocated coexistence-aware scheduling. [J97]

"Anomalous strength anisotropy of gamma ' -Fe 4 N identified by first-principles calculations"

gamma '-phase Fe4Nholds great promise for applications in magnetic recording devices and its (001) plane shows the highest stiffness according to elastic constant calculations. Here we demonstrate by first-principles stress-strain calculations that, contrary to the prevailing view, gamma '-Fe4Nexhibits the greatest strength and strongest wear resistance in its (011) plane. This unusual behavior stems from the nonlinear stress response at large strains which cannot be derived from elastic parameters. We analyze the underlying deformation mechanism and discuss implications of the present results on the design of hard coating materials in general. [J98]

"Design and fabrication of an ultrahigh-luminance field-emission display"

An ultrahigh-luminance field-emission display (FED) is designed in which a field emitter array (FEA) and memory function are integrated in every pixel of the display panel. The memory function consists of an emission-control thin-film transistor (TFT), a memory capacitor, a write-enable TFT, and a memory-discharging TFT. The operation mechanism is that the time of luminance of the pixel is made longer by the memory function; thus, luminance becomes higher. In principle, the maximum luminance of such a display is expected to be more than 100 000cd/m2. The ultrahigh-luminance FED is applicable for daylight-readable displays used in mobile electronic equipment. The authors fabricated a prototype of the ultrahigh-luminance FED using Spindt-type FEA and poly-Si TFT technology. It was confirmed that the luminance of the display panel is controlled by the signal for the memory-discharging TFT, which means that the luminance can be dynamically controlled by the input signal. The maximum luminance of 1700cd/m2was achieved at a relatively low anode voltage of 1.5 kV. The higher luminance can be expected by applying higher anode voltage. [J99]

"Methods, Accuracy and Reliability of ITER Conductor Tests in SULTAN"

In the last decade, a large number of high current, force flow superconductors have been tested as short length samples in the SULTAN facility. The object of the test ranged over transient stability, thermal-hydraulic behavior, AC losses, joint resistance and proof-of-principle for innovative conductor design. Recently, with the ITER cable-in-conduit conductors (CICC), the basic DC transport properties have been the focus of the SULTAN test. The critical steps of the sample assembly and instrumentation are described, with emphasis on the application of the temperature sensors, verification of the signal treatment chain and calibration. The post-processing and the data reduction are focused on the assessment of the current sharing temperature, Tcs: the conventional method of electrical field threshold detection by voltage taps is compared with the current sharing power detection by steady state gas-flow calorimetry. The longitudinal strain state of the conductors is discussed through the results of strain gauges applied on the jacket. Eventually, the value of a certified conductor test is highlighted in the frame of the quality control for the ITER magnets. [J100]

"The AC Loss Analysis in the 5 m HTS Power Cables"

In the framework of the Russian R&D Program for superconducting power devices, the 30 m HTS power cable has been developed made of 1 G Bi-2223 tapes. Before the full length cable production, as the first prototype the short 5 m cable model was produced and tested. After 30 m cable production the 5 m witness sample has been cut from the long piece and tested as well. To verify the calculations and designing principles both 5 m cables were heavily instrumented by potential taps and sensors to measure current distribution among layers, voltage-current characteristics and other parameters. AC losses in these short cable pieces have been analyzed by use of digital measurements of current and voltages along the cable. The witness sample has been provided by thermocouples to evaluate AC losses by calorimetric method. The details of AC losses measurements are discussed. Their analysis and comparison with calculations by standard theoretical models are presented. [J101]

"A compact electron beam ion source with integrated Wien filter providing mass and charge state separated beams of highly charged ions"

A Wien filter was designed for and tested with a room temperature electron beam ion source (EBIS). Xenon charge state spectra up to the charge state Xe46+were resolved as well as the isotopes of krypton using apertures of different sizes. The complete setup consisting of an EBIS and a Wien filter has a length of less than 1 m substituting a complete classical beamline setup. The Wien filter is equipped with removable permanent magnets. Hence total beam current measurements are possible via simple removal of the permanent magnets. In dependence on the needs of resolution a weak (0.2 T) or a strong (0.5 T) magnets setup can be used. In this paper the principle of operation and the design of the Wien filter meeting the requirements of an EBIS are briefly discussed. The first ion beam extraction and separation experiments with a Dresden EBIS are presented. [J102]

"Test of a NbTi Superconducting Quadrupole Magnet Based on Alternating Helical Windings"

It has been shown that by superposing two solenoid-like thin windings, that are oppositely skewed (tilted) with respect to the bore axis, the combined current density on the surface is cos(thetas) -like and the resulting magnetic field in the bore is a pure dipole field. Following a previous test of such a superconducting dipole magnet, a quadrupole magnet was designed and built using similar principles. This paper describes the design, construction and test of a 75 mm bore 600 mm long superconducting quadrupole made with NbTi wire. The simplicity of the design, void of typical wedges, end-spacers and coil assembly, is especially suitable for future high field insert coils using Nb3Sn as well as HTS wires. The 3 mm thick coil reached 46 T/m but did not achieve its current plateau. [J103]

"Design Study of the Multipole Corrector Magnet for SIS 100"

A design study of the multipole corrector magnet for the SIS 100 is in progress. This magnet, which has to integrate functions of a quadrupole, a sextupole and an octupole magnet, contains nested three windings to save longitudinal space in the accelerator ring. Although the windings are made from a Nuclotron type cable as for the SIS 100 main dipole magnet, insulated superconducting wires which are connected in series to allow low current operation, are used for the cable. In this paper, we describe the design principle and mechanical structure of the magnet and present computation results. [J104]

"Development of an integral optics system for a slim optical mouse in a slim portable electric device"

This paper presents the development of an integral optics system for a slim optical mouse whose operation principle in light propagation is based on total internal refection to prevent image distortion. The slim optical mouse can be applied to a portable electric device which has been becoming thinner and smaller and has a variety of functions for entertainment applications. The integral optics system was designed as a combination of an illumination system with a reflector and refractor, an object system, and a lens system with array multilevel lenses for a slim optical mouse with the thickness of 2.5mm. Fabrications were performed on photo and EB lithography, thermal evaporation by shadowing effect, FAB etching, TMAH etching, and hot embossing. The results show that this system is quite appropriate for a slim optical mouse with the measuring image performance through the lens system and light efficiency traveling to the object plane through the illumination system. [J105]

"Identification and lattice location of oxygen impurities in alpha -Si 3 N 4"

For over 40 years impurities have been believed to stabilize the ceramic alpha -Si3N4but there is no direct evidence for their identity or lattice location. In bulk materials electron microscopy can generally image heavy impurities. Here we report direct imaging of N columns in alpha -Si3N4that suggests the presence of excess light elements in specific N columns. First-principles calculations rule out Si or N interstitials and suggest O impurities, which are then confirmed by atomically resolved electron-energy-loss spectroscopy. The result provides a possible explanation for the stability of alpha -Si3N4with implications for the design of next-generation structural ceramics. [J106]

"Bilayer graphene nanoribbon nanoelectromechanical system device: A computational study"

A bilayer graphene nanoribbon nanoelectromechanical device is investigated via first-principle simulations. The output characteristics as a function of interlayer distance are calculated, with the proposed device acting as a displacement and a force sensor. The operating mechanism of a bistable switch based on this device structure is also explored, and in the present floating gate design, a switching gate bias of 5.6 V is required, resulting in an ON-OFF current ratio of 3 orders at a device bias of 20 mV. This minuscule bistable device could potentially be implemented in future semiconductor memory devices and radio frequency communication circuitry. [J107]

"Ultrasonic guided-waves characterization with warped frequency transforms"

Guided wave (GW) dispersion curves can be extracted from a time-transient measurement by means of time-frequency representations (TFRs). Unfortunately, any TFR is subject to the time-frequency uncertainty principle. This, in general, limits the capability of TFRs to characterize closely spaced guided modes over a wide frequency range. To overcome this limitation, we implemented a new warped frequency transform that presents enhanced mode extraction capabilities because of a more flexible tiling of the time-frequency domain. The tiling is designed to match the dispersive spectro-temporal structure of a GW by selecting an appropriate map of the time-frequency plane. The proposed transformation is fast, invertible, and covariant to group delay shifts. An application to Lamb waves propagating in an aluminum plate is presented. Time-transient GWs propagation

events obtained both numerically and experimentally are considered. The results show that the proposed warped frequency transform limits the interference patterns which appear with other TFRs and produces a sparse representation of the Lamb wave pattern that can be suitable for identification and characterization purposes. [J108]

"Terahertz detector based on a superconducting tunnel junction coupled to a thin superconductor film"

The principle of a terahertz detector using a superconducting tunnel junction (STJ) coupled to a large terahertz-absorbing superconductor film is verified. We have detected terahertz radiation based on the Cooper-pair breaking process, and confirmed that the sensitivity has a sharp increase around 0.7 THz, a value that is in agreement with the gap frequency of the superconducting Nb. For high-sensitivity terahertz detection, we propose an improved design of the STJ detector composed of a smaller junction coupled to a thinner superconductor film. We also discuss the expected noise equivalent power of the optimized detector. [J109]

"Materials, Devices, and Circuits of Transparent Amorphous-Oxide Semiconductor"

This paper presents the following recent investigations of transparent amorphous-oxide semiconductors (TAOS) from materials to devices and circuits. 1) Composition of metals in TAOS are widely explored with the aim of seeking semiconductors suitable for the channel layers of thin-film transistors (TFTs) composing backplanes for flat-panel displays. It is found in combinatorial approaches to the materials exploration that indium-based ternary TAOS (In-X-O) and their TFTs show the properties and the performance as good as those of the most popular material of amorphous In-Ga-Zn-O (alpha-IGZO) when X = Zn or Ge. 2) Defects and impurities in TAOS are investigated by theoretical approaches. The first-principle calculation of the electron states reveals that charge-neutral oxygen vacancy or interstitial forms the density of states around mid-gap level and does not generate carriers directly, while hydrogen impurity raises the Fermi level beyond the conduction-band minimum and acts as a donor in TAOS. 3) Device structures of TAOS-TFTs are also investigated extensively for better performance and stability. It is found in channel-etch type TFTs with bottom-gate inverse-stagger structures that the TFT characteristics and stability are significantly improved by chemically removing the back-channel layer in a wet-etching process. Coplanar homojunction (CH) structure is proposed as a novel device structure where conductive alpha-IGZO regions work as the source and drain electrodes to the channel region of semiconductor alpha-IGZO. The CH TFTs show excellent characteristics and stability, with low series resistance without any difficulty in making good electrical contact between metals and TAOS. 4) Circuits using TAOS-TFTs are demonstrated. A ring oscillator composed of fifteen-stage inverters with a buffer circuit operates as designed by circuit simulation with a TFT model for hydrogenated amorphous Si TFTs. Pixel circuits composed of three TFTs and one transparent capacitor suc- cessfully drive organic light-emission diode cells without a planarization layer on a 2-in diagonal panel having 176 times144 times 3 pixels. [J110]

"Theoretical design of GaN/ferroelectric heterostructure: Toward a strained semiconductor on ferroelectrics"

Ferroelectric/semiconductor heterostructures are of great interest for future electronic devices. This letter examined the material parameters and carrier distributions of an AlGaN(0001)/GaN(0001)/BaTiO3(111)double heterostructure by combining first principles and charge control model. Results show that in the optimized case, there will appear two channels in GaN layer, and the sheet electron density will be doubled compared to conventional AlGaN/GaN heterojunction. A possible device structure was proposed to make the channel become switchable and reduce the source/drain resistance. This strained semiconductor on ferroelectric structure may be promising for high speed power devices. [J111]

"Linear correlation between binding energy and Young's modulus in graphene nanoribbons"

Graphene nanoribbons (GNRs) have been suggested as a promising material for its use as nanoelectromechanical reasonators for highly sensitive force, mass, and charge detection. Therefore the accurate determination of the size-dependent elastic properties of GNRs is desirable for the design of graphene-based nanoelectromechanical devices. In this study we determine the size-dependent Young's modulus and carbon-carbon binding energy in a homologous series of GNRs, C4n2+6n+2H6n+4(n=2-12), with the use of all electron first principles computations. An unexpected linearity between the binding energy and Young's modulus is observed, making possible the prediction of the size-dependent Young's modulus of GNRs through a single point energy calculation of the GNR ground state. A quantitative-structure-property relationship is derived, which correlates Young's modulus to the total energy and the number of carbon atoms within the ribbon. In the limit of extended graphene sheets we determine the value of Young's modulus to be 1.09 TPa, in excellent agreement with experimental estimates derived for graphite and suspended graphene sheets. [J112]

"Guided growth of in-plane silicon nanowires"

We report on a guided growth of silicon nanowires (SiNWs) based on an in-plane solid-liquid-solid mechanism, which provides a general strategy to deploy SiNWs precisely into desired circuits. During a reacting-gas-free annealing process, the SiNWs are activated to grow and be guided into predefined patterns by effective controlling the movement of the catalyst drops. We demonstrate three different approaches to achieve a guided growth of SiNWs, which are as follows: (1) by an a-Si:Hchannel, (2) by a step edge, and (3) by an a-Si:Hedge. These results provide a design principle for future SiNWs-based nanodevices. [J113]

"G.hn: The new ITU-T home networking standard"

Several wired in-home networking technologies are currently available to consumers, although most of them were designed to cope with only one type of home wiring and are not interoperable with each other. In 2006 ITU-T started a standardization project called G.hn for a unified next generation networking technology, operating over all types of in-home wiring (phone line, power line, coaxial cable, and Cat-5 cable). ITU-T Recommendation G.9960, consented in December 2008, is the G.hn foundation: it specifies network architecture, most of the PHY, and some aspects of the MAC. The complete Recommendation is expected within 2009. Besides residential premises, G.hn is intended for small/home offices and public places such as multiple dwelling units, hotels, and conference rooms. This article gives an overview of G.hn technology focusing on the main principles used to build a single transmission scheme for multiple types of wires. [J114]

"Optical transitions and band gap discontinuities of GaInAsSb/AlGaAsSb quantum wells emitting in the 3 mcm range determined by modulation spectroscopy"

Modulation spectroscopy, in a form of photoreflectance (PR), has been used to study the electronic structure properties of Ga0.55In0.45AsxSb1-x/Al0.30Ga0.70AsySb1-yquantum wells (QWs) designed for the 3mcmemission range at room temperature. A number of spectral features related to QW transitions have been revealed. With the support of energy level calculations they could be identified unambiguously for the unstrained (chemical) conduction band offset of 85%, almost independent of a small As/Sb content change in both the well and the barrier. This has been recalculated into the band discontinuities of the realistic (strained) structure, which have been found to be in a good agreement with the values obtained based on the first principles method. [J115]

"Understanding the software communications architecture"

The Software Communications Architecture is an open architecture developed by the U.S. Department of Defense to standardize the development of software-defined radio, improve communication systems interoperability, and reduce development and deployment costs. The SCA facilitates software reuse and technology insertion by abstracting radio applications from the supporting platform and defining a common operational environment across platforms. The SCA relies on commercial standards, classic software engineering principles, and software design patterns. While some SCA design choices are controversial and tightly tied to the specific needs for which it was developed, the basic design principles of software reuse and abstraction are sound and necessary if SDR is to achieve its full potential. Some of the techniques and concepts used in the SCA may be foreign to a communications engineer, and can result in confusion and long learning curves. The understanding of these concepts is of great relevance for communications engineers independent of any opinion about the SCA itself. This tutorial is aimed at educating communication engineers on these software engineering principles and describing how the SCA applies them to achieve its goals. We describe the different interfaces of the SCA that provide a framework for the implementation of SDR. The tutorial provides introductory material to understand the basic operation of the SCA as implemented in the Open-Source SCA Implementation::Embedded developed by Wireless @ Virginia Tech. [J116]

"Design of half-metallic ferrimagnets: Doped MnX (X =Te, Se, S)"

Half-metallic ferrimagnetism of transition-metal-doped MnX (transition-metal=V, Cr and X=Te, Se, S) is examined in the framework of first-principles Korringa-Kohn-Rostoker-coherent potential approximation calculation. Such unusual ferrimagnetism becomes possible due to the coexistence of ferromagnetic coupling among transition-metal impurities (here, Cr and V) and antiferro-magnetic coupling among Mn ions. In particular, NaCl-type MnSe and MnS compounds exhibit clear half-metallic ferrimagnetism even when the doping concentrations are as low as a few percents. On the other hand, NiAs-type MnTe compounds exhibit pseudo half-metallic ferrimagnetism. For a metastable zinc-blende structure, half-metallic ferrimagnetism is realized in all cases except in a low doping region. [J117]

"A luminescence lifetime assisted ratiometric fluorimeter for biological applications"

In general, the most difficult task in developing devices for fluorescence ratiometric sensing is the isolation of signals from overlapping emission wavelengths. Wavelength discrimination can be achieved by using monochromators or bandpass filters, which often lead to decreased signal intensities. The result is a device that is both complex and expensive. Here we present an alternative system-a low-cost standalone optical fluorimeter based on luminescence lifetime assisted ratiometric sensing (LARS). This paper describes the principle of this technique and the overall design of the sensor device. The most significant innovation of LARS is the ability to discriminate between two overlapping luminescence signals based on differences in their luminescence decay rates. Thus, minimal filtering is required and the two signals can be isolated despite significant overlap of luminescence spectra. The result is a device that is both simple and inexpensive. The electronic circuit employs the lock-in amplification technique for the signal processing and the system is controlled by an onboard microcontroller. In addition, the system is designed to communicate with external devices via Bluetooth. [J118]

"Self-ordering mechanism of nanocluster-chain on the functional vicinal surfaces"

An energy model of nanoclusters-chain self-organized on the functional vicinal surfaces is established to investigate the self-ordering processes, which provides a promising and challenging nanomaterial-design method by means of the energy minimum principle and entropy change principle. The cluster-chain structure can be predicted through controlling the linear coverage of nanoclusters (PM)and the step width (L). The different interactions including the steps and terraces will perform a positive influence on the self-ordering due to their long-range forces. [J119]

"Using virtualization for high availability and disaster recovery"

Traditional high-availability and disaster recovery solutions require proprietary hardware, complex configurations, application-specific logic, highly skilled personnel, and a rigorous and lengthy testing process. The resulting high costs have limited their adoption to environments with the most critical applications. However, high availability and disaster recovery are becoming increasingly important in many environments that cannot bear the complexity and the expense involved. In this paper, we show that virtualization can be used to develop solutions that meet this market demand. We describe the recently released Virtual Availability Manager (VAM) product offering, which provides simplified availability solutions using Xen®-based virtualization, and which is available as part of the IBM Systems Director product. We present key design principles of VAM, explain its architecture and current capabilities, and describe the way it is being extended to enable recovery in case of disaster. [J120]

"A service delivery platform for server management services"

Computer server management is an important component of the global IT (information technology) services business. The providers of server management services face unrelenting efficiency challenges in order to remain competitive with other providers. Server system administrators (SAs) represent the majority of the workers in this industry, and their primary task is server management. Since system administration is a highly skilled position, the costs of employing such individuals are high, and thus, the challenge is to increase their efficiency so that a given SA can manage larger numbers of servers. In this paper, we describe a widely deployed Service Delivery Portal (SDP) in use throughout the Server Systems Operations business of IBM that provides a set of well-integrated technologies to help SAs perform their tasks more efficiently. The SDP is based on three simple design principles: 1) user interface aggregation, 2) data aggregation, and 3) knowledge centralization. This paper describes the development of the SDP from the vantage point of these three basic design principles along with lessons learned and the impact assessed from studying the behavior of SAs with and without the tool. [J121]

"Nanomechanically induced molecular conductance switch"

A mechanical single molecular switch using specific metallic broken carbon nanotubes (BCNTs) as electrodes is designed. It can operate by simply pressing one of the electrodes mechanically with robust performance. The device has been modeled by combining molecular dynamics simulations and first principles calculations. With the help of molecular dynamic simulations, a realistic description of the broken ends of the BCNT is obtained, while high ON/OFF conductance ratio has been obtained from nonequilibrium Green's function calculations. A microscopic mechanism is suggested for the switch behavior. [J122]

"A laser interferometer for measuring straightness and its position based on heterodyne interferometry"

Not only the magnitude but also the position of straightness errors are of concern to users. However, current laser interferometers used for measuring straightness seldom give the relative position of the straightness error. To solve this problem, a laser interferometer for measuring straightness and its position based on heterodyne

interferometry is proposed. The optical configuration of the interferometer is designed and the measurement principle is analyzed theoretically. Two experiments were carried out. The first experiment verifies the validity and repeatability of the interferometer by measuring a linear stage. Also, the second one for measuring a flexure-hinge stage demonstrates that the interferometer is capable of nanometer measurement accuracy. These results show that this interferometer has advantages of simultaneously measuring straightness error and the relative position with high precision, and a compact structure. [J123]

"A short pulse (7 mu s FWHM) and high repetition rate (dc-5kHz) cantilever piezovalve for pulsed atomic and molecular beams"

In this paper we report on the design and operation of a novel piezovalve for the production of short pulsed atomic or molecular beams. The high speed valve operates on the principle of a cantilever piezo. The only moving part, besides the cantilever piezo itself, is a very small O-ring that forms the vacuum seal. The valve can operate continuous (dc) and in pulsed mode with the same drive electronics. Pulsed operation has been tested at repetition frequencies up to 5 kHz. The static deflection of the cantilever, as mounted in the valve body, was measured as a function of driving field strength with a confocal microscope. The deflection and high speed dynamical response of the cantilever can be easily changed and optimized for a particular nozzle diameter or repetition rate by a simple adjustment of the free cantilever length. Pulsed molecular beams with a full width at half maximum pulse width as low as 7mu shave been measured at a position 10 cm downstream of the nozzle exit. This represents a gas pulse with a length of only 10 mm making it well matched to for instance experiments using laser beams. Such a short pulse with 6 bar backing pressure behind a 150mcmnozzle releases about 1016particles/pulse and the beam brightness was estimated to be 4Ч1022particles/(s str). The short pulses of the cantilever piezovalve result in a much reduced gas load in the vacuum system. We demonstrate operation of the pulsed valve with skimmer in a single vacuum chamber pumped by a 520 l/s turbomolecular pump maintaining a pressure of 5Ч10-6Torr, which is an excellent vacuum to have the strong and cold skimmed molecular beam interact with laser beams only 10 cm downstream of the nozzle to do velocit- y map slice imaging with a microchannel-plate imaging detector in a single chamber. The piezovalve produces cold and narrow (Delta v/v=2%-3%)velocity distributions of molecules seeded in helium or neon at modest backing pressures of only 6 bar. The low gas load of the cantilever valve makes it possible to design very compact single chamber molecular beam machines with high quality cold and intense supersonic beams. The high speed cantilever piezovalve may find broad applicability in experiments where short and strong gas pulses are needed with only modest pumping, the effective use of (expensive) samples, or the production of cold atomic and molecular beams. [J124]

"Safebook: A privacy-preserving online social network leveraging on real-life trust"

Online social network applications severely suffer from various security and privacy exposures. This article suggests a new approach to tackle these security and privacy problems with a special emphasis on the privacy of users with respect to the application provider in addition to defense against intruders or malicious users. In order to ensure users' privacy in the face of potential privacy violations by the provider, the suggested approach adopts a decentralized architecture relying on cooperation among a number of independent parties that are also the users of the online social network application. The second strong point of the suggested approach is to capitalize on the trust relationships that are part of social networks in real life in order to cope with the problem of building trusted and privacy- preserving mechanisms as part of the online application. The combination of these design principles is Safebook, a decentralized and privacy- preserving online social network application. Based on the two design principles, decentralization and exploiting real-life trust, various mechanisms for privacy and security are integrated into Safebook in order to provide data storage and data management functions that preserve users' privacy, data integrity, and availability. Preliminary evaluations of Safebook show that a realistic compromise between privacy and performance is feasible. [J125]

"Perturbed frequency-selective surfaces fabricated on large thin polymer membranes for multiband infrared applications"

The design, fabrication, and characterization of single-screen perturbed frequency-selective surfaces (FSS) at infrared frequencies for single and multiband applications are reported. Single-band FSS based on parallel strips have been perturbed by decreasing the length of every second strip within the array in order to achieve dual band-stop responses. The same principle has been extended to design FSS exhibiting tri- and quadreflection bands. In addition, strip FSSs have been perturbed by replacing every second strip for a metallic ring, resulting in dual-band filters with different polarization responses of the bands. These designs have been fabricated on large thin polyimide membranes using sacrificial silicon wafers. An oxide interlayer between the sacrificial silicon wafer and the polyimide membrane is employed to stop the silicon etching and is wet etched subsequently by a solution of ammonium fluoride and acetic acid that does not attack either the polyimide membrane or the

aluminium FSS elements. Fourier transform infrared spectroscopy measurements are presented to validate the predicted responses of the fabricated prototypes. [J126]

"Effects of aggregation on the permittivity of random media containing monodisperse spheres"

Numerical simulations were used to calculate the effective permittivities of three-dimensional random particle suspensions containing up to 2440 particles and exhibiting two types of particle aggregation. The particles were modeled as 200mcmspheres that were aggregated into either large spherical clusters or into foam-type microstructures with large spherical voids. Multiple scattering of 0.01-10.0 GHz electromagnetic fields was simulated using a first-principles iterative multipole approach with matrix and particle permittivities of 1.0 and 8.5, respectively. The computational results showed both significant and highly significant trends. Aggregation into spherical clusters decreased the effective permittivity by up to 3.2±0.2%, whereas aggregation into foam-type microstructures increased the effective permittivity by up to 3.0±1.6%. The effective permittivity trends exhibited little change with frequency. These results were compared to effective medium approximations that predicted higher permittivities than those from the simulations and showed opposite trends for cluster aggregation. Three theories are proposed to explain the simulation results. The first theory invokes a waveguidelike mechanism. The simulations indicate that the wave fields propagate more through the continuous paths of greater or lesser particle density created by aggregation, rather than through the isolated particle clusters or large voids. This quasicontinuous phase, or quasimatrix, therefore behaves like a random waveguide structure in the material. A second theory is proposed where the quasicontinuous phase governs the behavior of the system by a percolationlike process. In this theory, the multipole interactions are modeled as the percolation of virtual charges tunneling from one particle to another. A third mechanism for the permittivity changes is also proposed involving collecti- ve polarization effects associated with the particle clusters or large voids. The simulation results challenge the general applicability of the quasistatic limit for heterogeneous media by showing how microstructural changes much smaller than the electromagnetic wavelength can alter the effective permittivity by a statistically significant degree. The results also provide a quantitative indication of the effects of aggregation and hierarchical microstructures on the electromagnetic properties of random media and have application to the remote and in situ sensing of soils, the rational design and nondestructive evaluation of composites, and the study of biological tissues and other random materials. [J127]

"Tunable coupling in CrO 2 via RuO 2 layers"

Theoretical calculations of the magnetic structure of CrO2-RuO2interfaces and multilayer structures are presented. The antiferromagnetic coupling between Ru ions and neighboring Cr ions in such interfaces is explored both for contiguous layers of CrO2and RuO2and for Cr layers separated by RuO2spacers. The Fermi surface of the RuO2spacer is calculated and kF100is utilized to determine the oscillatory behavior of the interlayer exchange coupling as described by Bruno [Phys. Rev. B 52, 411 (1995)]. The first-principles calculations are found to be qualitatively consistent with the Bruno theory, which suggests that CrO2-RuO2layered structures could be designed to give the desired magnetic ordering between CrO2layers given sufficient control over the composition and roughness of the deposited material. [J128]

"High-resolution, high-transmission soft x-ray spectrometer for the study of biological samples"

We present a variable line-space grating spectrometer for soft x-rays that covers the photon energy range between 130 and 650 eV. The optical design is based on the Hettrick-Underwood principle and tailored to synchrotron-based studies of radiation-sensitive biological samples. The spectrometer is able to record the entire spectral range in one shot, i.e., without any mechanical motion, at a resolving power of 1200 or better. Despite its slitless design, such a resolving power can be achieved for a source spot as large as (30Ч3000)mcm2, which is important for keeping beam damage effects in radiation-sensitive samples low. The high spectrometer efficiency allows recording of comprehensive two-dimensional resonant inelastic soft x-ray scattering (RIXS) maps with good statistics within several minutes. This is exemplarily demonstrated for a RIXS map of highly oriented pyrolytic graphite, which was taken within 10 min. [J129]

"Curved electronic pixel arrays using a cut and bend approach"

Electronics fabricated on a flat flexible substrate can readily be bent into a cylinder or cone but not into a general three-dimensional curved shape. A solution to this problem is described, in which an electronic device is first fabricated on a flat surface and then shaped to a good approximation of any smooth curved shape, using a cut and bend approach, following the design principles of a geodesic dome. A small additional strain allows the surface to conform to an exact spherical cap. The array is fabricated with amorphous silicon thin film transistors and photodiodes on a plastic substrate. [J130]

"Frequency tunable gyrotron using backward-wave components"

We report a frequency tunable scheme for the gyrotron at millimeter/submillimeter regime. Unlike the step-tunable type where oscillation frequencies change discretely, this scheme continuously adjusts the oscillation frequency as the magnetic field varies. It is a hybrid system, taking the advantages of the backward-wave interaction and the converter-free output structure. The characteristics of backward-wave interaction will be shown. A proof of principle experiment was conducted with a scaled cavity. The result shows the oscillation frequency smoothly transitions over a wide range of 6 GHz from 134 to 140 GHz. With proper design this mechanism is capable of producing medium output power with broad frequency tunability up to the terahertz region. [J131]

"Monte Carlo simulation of terahertz quantum cascade laser structures based on wide-bandgap semiconductors"

Wide-bandgap semiconductors such as GaN/AlGaNand ZnO/MgZnOquantum wells are promising for improving the spectral reach and high-temperature performance of terahertz quantum cascade lasers, due to their characteristically large optical phonon energies. Here, a particle-based Monte Carlo model is developed and used to quantify the potential of terahertz sources based on these materials relative to existing devices based on GaAs/AlGaAsquantum wells. Specifically, three otherwise identical quantum cascade structures based on GaN/AlGaN, ZnO/MgZnO, and GaAs/AlGaAsquantum wells are designed, and their steady-state carrier distributions are then computed as a function of temperature. The simulation results show that the larger the optical phonon energies (as in going from the AlGaAs to the MgZnO to the AlGaN materials system), the weaker the temperature dependence of the population inversion. In particular, as the temperature is increased from 10to300K, the population inversions are found to decrease by factors of 4.48, 1.50, and 1.25 for the AlGaAs, MgZnO, and AlGaN structure, respectively. Based on these results, the AlGaN and MgZnO devices are then predicted to be in principle capable of laser action without cryogenic cooling. [J132]

"A system for high-resolution depth-resolved optical imaging of fluorescence and absorption contrast"

Laminar optical tomography (LOT) is a new three-dimensional in vivo functional optical imaging technique. Adopting a microscopy-based setup and diffuse optical tomography (DOT) imaging principles, LOT can perform both absorption- and fluorescence-contrast imaging with higher resolution (100-200mcm)than DOT and deeper penetration (2-3 mm) than laser scanning microscopy. These features, as well as a large field of view and acquisition speeds up to 100 frames per second, make LOT suitable for depth-resolved imaging of stratified tissues such as retina, skin, endothelial tissues and the cortex of the brain. In this paper, we provide a detailed description of a new LOT system design capable of imaging both absorption and fluorescence contrast, and present characterization of its performance using phantom studies. [J133]

"A microfluidic Coulter counting device for metal wear detection in lubrication oil"

We present the design, fabrication, and testing of a microfluidic device for metal wear detection in lubrication oils. The detection is based on the capacitance Coulter counting principle, that is, on the change in a microchannel's capacitance caused by the presence of a metal particle in the microchannel. The testing of the microfluidic device using 10-25mcmaluminum particles has demonstrated the feasibility for detection and counting of microscale metal particles in low-conductive lubrication oils. This microfluidic device is promising for online oil debris detection by the use of multiple detection microfluidic channels. [J134]

"Compact collimated fiber optic array diagnostic for railgun plasmas"

We developed and tested a compact collimated 16 channel fiber optic array diagnostic for studying the light emission of railgun armature plasmas with approximately millimeter spatial and submicrosecond temporal resolution. The design and operational details of the diagnostic are described. Plasma velocities, oscillation, and dimension data from the diagnostic for the Livermore fixed hybrid armature experiment are presented and compared with one-dimensional simulations. The techniques and principles discussed allow the extension of the diagnostic to other railgun and related dense plasma experiments. [J135]

"Adaptive spatially resolving detector for the extreme ultraviolet with absolute measuring capability"

A spatially resolving detector for the extreme ultraviolet (XUV) and soft x-ray spectral region is presented. Principle of operation is conversion of XUV radiation to visible light by a scintillator crystal. Luminescence is detected using charge coupled device camera and imaging optics. Single layer and multilayer coatings are applied to match the system to different spectral regions of interest. Field of view and spatial resolution can be

adapted to the application. Calibration of the system enables to absolutely measure in-band radiation flux on the scintillator. The setup is designed for the characterization and optimization of XUV sources and XUV optical systems. Measurements, carried out to characterize the focus in a soft x-ray microscope, are presented as an application example. [J136]

"A metrological large range atomic force microscope with improved performance"

A metrological large range atomic force microscope (Met. LR-AFM) has been set up and improved over the past years at Physikalisch-Technische Bundesanstalt (PTB). Being designed as a scanning sample type instrument, the sample is moved in three dimensions by a mechanical ball bearing stage in combination with a compact z-piezostage. Its topography is detected by a position-stationary AFM head. The sample displacement is measured by three embedded miniature homodyne interferometers in the x, y, and zdirections. The AFM head is aligned in such a way that its cantilever tip is positioned on the sample surface at the intersection point of the three interferometer measurement beams for satisfying the Abbe measurement principle. In this paper, further improvements of the Met. LR-AFM are reported. A new AFM head using the beam deflection principle has been developed to reduce the influence of parasitic optical interference phenomena. Furthermore, an off-line Heydemann correction method has been applied to reduce the inherent interferometer nonlinearities to less than 0.3 nm (p-v). Versatile scanning functions, for example, radial scanning or local AFM measurement functions, have been implemented to optimize the measurement process. The measurement software is also improved and allows comfortable operations of the instrument via graphical user interface or script-based command sets. The improved Met. LR-AFM is capable of measuring, for instance, the step height, lateral pitch, line width, nanoroughness, and other geometrical parameters of nanostructures. Calibration results of a one-dimensional grating and a set of film thickness standards are demonstrated, showing the excellent metrological performance of the instrument. [J137]

"High-power millimeter-wave rotary joint"

The rotary joint is a useful microwave component that connects a fixed part to a rotatable part. This study systematically analyzes the effect of the discontinuity on the interface of a rotary joint for several waveguide modes. Simulation results indicate that the transmission of the TE01mode is independent of the geometry of the joint, and thus is ideal for such application. A rotary joint consisting of two identical TE01mode converters, clasped each other by a bearing, is designed, fabricated, and tested. Back-to-back transmission measurements exhibit an excellent agreement to the results of computer simulations. The measured optimum transmission is 97% with a 3 dB bandwidth of 8.5 GHz, centered at 35.0 GHz. The cold measurement shows that the results are independent of the angle of rotation. In addition, a high-power experiment is conducted. The just developed rotary joint can operate up to a peak input power of 210 W with a duty of 18%. The working principle, although demonstrated in the millimeter-wave region, can be applied up to the terahertz region where the joint gap is generally critical except for the operating TE01mode. [J138]

"Cognitive radio sensor networks"

Dynamic spectrum access stands as a promising and spectrum-efficient communication approach for resource-constrained multihop wireless sensor networks due to their event-driven communication nature, which generally yields bursty traffic depending on the event characteristics. In addition, opportunistic spectrum access may also help realize the deployment of multiple overlaid sensor networks, and eliminate collision and excessive contention delay incurred by dense node deployment. Incorporating cognitive radio capability in sensor networks yields a new sensor networking paradigm (i.e., cognitive radio sensor networks). In this article the main design principles, potential advantages, application areas, and network architectures of CRSNs are introduced. The existing communication protocols and algorithms devised for cognitive radio networks and WSNs are discussed along with the open research avenues for the realization of CRSNs. [J139]

"Closed-loop evolutionary multiobjective optimization"

Artificial evolution has been used for more than 50 years as a method of optimization in engineering, operations research and computational intelligence. In closed-loop evolution (a term used by the statistician, George Box) or, equivalently, evolutionary experimentation (Ingo Rechenberg's terminology), the "phenotypes" are evaluated in the real world by conducting a physical experiment, whilst selection and breeding is simulated. Well-known early work on artificial evolution-design engineering problems in fluid dynamics, and chemical plant process optimization-was carried out in this experimental mode. More recently, the closed-loop approach has been successfully used in much evolvable hardware and evolutionary robotics research, and in some microbiology and biochemistry applications. In this article, several further new targets for closed-loop evolutionary and multiobjective optimization are considered. Four case studies from my own collaborative work are described: (i)

instrument optimization in analytical biochemistry; (ii) finding effective drug combinations in vitro; (iii) onchip synthetic biomolecule design; and (iv) improving chocolate production processes. Accurate simulation in these applications is not possible due to complexity or a lack of adequate analytical models. In these and other applications discussed, optimizing experimentally brings with it several challenges: noise; nuisance factors; ephemeral resource constraints; expensive evaluations, and evaluations that must be done in (large) batches. Evolutionary algorithms (EAs) are largely equal to these vagaries, whilst modern multiobjective EAs also enable tradeoffs among conflicting optimization goals to be explored. Nevertheless, principles from other disciplines, such as statistics, design of experiments, machine learning and global optimization are also relevant to aspects of the closed-loop problem, and may inspire futher development of multiobjective EAs. [J140]

"Incorporating Haptic Effects Into Three-Dimensional Virtual Environments to Train the Hemiparetic Upper Extremity"

Current neuroscience has identified several constructs to increase the effectiveness of upper extremity rehabilitation. One is the use of progressive, skill acquisition-oriented training. Another approach emphasizes the use of bilateral activities. Building on these principles, this paper describes the design and feasibility testing of a robotic/virtual environment system designed to train the arm of persons who have had strokes. The system provides a variety of assistance modes, scalable workspaces and hand-robot interfaces allowing persons with strokes to train multiple joints in three dimensions. The simulations utilize assistance algorithms that adjust task difficulty both online and offline in relation to subject performance. Several distinctive haptic effects have been incorporated into the simulations. An adaptive master-slave relationship between the unimpaired and impaired arm encourages active movement of the subject's hemiparetic arm during a bimanual task. Adaptive anti-gravity support and damping stabilize the arm during virtual reaching and placement tasks. An adaptive virtual spring provides assistance to complete the movement if the subject is unable to complete the task in time. Finally, haptically rendered virtual objects help to shape the movement trajectory during a virtual placement task. A proof of concept study demonstrated this system to be safe, feasible and worthy of further study. [J141]

"Performances of a bent-crystal spectrometer adapted to resonant x-ray emission measurements on gas-phase samples"

We describe a bent-crystal spectrometer adapted to measure x-ray emission resulting from core-level excitation of gas-phase molecules in the 0.8-8 keV energy range. The spectrometer is based on the Johann principle, and uses a microfocused photon beam to provide high-resolution (resolving power of 7500). A gas cell was designed to hold a high-pressure (300 mbar) sample of gas while maintaining a high vacuum (10-9mbar)in the chamber. The cell was designed to optimize the counting rate (2000 cts/s at the maximum of the Cl Kalpha emission line), while minimizing self-absorption. Example of the Kalpha emission lines of CH3Clmolecules is presented to illustrate the capabilities of this new instrument. [J142]

"Design Principles for Higher (Prime) Order Composite Directional Couplers"

The theoretical construction of ideal (lossless) 3 times 3, 4 times 4, and 5 times 5 dimensional directional couplers from 2 times 2 directional couplers is demonstrated. Such devices could be fabricated as planar waveguide circuit elements. [J143]

"A systems approach to evolutionary multiobjective structural optimization and beyond"

Multiobjective evolutionary algorithms (MOEAs) have shown to be effective in solving a wide range of test problems. However, it is not straightforward to apply MOEAs to complex real-world problems. This paper discusses the major challenges we face in applying MOEAs to complex structural optimization, including the involvement of time-consuming and multi-disciplinary quality evaluation processes, changing environments, vagueness in formulating criteria formulation, and the involvement of multiple sub-systems. We propose that the successful tackling of all these aspects give birth to a systems approach to evolutionary design optimization characterized by considerations at four levels, namely, the system property level, temporal level, spatial level and process level. Finally, we suggest a few promising future research topics in evolutionary structural design that consist in the necessary steps towards a life-like design approach, where design principles found in biological systems such as self-organization, self-repair and scalability play a central role. [J144]

"Improvement of Reversible Strain Limit for Critical Current of DI-BSCCO Due to Lamination Technique"

The DI (dynamically innovative)-BSCCO-Bi2223 tapes achieved high critical current as well as high modulus of elasticity. Further the reversible strain limit and the corresponding stress for critical current have been remarkably

increased by means of lamination technique. During the course of development, their optimized architecture has been designed based on the principle of the rule of mixture for maximizing the force free strain exerted on the superconducting component. The reversible strain/stress limit (Arev/Rrev) was defined as a strain, at which the critical current recovers to the level of 99% Ico. Selecting several kinds of laminating materials and changing condition of the fabrication, the excellent Cu alloy-3ply tape with Icoof 311 A/cm was realized of which Arevand Rrevreached 0.42% and 300 MPa, respectively. Further during the theoretical analysis, the increase of reversible strain limit were made clear to be attributed to the increase of thermally induced residual strain as well as the compensation effect of laminated layers against a local fracture mode. [J145]

"Numerical and Experimental Analysis of and AC Loss for Bent 2G HTS Wires Used in an Electric Machine"

Application of the second generation High Temperature Superconducting (HTS) YBCO tapes has been increasingly popular since the low-cost superconducting materials were discovered. This paper mainly presents the properties of two types of 2G YBCO tapes from American Superconductor Corporation (AMSC) and SuperPower, Inc, respectively. All superconducting materials are cooled by liquid nitrogen (77 K). At first, we will introduce the basic design strategy for synchronous motor and characteristics of superconducting materials. Then, the basic principle and algorithm for calculation and measurement of Ic and AC transport loss will be explained. Secondly, the novel measurement system using a high-precision digital lock-in amplifier is presented. Finally, we present and analyze simulation and experimental results for two types of YBCO tapes in bending condition. [J146]

"Nonsingular two dimensional cloak of arbitrary shape"

We propose a general method to circumvent the singularity (infinitely large values of material parameters) of arbitrary two dimensional (2D) cloaks. The presented method is based on the deformation view of the transformation design method. It is shown that by adjusting the principle stretch out of the cloaking plane, 2D cloaks of arbitrary shapes without singularity can be constructed. It is also demonstrated that the method based on the equivalent dispersion relation and the design method for nonsingular 2D cloak from mirror-symmetric cross section of a three dimensional (3D) cloak can be derived from the proposed theory. Examples of a cylindrical electromagnetic cloak and an arbitrary shaped 2D electromagnetic cloak without singularity are provided to demonstrate the method. [J147]

"Superconductive Traveling-Wave Photodetectors"

This paper introduces a novel family of devices for ultra-fast, ultra-sensitive and ultra-low-noise optoelectronics, namely superconductive traveling-wave photodetectors (STWPDs). STWPDs can be optimized for ultra-wideband/ultra-sensitive photodetection, photomixing and microwave/THz waveform generation. An STWPD is a distributed device, both electrically and optically, which consists of a superconductive thin film kinetic-inductive photodetector integrated with a microwave/THz transmission line and an optical waveguide. We will present the principles of operation of STWPDs, a framework to calculate the input-output relation and the effects of the modal characteristics of the optical propagation on the device performance. Moreover, we will elaborate on how one can design an STWPD for each of the aforementioned applications. Different strategies for the design of the optical waveguide as well as some important design rules will also be discussed. We will report the current status of STWPDs and point out some key issues that should be met in the future for further development. [J148]

"Selectively enhanced emission and suppression in Si 0.5 Ge 0.5 /Si multiple quantum wells by photonic crystals"

Selective enhancement and suppression of the photoluminescence arising from Si0.5Ge0.5/Simultiple quantum wells by photonic crystals (PCs) have been demonstrated. The formation of the stop band in PCs is designed to be a filter as well as a reflector. It is found that the self-assembled PCs are able to selectively enhance the luminescence of the type-II transitions at the interface between Si and Si0.5Ge0.5/Silayers and suppress the emission from Si. Our working principle shown here can be extended to many other material systems and should be very useful for creating high power solid-state emitters. [J149]

"Ad Hoc Mobile Wireless Networks: Principles, Protocols, and Applications (Sarkar, S. K. et al.; 2008) [JBook Review]"

Mobile wireless ad hoc networks (MANETs) are a rapidly evolving telecommunications technology. Their popularity is connected with their easy deployment and fast configuration. This book is targeted at a variety of

readers with different levels of wireless network knowledge. Most of the presented material focuses on different layer protocols for ad hoc networks. It covers practical applications review and cross-layer design aspects, as well as quality of service (QoS), energy, and mobility issues. The book consists of ten chapters, and begins with a short introduction to wireless and ad hoc networks. Each chapter includes a short introduction in which the motivation can be found. At the end of each chapter, final conclusions are given that summarize the presented knowledge. In addition, extensive bibliography sections for deeper reading are attached to the end of each chapter. The book should be attractive to students and graduate students as well as lecturers and network engineers. [J150]

"Product Attribute Function Deployment (PAFD) for Decision-Based Conceptual Design"

The critical product planning phase, early in the product development cycle, requires a design tool to establish engineering priorities, select the preferred design concept, and set target levels of engineering performance while considering the needs of both the consumer and producer. The quality function deployment (QFD) method was developed as a design process tool to translate customer needs into engineering characteristics; however, limitations have been identified in using the QFD method for product planning. In this paper, a new design tool called product attribute function deployment (PAFD), based on the principles of decision-based design (DBD), is introduced as a decision-theoretic, enterprise-level process tool to guide the conceptual design phase. The PAFD method extends the qualitative matrix principles of QFD while utilizing the quantitative decision-making processes of DBD. The PAFD method is built upon established methods in engineering, marketing, and decision analysis to eliminate the need for the user ratings and rankings of performance, priority, and attribute coupling in the QFD method. The differences between the QFD and the PAFD processes are compared and contrasted, and the conceptual design of an automotive manifold absolute pressure sensor is used as a case study to demonstrate the features and benefits of the PAFD method. [J151]

"Practical implementation of a two-hemisphere plasma absorption probe"

The plasma absorption probe is a recently developed tool for efficient determination of electron densities of low temperature plasmas. The occurrence of multiple absorption signals was a serious drawback for interpretation of the probe data. To remedy this drawback, a spherically symmetric design of an absorption probe is proposed. A spherical probe is tested in experiment and simulation and the suppression of the multiple absorption signals is demonstrated. The proof of principle for the concept is given. [J152]

"High-fidelity and time-driven simulation of large wireless networks with parallel processing"

Parallel processing is a promising technique for reducing the execution time of a large and complex wireless network simulation. In this article, a parallel processing technique is presented for time-driven simulations of large and complex wireless networks. The technique explicitly considers the physical-layer details of wireless network simulators such as shadowing and co-channel interference. The technique uses multiple processors interconnected with highspeed links. Principles and issues are elaborated, including workload partitioning, synchronization, and database design. Numerical results from two different wireless network simulators employing the technique are presented to demonstrate the performance of the technique. The results indicate that the technique can significantly improve the run-time performance of time-driven simulations of large and complicated wireless networks of different types. [J153]

"Numerical Investigation of Ultrashort Complex Pulse Generation Based on Pulse Shaping Using a Superstructure Fiber Bragg Grating"

A technique for ultrashort complex pulse generation based on the pulse shaping of superstructure fiber Bragg grating (SSFBG) is presented. We apply this technique to illuminate the mutual transformation between Gaussian pulse and soliton pulse, generations of double optical pulse and complex millimeter wave (MMW) pulse by phase and amplitude profiling of 1-ps transform-limited pulse. The designed principle of grating is demonstrated; the corresponding refractive index distribution, the reflection spectrum and the characteristics of pulse transmission are also simulated. The results of this study indicate that this design method is very flexible for complex pulse generations. Finally, some potential applications for these complex pulses in the areas of ultrafast photonics, optical measurement, novel devices for optical communication system and so on are also listed and discussed. [J154]

"Qubit dispersive readout scheme with a microstrip superconducting quantum interference device amplifier"

A flux qubit readout scheme involving a dispersive technique coupled to a microstrip superconducting quantum

interference device (SQUID) amplifier has been tested experimentally. Thanks to the almost quantum limited noise of this amplifier at low temperature, this readout device is very promising for a design with actual qubits. Its proof of principle and low noise performance have been tested by simulating the qubit presence by applying a tiny flux change in the input SQUID. The resonant frequency of the amplifier is adjusted in situ with a varactor diode to approach the frequency of the tank circuit. Two operating modes (crossing or anticrossing regime) were identified. [J155]

"Block-Layout Design Using MAX-MIN Ant System for Saving Energy on Mass Rapid Transit Systems"

This paper presents a method of block-layout design between successive stations for mass rapid transit systems (MRTSs). The aim is to save energy under the framework of the fixed-block signaling (FBS) system and the equi-block principle. Unlike past research regarding the energy savings of train operation, this paper proposes a combinatorial optimization model to reduce the computation time. In the presented approach, the problem of minimizing the energy consumption between successive stations is first formulated as a combinatorial optimization problem. Then, the train-speed trajectory for saving energy is optimized by a MAX-MIN ant system (MMAS) of ant colony optimization (ACO) algorithms. Finally, the block layout is designed in accordance with the shortest block length under the equi-block principle. It is shown that the method presents a significant improvement for the reduction of computational burden on the block-layout design. The feasibility and benefits are verified via simulation study. Analyses and discussions are also given. [J156]

"Polarization tunable selective polariton generator"

A selective polariton generator (SPG) design, based on surface plasmon antennae principles, is demonstrated to provide a selective light transmission peak. The polarization-sensitive structure selectively generates and transports polaritons of a desired wavelength through a circular subwavelength aperture. By varying the SPG structure around a central nanohole, we are able to control the peak optical transmission wavelengths via the polarization state of the incident photons. We find good agreement between simulations and experimental results. [J157]

"Hydrogen storage in Al-N cage based nanostructures"

Recent efforts have been devoted to design new materials with exposed metal sites for hydrogen storage. Different from bulk AlN having the wurtzite structure and fourfold coordination, the Al sites in AlN cages are unsaturated and have threefold coordination, resulting in a storage weight percentage of 4.7%, while the adsorption energy of H2molecules can be controlled by the relative ratio of the unequivalent Al sites. A general expression of the adsorption energy is derived from first-principle calculations, which gives a guideline for tuning the structure to reach the desirable energy range for the storage operation under ambient thermodynamic conditions. [J158]

"Book reviews [Jreviews of ("Security and Cooperation in Wireless Networks: Thwarting Malicious and Selfish Behavior in the Age Ubiquitous Computing" ; Buttyan, L. and Hubaux, J.-P.; 2008) and ("RFID Design Principles"; Lehpamer, H. Ed.; 2008)]"

Two books are reviewed in this issue: Security and Cooperation in Wireless Networks: Thwarting Malicious and Selfish Behavior in the Age of Ubiquitous Computing (Buttyan, L. and Hubaux, J.-P.; 2008) and RFID Design Principles (Lehpamer, H., Ed.; 2008). [J159]

"A completely mechanical adjustable 2 GHz low-pass filter [JTechnical Committee]"

This article presents the design and the realization of a mechanical tunable stepped impedance low-pass filter. The basic concept of the filter is an adjustability that completely depends on a variation of the mechanical parts. The transmission line impedance is varied by changing the height of the grounded top cover above the filter structure. Designed for a basic cut-off frequency of 2 GHz, this produces a frequency deviation of approximately 33%. This article includes a brief theoretical background, the principle steps of the filter design with Agilent ADS and Ansoft Designer, a three-dimensional (3-D) simulation set-up with EMPIRE XCcel, and an overview of the hardware realization with a comparison of the measurement and simulation results. [J160]

"Multiobjective Evolutionary Decision Support for Design-Supplier-Manufacturing Planning"

Product development in modern enterprises usually involves collaboration among designers, suppliers, contract manufacturers to achieve efficiency and rapid response to changing markets. Product-development cost, lead time, and reliability are very critical elements in addition to functional features. However, it becomes increasingly

challenging to obtain an optimal decision with respect to these multiple criteria as the number of involved entities increases in modern product developments. There is a clear need for planning tools to support effective decision making in this domain. The availability of efficient and accurate multiobjective optimization (MOO) algorithms becomes critical in such a decision support tool. This paper poses the product development as a multiobjective assignment problem in the context of printed circuit board assembly (PCBA) industry. We describe a new class of MOO algorithm based on the principles of differential evolution (DE). The multiobjective DE (MODE) algorithm is shown to approach Pareto-optimal solutions in a wide class of problems with better performance than the nondominated sorting genetic algorithm II from the literature, providing a practical tool for product-development decision support. A decision support system based on the object-oriented design methodology is described in this paper with the MODE as the core search engine. Experimental study of this decision support system is conducted using two real-world PCBA designs. We demonstrate the effectiveness of this proposed MODE algorithm and some use cases of such decision support system on facilitating decision makers' tradeoff analysis. [J161]

"Boundary Search for Constrained Numerical Optimization Problems With an Algorithm Inspired by the Ant Colony Metaphor"

This paper presents a novel boundary approach that is included as a constraint-handling technique in an algorithm inspired by the ant colony metaphor. The necessity of approaching the boundary between the feasible and infeasible search space for many constrained optimization problems is a paramount challenge for every constraint-handling technique. Our proposed technique precisely focuses the search on the boundary region and can be either used alone or in combination with other constraint-handling techniques depending on the type and number of problem constraints. For validation purposes, an algorithm inspired by the ant colony metaphor is adopted as our search engine that works following one of the principles of the ant colony approach, i.e., a population of agents iteratively, cooperatively, and independently search for a solution. Each ant in the distributed algorithm applies a simple mutation-like operator, which explores the neighborhood region of a particular point in the search space (individualsearchlevel). The operator is designed for exploring the boundary between the feasible and infeasible search space. In addition, each ant obtains global information from the colony in order to exploit the most promising regions of the search space (cooperationlevel). We compare our proposed approach with respect to a well-known constraint-handling technique that is representative of the state-of-the-art in the area, using a set of standard test functions. [J162]

"Inverted-load network for high-power Doherty amplifier"

In this article, a high-power, high-efficiency inverted Doherty power amplifier (PA), having a more compact load network than that of the conventional Doherty amplifier, was designed and implemented for wide-band code-division multiple access (WCDMA) base-station applications. Its configuration and working principle are compared with the conventional Doherty amplifier. For experimental verification, we implemented an inverted Doherty amplifier, using a 190 W peak-envelope-power (PEP) laterally diffused metal-oxide-semiconductor (LDMOS) field-effect transistors (FETs). Using a four-carrier down-link WCDMA signal, we achieved a high power-added efficiency (PAE) of 32% and an average output power level as high as 46.3 dBm at a given adjacent channel leakage ratio (ACLR) level of -30 dBc. This is a 9.5% improvement in efficiency and 1 dB improvement in output power under the same ACLR conditions from those of the balanced class-AB operation using the same devices. [J163]

"PCA-Based Spatially Adaptive Denoising of CFA Images for Single-Sensor Digital Cameras"

Single-sensor digital color cameras use a process called color demosaicking to produce full color images from the data captured by a color filter array (CFA). The quality of demosaicked images is degraded due to the sensor noise introduced during the image acquisition process. The conventional solution to combating CFA sensor noise is demosaicking first, followed by a separate denoising processing. This strategy will generate many noise-caused color artifacts in the demosaicking process, which are hard to remove in the denoising process. Few denoising schemes that work directly on the CFA images have been presented because of the difficulties arisen from the red, green and blue interlaced mosaic pattern, yet a well designed ldquodenoising first and demosaicking laterrdquo scheme can have advantages such as less noise-caused color artifacts and cost-effective implementation. This paper presents a principle component analysis (PCA) based spatially-adaptive denoising algorithm, which works directly on the CFA data using a supporting window to analyze the local image statistics. By exploiting the spatial and spectral correlations existed in the CFA image, the proposed method can effectively suppress noise while preserving color edges and details. Experiments using both simulated and real CFA images indicate that the proposed scheme outperforms many existing approaches, including those sophisticated demosaicking and denoising schemes, in terms of both objective measurement and visual evaluation. [J164]

"Complete Logic Functionality of Reconfigurable RTD Circuit Elements"

Innovative nanoscale devices have been developed to enhance future circuit design to overcome physical barriers hindering the CMOS technology. Among the emerging nanodevices, resonant tunneling diodes (RTDs) have demonstrated promising electronic features due to their high-speed switching capability and functional versatility. Great circuit functionality can be achieved through integrating heterostructure FETs (HFETs) in conjunction with RTDs to modulate effective negative differential resistance. In this paper, we propose novel programmable logic elements (PLEs) implemented in threshold gates (TGs) and multithreshold TGs by exploring RTD/HFET monostable-bistable transition logic element (MOBILE) principles. Our three-input PLE can be configured through five binary control bits to realize all the three-variable logic functions, which is, to the best of our knowledge, the first single RTD-based structure that provides complete Boolean logic implementation. It is also a more efficient reconfigurable circuit element than a general lookup table that requires eight configuration bits for three-variable functions. We further extend the design concept to construct a more versatile four-input PLE. A comprehensive comparison of three- and four-input PLEs provides an insightful view of design tradeoffs between performance and area. We present the mathematical proof of PLE's logic completeness based on Shannon expansion, as well as the HSPICE simulation results of the programmable and primitive RTD/HFET gates that we have designed. An efficient control bit generating algorithm is developed by using a special encoding scheme to implement any given logic function. Based on our PLE structures, we propose a reconfigurable architecture, namely MORE, which offers dynamic reconfigurability without incurring latency overheads, due to the intrinsic self-latching property of MOBILE circuits. An efficient reconfiguration data generation algorithm is also built to take full advantage of-- our MORE architecture. The experimental results indicate that it can help reduce the reconfiguration cost by 37% on average. [J165]

"FPGA-based elman neural network control system for linear ultrasonic motor"

A field-programmable gate array (FPGA)-based Elman neural network (ENN) control system is proposed to control the mover position of a linear ultrasonic motor (LUSM) in this study. First, the structure and operating principle of the LUSM are introduced. Because the dynamic characteristics and motor parameters of the LUSM are nonlinear and time-varying, an ENN control system is designed to achieve precision position control. The network structure and online learning algorithm using delta adaptation law of the ENN are described in detail. Then, a piecewise continuous function is adopted to replace the sigmoid function in the hidden layer of the ENN to facilitate hardware implementation. In addition, an FPGA chip is adopted to implement the developed control algorithm for possible low-cost and high-performance industrial applications. The effectiveness of the proposed control scheme is verified by some experimental results. [J166]

"Rotary-linear piezoelectric actuator using a single stator"

We report a piezoelectric actuator having a single stator with rotary and linear motions (RLPA). The stator is fabricated as a single metallic cube with a through-hole. The surface of the inner circle of the hole generates elliptical motions at each natural frequency, transferring the energy to an output shaft, when AC voltages at the appropriate resonant frequency are applied to the piezoelectric elements. This study clarifies the principle of rotary and linear motions and uses finite element methods (FEM) to show how the elliptical motions are generated. Modal analysis illustrated the shapes of the vibration modes and the natural frequencies, and the shape of the stator was designed accordingly. A dynamic analysis of the stator showed the generation of elliptical motion in the directions of the rotary and linear motions. The prototype RLPA was successfully actuated at the resonant frequencies, consistent with the dynamic analysis. The speed of the rotary and linear motions was obtained. [J167]

"Quality Assessment of Computational Techniques and Software Tools for Planar-Antenna Analysis"

The goal of this paper is a thorough investigation of the quality of the software tools widely used nowadays in the field of planar-antenna analysis and synthesis. Six simulation tools-five well-known commercial tools and one developed in-house-are compared with each other for four different planar antennas. It is crucial to point out that all possible efforts have been made to guarantee the most optimal use of each of the software packages, to study in detail any discrepancies between the solvers, and to assess the remaining simulation challenges. The study clearly highlights the importance of understanding EM simulation principles and their inherent limitations for antenna designers. Finally, some designing guidelines are provided that also can simplify the initial selection of EM solvers. [J168]

"A Novel 3-D Microcavity Based on Bragg Fiber Dual-Tapers"

In this paper, a novel 3-D microcavity based on Bragg fiber dual-tapers is proposed. The principle and characteristics of the Bragg fiber dual-taper are analyzed firstly, showing that the dual-taper can function as a fiber mirror. Its reflection and transmission can be adjusted by the design of taper structure parameters. Then, the structure of a 3-D microcavity composed by two Bragg fiber dual-tapers is investigated by the finite-difference time domain method. The relation between the cavity-mode wavelengths and the cavity lengths shows that it can be looked as a Fabry-PEacuterot cavity, using the Bragg fiber dual-tapers as the mirrors. By proper design, a cavity-mode Q factor up to 4.0093times106can be realized in this cavity. Its characteristics as narrowband filters are investigated, showing that its transmission spectrum has the shape of Lorenz curve and a finesse up to 105can be realized if cavity mode with a high Q factor is used. The analysis shows that high-quality 3-D light confinement can be realized in the proposed Bragg fiber dual-taper microcavity, which has great potential in high-efficiency light-emitting devices and small fiber components. [J169]

"Component-Specific Usability Testing"

This paper presents the results of a meta-analysis carried out on the results of six experiments to support the claim that component-specific usability measures are on average statistically more powerful than overall usability measures when comparing different versions of a part of a system. An increase in test effectiveness implies the need for fewer participants in usability tests that study different versions of a component. Three component-specific measures are presented and analyzed: an objective efficiency measure and two subjective measures, one about the ease-of-use and the other about the users' satisfaction. Whereas the subjective measures are obtained with a questionnaire, the objective efficiency measure is based on the number of user messages received by a component. Besides describing the testing method, this paper also discusses the underlying principles such as layered interaction and multiple negative-feedback loops. The main contribution of the work described is the presentation of component-based usability testing as an alternative for traditional holistic-oriented usability tests. The former is more aligned with the component-based software engineering approach, helping engineers to select the most usable versions of a component. [J170]

"Voltage Contrast Inspection Methodology for Inline Detection of Missing Spacer and Other Nonvisual Defects"

A test structure specifically designed to allow inline detection of missing spacer is introduced. Missing spacer is too small to be physically detected with any current inspection tool and therefore its existence must be flagged using voltage contrast for detection with an e-beam inspection system. The structure and methodology used to address this defect during the ramp of a recent technology is described. Key benefits include a dramatically faster learning cycle and much better signal-to-noise ratio for split experiment evaluation. Missing spacer is one example of a growing class of nonvisual defects which will greatly impact future semiconductor technologies. General principles for designing test structures to detect these defect types are discussed. [J171]

"Tunable Ultranarrow Dual-Channel Filter Based on Sampled FBGs"

A new kind of ultranarrow dual-bandpass fiber Bragg grating is proposed and demonstrated, for the first time to the author's best knowledge, with a symmetrical technique in which the first and second half gratings are sampled with the period of 0-and-pi and pi-and-0, respectively. This kind of grating can achieve dual-wavelength operation with a symmetrical spectrum. The unique spectral property of the proposed gratings is analyzed by means of Fourier theory and confirmed experimentally. By integrating the proposed grating with the 0-and-pi sampling grating, an ultranarrow dual-channel filter is designed in principle and demonstrated experimentally whose 3-dB bandwidth is less than 1 pm. By stretching the gratings, the two wavelengths of the proposed filter can be tuned whereas their channel spacing remains unchanged. [J172]

"Detection and avoidance scheme for direct-sequence ultra-wideband system: a step towards cognitive radio"

Detection and avoidance (DAA) is a soft-spectrum-based adaptation scheme proposed for multi-band ultra-wideband (MB-UWB) radio as a measure of co-existence between UWB devices and existing radio systems in overlapped bands. However, the principle of DAA in the direct-sequence UWB (DS-UWB) is very different from that in MB-UWB method. In DS-UWB, re-design of transmission pulses is required each time a new set of allowed bandwidths is discovered, as opposed to the turning-off-carrier-tone way in MB-UWB. Therefore the re-design of DS-UWB pulses in a cognitive radio environment must be easily reconfigurable. The problem of synthesising DS-UWB pulses conforming to arbitrary spectrum masks is addressed. In the proposed method, the masks are expanded by orthonormal functions chosen to be Hermite-Gaussian functions (HGFs). As the HGFs are eigenfunctions to the fractional Fourier transform, of which the inverse Fourier transform is a particular case, the set of the HGFs constitutes both a time-domain and a frequency-domain basis, that is, a co-basis, and

therefore the transmission pulses can be easily obtained from the expansion of the specified spectrum masks. The co-basis-expansion-based DAA scheme for DS-UWB is evaluated through computer simulations. [J173]

"The Heterogeneous Systems Integration Design and Implementation for Lane Keeping on a Vehicle"

In this paper, an intelligent automated lane-keeping system is proposed and implemented on our vehicle platform, i.e., TAIWAN i TS-1. This system challenges the online integrating heterogeneous systems such as a real-time vision system, a lateral controller, in-vehicle sensors, and a steering wheel actuating motor. The implemented vision system detects the lane markings ahead of the vehicle, regardless of the varieties in road appearance, and determines the desired trajectory based on the relative positions of the vehicle with respect to the center of the road. To achieve more humanlike driving behavior such as smooth turning, particularly at high levels of speed, a fuzzy gain scheduling (FGS) strategy is introduced to compensate for the feedback controller for appropriately adapting to the SW command. Instead of manual tuning by trial and error, the methodology of FGS is designed to ensure that the closed-loop system can satisfy the crossover model principle. The proposed integrated system is examined on the standard testing road at the Automotive Research and Testing Center (ARTC)1and extra-urban highways. [J174]

"Logistic Regression Modeling of Construction Negotiation Outcomes"

Construction disputes are always negotiated before other resolution methods are considered. When it comes to negotiation, the tactics used by a negotiator is central in deriving desired outcomes. This paper reports a research that employs logistic regression (LR) to predict the probabilistic relationship between negotiator tactics and negotiation outcomes. To achieve this, three main stages of work were involved. Negotiator tactics and negotiation outcomes were first identified from literature. Then, four LR prediction models with negotiation outcomes as the dependent variable and negotiator tactics as the independent variables were constructed. Finally, these models were validated with an independent set of testing data. These models collectively suggested that: 1) increasing time pressure, taking threats, or subjecting the opponent to reality testing are inductive to "deterioration" negotiation outcomes; 2) providing various options and increasing flexibility would achieve "substantial improvement" in negotiation; 3) relationships between parties could be maintained by fair play; and 4) focusing on information exchange, giving middiscussion summaries, and offering counterproposal could clarify a party's position. Despite the skepticism over frank and open discussion of the issues and the existence of game plan, the findings of this research do support some well-established negotiation principles-focus on the issue and play down behavioral factors. [J175]

"WIPL-D Software Validates Babinet's Principle"

Antenna CAD software continues to increase in its capacity to solve electromagnetic problems. Recently, the WIPL-D software added a feature that permits the validation of the long-standing antenna design principle, Babinet's principle. This is truly unique, and is indicative of how advanced antenna computer software has become. This paper presents a WIPL-D validation of Babinet's principle. [J176]

"Robust Engineered Circuit Design Principles for Stochastic Biochemical Networks With Parameter Uncertainties and Disturbances"

Biochemical regulatory networks including genes, proteins and other regulatory molecules suffer from internal parametrical fluctuations (thermal, transcriptional, and splicing) as well as external noises (environmental and intercellular). Robustness is an essential property of intracellular biochemical regulatory networks to attenuate the effects of internal fluctuation and external noise. In this study, several system control schemes are proposed for the robust circuit control design of stochastic linear and nonlinear biochemical regulatory networks. First, the robust stability of genetic and proteomic regulatory networks is discussed under internal fluctuations. Then, the filtering ability of external noises is analyzed for stochastic biochemical regulatory networks. For the case where a biochemical regulatory network is not sufficiently robust to tolerate internal fluctuation and does not have enough filtering ability to filter the external noise, how to improve the robustness and noise filtering ability of stochastic biochemical regulatory networks by engineered control mechanisms is also proposed via biochemical circuit design. The proposed robust gene circuit design principles have potential applications for robust biosynthetic network design. Finally, two design examples are given in-silicoto illustrate the design procedure and to confirm the performance of the proposed robust circuit design method. [J177]

"Soliton Spectral Tunneling in Dispersion-Controlled Holey Fibers"

We design a number of index-guiding holey fibers with relatively simple structure which possess suitable

dispersive properties for the observation of soliton spectral tunneling. Although the fabrication tolerances for these fibers are demanding, numerical simulations show that tunneling across a normal dispersion region of 150 nm width when pumped in the near infrared is in principle possible using just a few meters of these fibers. [J178]

"Bulk acoustic wave RF technology"

In this article, we will provide an overview of BAW filter technology by discussing comparison between BAW and SAW RF filter technologies, working principles of BAW resonator and filter, BAW resonator key performance parameters, comparison between free-standing bulk acoustic resonator (FBAR) and solidly mounted resonator (SMR) technologies, status of BAW resonator design and models, BAW filter manufacturing challenges, and future BAW technology improvement directions. [J179]

"Dynamic switching behavior of bistable chiral-tilted homeotropic nematic liquid crystal displays"

This investigation elucidates the transient behavior associated with switching between two stable states of a bistable chiral-tilted homeotropic nematic liquid crystal device. Experimental results reveal that the applied pulse voltages and durations not only determine the final states but are interestingly related to the relaxation time. When a suitable pulse voltage is applied, the minimum relaxation time can be obtained by adjusting the pulse duration. Analyzing the hydrodynamic behavior of the liquid crystal directors explicates the switching mechanism and relaxation processes. The principles that underlie the design of the waveforms to have the minimum relaxation time are obtained. [J180]

"Planar Hollow-Core Waveguide Technology for Atomic Spectroscopy and Quantum Interference in Alkali Vapors"

Atomic vapors of alkali metals are widely used to slow and stop light in tabletop experiments. In order to take advantage of the underlying quantum interference effects in future commercial devices, highly reactive alkali atoms must be incorporated into small volumes with integrated optical access. With integration in mind, we describe the development of a hollow-core waveguide technology based on the combination of vapor-filled hollow waveguides and conventional solid-core waveguides on a silicon chip. We discuss the underlying principles of the waveguide design, the development of different approaches to building on-chip vapor cells, the demonstration of linear and nonlinear rubidium spectroscopy on a chip, and the prospects for quantum interference effects such as slow light and giant Kerr nonlinearities using this approach. Ultrasmall active vapor volumes on the order of 100 picoliters with simultaneously high optical density in excess of two illustrate the potential of planar hollow-core waveguides for linear and nonlinear optical spectroscopy of atoms confined on a chip. [J181]

"Principles of design of a set-reset finite state logic nanomachine"

Pulsed electrical set and reset inputs are used to simulate the temporal action of a finite state machine in a three terminal configuration for a variety of arrangements. The gate electrode is necessary only if it is of interest to tune the tunneling rate and to compensate for background charges. When the output is the current, a source and drain electrodes are required. If the output is determined by measuring charge occupancy, then a single junction suffices. The electron transfer rates are computed from the free energy change for a single electron transfer to or from a quantum dot of size such that only charge quantization matters. For a small enough dot the device could operate at room temperature. An asymmetric configuration of the source and drain favors a longer term time preservation of the memory of the device. An alternative design that operates with the same energetics and kinetic parameters is to pulse the resistance rather than the voltage. [J182]

"Simulation on binding efficiency of immunoassay for a biosensor with applying electrothermal effect"

The working principle of immunoassays is based on the specific binding reaction of an analyte-ligand protein pair in physiological environments. However, for a diffusion-limited protein, the diffusion boundary layer of the analyte on the reaction surface of a biosensor would hinder the binding reaction from association and dissociation. The formation of such association and dissociation layers thus limits the response time and the overall performance of a biosensor. In this work we have performed a two-dimensional full time scale finite element simulation on the binding reaction kinetics of two commonly used proteins, C-reactive protein (CRP) and immunoglobulin G (IgG). By applying a nonuniform ac electric field to the flow microchannel of the biosensor, the electrothermal force can be generated to induce a pair of vortices to stir the flow field. With the aid of the vortices and a suitable choice of the location of the biosensor, the fluids flowing over the reacting surface can be accelerated fast enough to

depress efficiently the growth of the diffusion boundary layer on the reaction surface, and enhance the association or dissociation of analyte-ligand complex. The interference patterns of the flow field due to the existence of the sensor at different locations of the microchannel could cause different degrees of enhancement to the association and the dissociation. By changing the location of the sensor the largest enhancement is found at the position near the negative electrode. For the configuration of the microchannel we studied, the initial slope of the curve of the analyte-ligand complex versus time can be raised up to 5.17 for CRP and 1.93 for IgG in association, and 3.74 for CRP and 1.28 for IgG in dissociation, respectively, under the applied ac field 15Vrmspeak-to-peak and operating frequency 100 kHz. At this optimal sensor location, we also studied the effect of various settings of te- mperature boundary conditions on the top and bottom walls, including the two limiting cases, namely, constant temperature and thermal insulation on both walls. We show that varying the temperature boundary conditions can cause an essential effect on the enhancement of the binding reaction and can be employed to find an optimal binding enhancement. Utilizing these simulation results, an improved design incorporating a pair of electrodes and a neck region near the reaction surface is demonstrated. The sensor is fixed to locate at the middle of the bottom side. With the existence of the stirring flow field, the association rate of the 30mcmneck is 2.73 times faster than that of the original channel with no neck. [J183]

"Tunable bandgap structures of two-dimensional boron nitride"

Electronic structures of two-dimensional (2D) hexagonal boron nitride (h-BN) with different planar strain distributions have been studied using the first principles methods. We found that the 2D h-BN without strain has a large direct bandgap and its bandgap structure strongly depends on the strength and direction of the strain. The bandgap width can be reduced significantly under both symmetrical and asymmetrical strain distributions. Moreover, the bandgap feature exhibits strong anisotropic behaviors. The bandgap remains direct under large symmetrical tensile strain or asymmetrical tensile strain perpendicular to B-N bonds. However, a small amount of symmetrical compressive strain larger than 1.5% or asymmetrical tensile strain parallel to B-N bonds larger than 1.2% turns the direct bandgap into indirect. Our results indicate that optical and electronic transport properties of 2D h-BN can be effectively tuned by applying different planar forces, offering a unique route for designing nanoscale tunable ultrathin optoelectronic devices only one atomic layer thick. [J184]

"Design Principles and IT Overviews of the GEO Grid"

As the Earth's ecosystem is a spatially and temporally complex system by nature, it is not sufficient to observe such events and phenomena locally; problems must be solved on a global scale. Therefore, the accumulation of knowledge about the Earth in various forms and a scientifically correct understanding of the Earth are necessary. The authors have been leading the ldquoGlobal Earth Observation (GEO) Gridrdquo project since 2005, which is primarily aimed at providing an e-Science infrastructure for the worldwide Earth sciences community. In the community, there are wide varieties of existing datasets including satellite imagery, geological data, and ground sensed data that each data owner insists own licensing policy. Also, there are so many related projects that will be configured as a virtual organization (VO) enabled by Grid technology. The GEO Grid is designed to integrate all of the relevant data virtually, again enabled by Grid technology, and is accessible as a set of services. In this paper, first we describe design principles of the GEO Grid that are determined based on accommodating users requirements for publishing, managing, and using data. Second, software architecture and its preliminary implementations are specified where we take the Grid computing and Web service technologies as the core components that comply with a standard set of technologies and protocols. In addition, GEO Grid has been recognized to contribute to GEO or Global Earth Observation System of Systems (GEOSS) as a part of the Japanese government's commitment. [J185]

"RFID Transponders"

The objective of this article is to review radio frequency identification (RFID) technology, its developments on RFID transponders, design and operating principles, so that end users can benefit from knowing which transponder meets their requirements. In this article, RFID system definition, RFID transponder architecture and RFID transponder classification based on a comprehensive literature review on the field of research are presented. Detailed descriptions of these tags are also presented, as well as an in-house developed semiactive tag in a compact package. [J186]

"Structural, wetting, and electronic properties of metal clusters adsorbed on carbon nanotubes"

Atomic structures of M4(M=TiandFe)metal clusters on the surface of single-walled carbon nanotubes (SWNT) are studied by the first principles calculations. The various equilibrium structures and total energies of M4cluster-SWNT composites are presented, which reveal that the relative energies between the tetrahedral and planar configurations correspond to the wetting properties of metal clusters adsorbed on carbon nanotubes. Electronic

properties of the M4+SWNTcomposites are also presented to show the highly spin polarized behaviors. Our results suggest that the M4+SWNTcomposite is a simple and typical model to study the interactive effects and architectures of metal clusters absorbed on carbon nanotubes, which can be further exploited for the design of nanoscale electrodes and nanoelectronic devices. [J187]

"Complex Wavelet Bases, Steerability, and the Marr-Like Pyramid"

Our aim in this paper is to tighten the link between wavelets, some classical image-processing operators, and David Marr's theory of early vision. The cornerstone of our approach is a new complex wavelet basis that behaves like a smoothed version of the Gradient-Laplace operator. Starting from first principles, we show that a single-generator wavelet can be defined analytically and that it yields a semi-orthogonal complex basis of L2(R2), irrespective of the dilation matrix used. We also provide an efficient FFT-based filterbank implementation. We then propose a slightly redundant version of the transform that is nearly translation-invariant and that is optimized for better steerability (Gaussian-like smoothing kernel). We call it the Marr-like wavelet pyramid because it essentially replicates the processing steps in Marr's theory of early vision. We use it to derive a primal wavelet sketch which is a compact description of the image by a multiscale, subsampled edge map. Finally, we provide an efficient iterative algorithm for the reconstruction of an image from its primal wavelet sketch. [J188]

"Efficient Nonlocal Means for Denoising of Textural Patterns"

This paper contributes two novel techniques in the context of image restoration by nonlocal filtering. First, we introduce an efficient implementation of the nonlocal means filter based on arranging the data in a cluster tree. The structuring of data allows for a fast and accurate preselection of similar patches. In contrast to previous approaches, the preselection is based on the same distance measure as used by the filter itself. It allows for large speedups, especially when the search for similar patches covers the whole image domain, i.e., when the filter is truly nonlocal. However, also in the windowed version of the filter, the cluster tree approach compares favorably to previous techniques in respect of quality versus computational cost. Second, we suggest an iterative version of the filter that is derived from a variational principle and is designed to yield nontrivial steady states. It reveals to be particularly useful in order to restore regular, textured patterns. [J189]

"Prediction of surface temperature rise of ultrasonic diagnostic array transducers"

Temperature rise at the surface of an ultrasound transducer used for diagnostic imaging is an important factor in patient safety and regulatory compliance. This paper presents a semianalytical model that is derived from first principles of heat transfer and is simple enough to be implemented in a commercial ultrasound scanner for real-time forecasting of transducer surface temperature. For modeling purposes, one-dimensional array transducers radiating into still air are considered. Promising experimental verification data are shown and practical implementation benefits of the model for thermal design and management of ultrasonic array transducers are discussed. In particular, the reduction in the amount of thermal characterization data required, compared to empirical models, shows promise. [J190]

"Equivariant Holomorphic Filters for Contour Denoising and Rapid Object Detection"

It is well known that linear filters are not powerful enough for many low-level image processing tasks. However, it is also very difficult to design robust nonlinear filters that respond exclusively to features of interest and that are, at the same time, equivariant with respect to translation and rotation. This paper proposes a new class of rotation-equivariant nonlinear filters that is based on the principle of group integration. These filters become efficiently computable by an iterative scheme based on repeated differentiation of products and summations of intermediate results. The relations of the proposed approach to Volterra filters and steerable filters are shown. In the context of detection problems, the filter may be interpreted as some kind of generalized Hough transform. The experiments show that the new filter can be used for enhancing noisy contours and rapid object detection in microscopical images. In the detection context, our experiments show that the proposed filter is definitely superior to alternative approaches, when high localization accuracy is required. [J191]

"Z-path SAW RFID tag"

Surface acoustic wave (SAW) radio-frequency identification (RFID) tags are soon expected to be produced in very high volumes. The size and cost of a SAW RFID tag will be key parameters for many applications. Therefore, it is of primary importance to reduce the chip size. In this work, we describe the design principles of a 2.4-GHz SAW RFID tag that is significantly smaller than earlier reported tags. We also present simulated and experimental results. The coded signal should arrive at the reader with a certain delay (typically about 1 mus), i.e., after the reception of environmental echoes. If the tag uses a bidirectional interdigital transducer (IDT), space for the initial delay is needed on both sides of the IDT. In this work, we replace the bidirectional IDT by a

unidirectional one. This halves the space required by the initial delay because all the code reflectors must now be placed on the same side of the IDT. We reduce tag size even further by using a Z-path geometry in which the same space in x-direction is used for both the initial delay and the code reflectors. Chip length is thus determined only by the space required by the code reflectors. [J192]

"Reduce Afterpulsing of Single Photon Avalanche Diodes Using Passive Quenching With Active Reset"

In this paper, we report a passive-quenching-with-active-reset circuit designed to reduce afterpulsing for single photon avalanche diodes. This circuit uses a large resistor to passively quench the avalanche current and a transistor to actively reset the device to the operating voltage after a specified hold-off time. Afterpulsing can be reduced by minimizing the stray capacitance of the package to reduce the total charge flow during avalanche. Proof of principle is demonstrated with discrete components. It is expected that by integrating the transistor with the avalanche photodiode the stray capacitance can be minimized to significantly reduce afterpulsing. [J193]

"Molecular Motors: Design, Mechanism, and Control"

Theoretical modeling and computer simulations of molecular motors provide insight that engineers can exploit to design and control artificial nanomotors.For obvious reasons, the study of molecular motors has been a traditional area of research in molecular cell biology and biochemistry, but in recent years, it has attracted physicists' as well as engineers. Exploring the design and mechanisms of these motors from an engineering perspective requires investigating their structure and dynamics using the fundamental principles of physics at the subcellular level. The insights gained from such fundamental research could also find practical applications in designing and manufacturing artificial nanomotors-motors whose typical size is usually in the rage of a few nanometers to a few tens of nanometers. In contrast to man-made macroscopically large motors, natural nanomotors have evolved over billions of years. While discussing the design, mechanism, and control of molecular motors, this article also compares their macroscopic counterparts to emphasize common features as well as differences. [J194]

"Design and Simulation of a Nanophotonic Traceable Memory Using Localized Energy Dissipation and Hierarchy of Optical Near-Field Interactions"

Optical near-field interactions allow energy localization at scales smaller than the diffraction limit of light. They also show intrinsic hierarchical responses, meaning that optical near-fields exhibit different physical behavior at different scales. In this paper, by combining the localized energy dissipation and hierarchy properties, we present an architecture for a novel traceable optical memory that records memory access events to each bit, which is useful in applications such as high-security information transfer. The basic principles are demonstrated by numerical simulations using a metal nanostructure. [J195]

"Architecture of Qbox: A scalable first-principles molecular dynamics code"

We describe the architecture of Qbox, a parallel, scalable first-principles molecular dynamics (FPMD) code. Qbox is a C++/Message Passing Interface implementation of FPMD based on the plane-wave, pseudopotential method for electronic structure calculations. It is built upon well-optimized parallel numerical libraries, such as Basic Linear Algebra Communication Subprograms (BLACS) and Scalable Linear Algebra Package (ScaLAPACK), and also features an Extensible Markup Language (XML) interface built on the Apache Xerces-C library. We describe various choices made in the design of Qbox that led to excellent scalability on large parallel computers. In particular, we discuss the case of the IBM Blue Gene/L™ platform on which Qbox was run using up to 65,536 nodes. Future design challenges for upcoming petascale computers are also discussed. Examples of applications of Qbox to a variety of first-principles simulations of solids, liquids, and nanostructures are briefly described. [J196]

"A Suite of Robust Controllers for the Manipulation of Microscale Objects"

A suite of novel robust controllers is introduced for the pickup operation of microscale objects in a microelectromechanical system (MEMS). In MEMS, adhesive, surface tension, friction, and van der Waals forces are dominant. Moreover, these forces are typically unknown. The proposed robust controller overcomes the unknown contact dynamics and ensures its performance in the presence of actuator constraints by assuming that the upper bounds on these forces are known. On the other hand, for the robust adaptive critic-based neural network (NN) controller, the unknown dynamic forces are estimated online. It consists of an action NN for compensating the unknown system dynamics and a critic NN for approximating a certain strategic utility function and tuning the action NN weights. By using the Lyapunov approach, the uniform ultimate boundedness of the

closed-loop manipulation error is shown for all the controllers for the pickup task. To imitate a practical system, a few system states are considered to be unavailable due to the presence of measurement noise. An output feedback version of the adaptive NN controller is proposed by exploiting the separation principle through a high-gain observer design. The problem of measurement noise is also overcome by constructing a reference system. Simulation results are presented and compared to substantiate the theoretical conclusions. [J197]

"Vision Processing for Realtime 3-D Data Acquisition Based on Coded Structured Light"

Structured light vision systems have been successfully used for accurate measurement of 3D surfaces in computer vision. However, their applications are mainly limited to scanning stationary objects so far since tens of images have to be captured for recovering one 3D scene. This paper presents an idea for real-time acquisition of 3D surface data by a specially coded vision system. To achieve 3D measurement for a dynamic scene, the data acquisition must be performed with only a single image. A principle of uniquely color-encoded pattern projection is proposed to design a color matrix for improving the reconstruction efficiency. The matrix is produced by a special code sequence and a number of state transitions. A color projector is controlled by a computer to generate the desired color patterns in the scene. The unique indexing of the light codes is crucial here for color projection since it is essential that each light grid be uniquely identified by incorporating local neighborhoods so that 3D reconstruction can be performed with only local analysis of a single image. A scheme is presented to describe such a vision processing method for fast 3D data acquisition. Practical experimental performance is provided to analyze the efficiency of the proposed methods. [J198]

"Media-independent handover for seamless service provision in heterogeneous networks"

The performance of current Internet applications is based mainly on the capabilities of the underlying network technologies. Modern access systems usually can satisfy delay, loss, or bandwidth requirements; however, design inconsistencies can lead to service degradation as the terminals move across different systems. In this article, the focal point is the satisfaction of service requirements during mobility and more specifically, how the emerging IEEE 802.21 standard enables seamless, inter-technology handover. Based on prior work and a well-known example of seamless mobility, the main seamless mobility principles are identified and used as the basis for further evaluating the potential of the IEEE 802.21 standard to meet the requirements of applications for minimum disruption during an inter-technology handover. [J199]

"The Iseult/Inumac Whole Body 11.7 T MRI Magnet Design"

A neuroscience research center with very high field MRI equipments has been opened in November 2006 by the CEA life science division. One of the imaging systems will require a 11.75 T magnet with a 900 mm warm bore. Regarding the large aperture and field strength, this magnet is a real challenge as compared to the largest MRI systems ever built, and is then developed within an ambitious R&D program, Iseult, focus on high field MRI. The conservative MRI magnet design principles are not readily applicable and other concepts taken from high energy physics or fusion experiments, namely the Tore Supra tokamak magnet system, will be used. The coil will thus be made of a niobium-titanium conductor cooled by a He II bath at 1.8 K, permanently connected to a cryoplant. Due to the high level of stored energy, about 340 MJ, and a relatively high nominal current, about 1500 A, the magnet will be operated in a non-persistent mode with a conveniently stabilized power supply. In order to take advantage of superfluid helium properties and regarding the high electromagnetic stresses on the conductors, the winding will be made of wetted double pancakes meeting the Stekly criterion for cryostability. The magnet will be actively shielded to fulfill the specifications regarding the stray field. [J200]

"Superconductive Traveling-Wave Photodetectors: Fundamentals and Optical Propagation"

This paper studies the theory of superconductive traveling-wave photodector devices (STWPDs), as a general platform for ultrafast, ultrasensitive, and ultralow-noise optoelectronic functions such as detection, modulation, photomixing, high-frequency electrical signal generation and amplification. Principles of operation of STWPDs are discussed based on the kinetic-inductance theory of superconductive thin films and a thorough investigation of the guiding mechanism of light within this class of devices is presented. The transfer matrix method is introduced to model the superconductive optical waveguide in TWDs and an efficient numerical method based on the Cauchy integral method and the argument principle method are developed for the analysis and design of the waveguides. Moreover, several regimes of device operation will be distinguished in terms of the modal characteristics of the optical waveguide and their effects on the overall performance of the device will be highlighted. [J201]

"LARP Long Quadrupole Design"

A major milestone for the LHC Accelerator Research Program (LARP) is the test, by the end of 2009, of two 4

m-long quadrupole magnets (LQ) wound with Nb3Sn conductor. The goal of these magnets is to be a proof of principle that Nb3Sn is a viable technology for a possible LHC luminosity upgrade. The design of the LQ is based on the design of the LARP Technological Quadrupoles, presently under development at FNAL and LBNL, with 90-mm aperture and gradient higher than 200 T/m. The design of the first LQ model will be completed by the end of 2007 with the selection of a mechanical design. In this paper we present the coil design addressing some fabrication technology issues, the quench protection study, and three designs of the support structure. [J202]

"Magic Angle Rotating Field NMR/MRI Magnet for In Vivo Monitoring of Tissue"

A magic angle rotating field (MARF) NMR/MRI magnet has been designed and built, demonstrating future potential to realize vivo measurement of the chemical composition of specific biological tissues and organs, This proof of principle prototype opens the possibility for in situ magic angle scanning of stationary, living, biological specimens. Magnetic design strategy and performance capability are described. [J203]

"Study on Homopolar Superconductivity Synchronous Motors for Ship Propulsion Applications"

Superconductivity synchronous motors compared with conventional motors can reduce the motor size and enhance the motor efficiency for low-speed and high torque applications under the space constraints for propulsion system. Especially, homopolar superconductivity synchronous motors (HSSMs) need less superconductor and lower magnetic flux density in superconductor field coil than air-cored superconductivity synchronous motors (ASSMs). In addition, mechanical structure is more simplified and stability is increased because the superconductor field coil of HSSMs is not rotated in operation. In this paper, we present the outline of HSSMs including structure, characteristics and operational principles with the conceptual design of HSSM. [J204]

"Defect-Aware High-Level Synthesis and Module Placement for Microfluidic Biochips"

Recent advances in microfluidics technology have led to the emergence of miniaturized biochip devices, also referred to as lab-on-a-chip, for biochemical analysis. A promising category of microfluidic biochips relies on the principle of electrowetting-on-dielectric, whereby discrete droplets of nanoliter volumes can be manipulated using an array of electrodes. As chemists adapt more bioassays for concurrent execution on such ldquodigitalrdquo droplet-based microfluidic platforms, system integration, design complexity, and the need for defect tolerance are expected to increase rapidly. Automated design tools for defect-tolerant and multifunctional biochips are important for the emerging marketplace, especially for low-cost, portable, and disposable devices for clinical diagnostics. We present a unified synthesis method that combines defect-tolerant architectural synthesis with defect-aware physical design. The proposed approach allows architectural-level design choices and defect-tolerant physical design decisions to be made simultaneously. We use a large-scale protein assay and the polymerase chain reaction procedure as case studies to evaluate the proposed synthesis method. We also carry out simulations based on defect injection to evaluate the robustness of the synthesized biochip designs. [J205]

"Erbium-Based Photonic Flip-Flop Memories: Model and Experimental Validation"

Operating principle for a flip-flop memory cell based on erbium-doped devices is presented. A complete model for memory dynamics is introduced taking into account, at the same time, for memory writing, reading, and erasing. Simple equations are found relating writing, spontaneous and stimulated erasing times to device physical parameters, signals wavelength and power. In principle, for example, increasing writing and erasing energies at the appropriate wavelength it is possible to dramatically reduce transition times. Extinction ratio (ER) is also determined as a function of host medium, and signals properties. An optimization technique is proposed for erasing signal design in order to guarantee maximum ER. Numerical example are provided for Er and Er-Yb doped fibers whose doping ion density is rho = 1.1413middot1024ions/m3, and 2.0 middot1025ions/m3, respectively. Finally, an experimental demonstration giving an Er higher than 5 and 16 dB for the two fibers, respectively, is provided and discussed. [J206]

"In-Plane Silicon-On-Nothing Nanometer-Scale Resonant Suspended Gate MOSFET for In-IC Integration Perspectives"

A 14-MHz in-plane nanoelectromechanical resonator based on a resonant-suspended-gate (RSG) MOSFET principle and integrated in a front-end process is demonstrated. The devices are in-plane flexural vibration mode beams (L = 10 mum, w = 165 nm, and h = 400 nm) with 120-nm gaps. This letter details the design and process flow fabrication steps. Then, the electrical device characteristics are demonstrated, comprising static and dynamic studies around the resonant frequency. Devices enable the comparison of a pure capacitive detection with the RSG-MOSFET-based detection on the same component, showing a 4.3-dB-huge peak. Due to its

output signal amplification and in-IC integration potentialities, the RSG-MOSFET-based detection is ideal for any type of nanoelectromechanical structure displacement detection. [J207]

"Full Resolution Structural Finite Element Analysis of the CEA/Iseult 11.75T MRI Coil"

A neuroscience research center with very high field MRI equipments has been opened in November 2006 by the CEA life science division. One of the imaging systems requires a highly homogeneous 11.75T magnet with a 900 mm warm bore. We describe the principle of calculation of the main coil deformations in order to perform field homogeneity loss assessment and mechanical dimensioning. This coil is wounded as double pancakes laterally wetted by HeII. As preliminary calculation runs led to high hoop stress levels, and due to the composite nature of this winding pack, a detailed finite element model of the coil structure is needed to obtain accurate computation of the displacement and stresses. Also, this finite element model serves as reference solution to validate a homogenized model. Then, a mixed full resolution/homogenized model is constructed in order to reduce the mesh size. A good correlation between this mixed model and full resolution one is observed. These three kinds of models will be exploited during the development phase of the magnet, to conduct mechanical design and estimation of field homogeneity losses. [J208]

"Low-Loss NbTi Rutherford Cable for Application to the SIS-300 Dipole Magnet Prototype"

INFN (Istituto Nazionale di Fisica Nucleare, Italy) has started in 2006 the DISCORAP project, which foresees the design, manufacture and test of a dipole prototype for the SIS-300 synchrotron of the FAIR facility at GSI. In order to minimize the losses produced by the fast ramp rate (1 T/s) at which the magnet is operated, we are developing with European industries, a Rutherford cable which incorporates several technologies to reduce the losses, and namely a NbTi filament diameter on the order of 2.5-3.5 mum, Cu 0.5 wt%Mn interfilamentary matrix and stainless steel core. In this paper we present the design principles and the first experimental results; we also analyze the impact of the CuMn paramagnetism on the field distortion at the different operating magnetic fields. [J209]

"Birefringence of beta -Ba B 2 O 4 crystal in the terahertz region for parametric device design"

beta -BaB2O4(BBO) was found to have huge birefringence in the 0.1-1.1THzfrequency region. Polarized terahertz transmission spectroscopy revealed a Delta n/nvalue of about 0.12±0.02. This result could be related to a polarization-dependent absorption that was observed at about 0.65THz; in close agreement with first principles-calculations, showing this to be due to low-frequency phonon modes of the [B3O6]3-rings. These findings suggest the utilization of the birefringent properties of BBO for optical parametric devices including amplifiers and oscillators, operating in the terahertz regime. [J210]

"Phase stability and elastic modulus of Ti alloys containing Nb, Zr, and/or Sn from first-principles calculations"

The alloying effects of Nb, Zr, and/or Sn on the phase stability and elastic properties of Ti are investigated by using a first-principles method. Our calculation results indicate that a carefully designed Ti-Nb-Zr-Sn system can be a good candidate for low modulus biomedical materials. We find that the well-known correlation between the e/aratio and both elastic and phase stabilities for Ti alloyed with transition metal elements breaks down for the Ti-Sn alloy. [J211]

"Design principles for particle plasmon enhanced solar cells"

We develop fundamental design principles for increasing the efficiency of solar cells using light trapping by scattering from metal nanoparticles. We show that cylindrical and hemispherical particles lead to much higher path length enhancements than spherical particles, due to enhanced near-field coupling, and that the path length enhancement for an electric point dipole is even higher than the Lambertian value. Silver particles give much higher path length enhancements than gold particles. The scattering cross section of the particles is very sensitive to the thickness of a spacer layer at the substrate, which provides additional tunability in the design of particle arrays. [J212]

"Wavelength selective coupler with vertical gratings on silicon chip"

We propose a wavelength selective coupler using vertical grating structure on silicon chip and discuss the operation principle and the analytic design procedure. The transmission spectra expected by the procedure agree with finite difference time domain simulation results. We then fabricate the designed wavelength selective coupler and demonstrate the expected operation. The available wavelength-division-multiplexing bandwidth of this device is not limited by free spectral range as in ring resonators. We also propose some applications of the

wavelength selective coupler. [J213]

"An active-optic x-ray fluorescence analyzer with high energy resolution, large solid angle coverage, and a large tuning range"

A crystal-optic x-ray fluorescence energy analyzer has been designed and tested, which combines the features of electron-volt energy resolution, large solid angle coverage, and tunability over several kilo-electron-volts. The design is based upon the principle of active optics, with ten actuators available to optimally adjust the shape of a silicon crystal used in the Bragg geometry. In most applications the shape is that of a logarithmic spiral for high energy resolution with a spatially nonresolving detector, but a wide range of other shapes is also possible for applications such as imaging or single-shot spectroscopy in a spectral range of the operator's choosing. [J214]

"Dust as a versatile matter for high-temperature plasma diagnostic"

Dust varies from a few nanometers to a fraction of a millimeter in size. Dust also offers essentially unlimited choices in material composition and structure. The potential of dust for high-temperature plasma diagnostic is largely unfulfilled yet. The principles of dust spectroscopy to measure internal magnetic field, microparticle tracer velocimetry to measure plasma flow, and dust photometry to measure heat flux are described. Two main components of the different dust diagnostics are a dust injector and a dust imaging system. The dust injector delivers a certain number of dust grains into a plasma. The imaging system collects and selectively detects certain photons resulted from dust-plasma interaction. One piece of dust gives the local plasma quantity, a collection of dust grains together reveals either two-dimensional (using only one or two imaging cameras) or three-dimensional (using two or more imaging cameras) structures of the measured quantity. A generic conceptual design suitable for all three types of dust diagnostics is presented. [J215]

"Submillisecond response nematic liquid crystal modulators using dual fringe field switching in a vertically aligned cell"

A fast response nematic liquid crystal (LC) modulator using dual fringe field switching (DFFS) mode is demonstrated. Both top and bottom substrates have pixel and common electrodes to generate complementary fringing fields. The cell consists of a vertically aligned LC layer whose dielectric anisotropy is positive. In a voltage-on state, self-imposed thin LC walls near the center of the slits and electrodes are formed and the surrounding LC molecules exert a strong restoring force. As a result, submillisecond gray-to-gray response time is achieved. Two DFFS cells are used as examples to illustrate the design principles for display and photonic applications. [J216]

"Surface bound organic nanowires"

The results of a comparative study of nanowires grown on single crystalline substrates from para-hexaphenylene, alpha -sexithiophene, and 5,5'-Di-4-biphenyl-2,2'-bithiophene are presented. Due to their interesting optical properties such nanowires are of importance for future integrated optoelectronic devices. From atomic force microscopy and polarized far-field optical microscopy data, it is deduced that epitaxy and electrostatic interactions determine the microscopic growth mechanism, whereas kinetics ascertains the macroscopic habit. Understanding such basic growth principles for these systems allows one to predict qualitatively nanowire surface growth from other conjugated molecules and thus allows for a sophisticated design of new devices. [J217]

"Application of flux reversal principle for axial flux permanent magnet machines"

Applications of flux reversal machine can be found both for linear and radial flux machines. For axial flux machines, only one application is reported considering a two phase machine. In general, flux reversal effect can produce higher back electromotive forces than other topologies for the less amount of permanent magnets and thus can increase the performance of the machine. Combining the axial structure with the flux reversal effect feature allows higher power density machines suitable for high speed or low speed direct drive applications. Proposed model has a 12-slot stator and a 16-pole variable reluctance rotor. Nd-Fe-B magnets are fixed on the surface of the pole of the stator. The objective of this article is to present an effective method for the design and performance prediction for the axial flux reversal configuration. Basic dimension equations are presented and a two-dimensional equivalent model based on finite element analysis is used for the reduction of the simulation time. [J218]

"First principles calculations of the formation energy and deep levels associated with the neutral and charged vacancy in germanium"

Density functional theory with local density approximation including on-site Coulomb interaction has been used to calculate the formation energy of the neutral and charged vacancy in germanium as a function of the Fermi level. The calculations suggest that vacancies in germanium are multiple-level acceptors with a first level at 0.02eVand a second level at 0.26eVabove the valence band maximum in agreement with published experimental data. The formation energies of the neutral and charged vacancies line up well with the experimental values estimated from quenching experiments. [J219]

"The design evaluation of inductive power-transformer for personal rapid transit by measuring impedance"

The contact-less inductive power transformer (IPT) uses the principle of electromagnetic induction. The concept of the IPT for vehicles such as the personal rapid transit (PRT) system is proposed and some suggestions for power collector design of IPT to improve power transfer performance are presented in this paper. The aim of this paper is to recommend the concept of IPT for vehicles such as the PRT system and also to present some propositions for the power collector design of the IPT, which is to improve the power transfer performance. Generally, there are diverse methods to evaluate transfer performance of the traditional transformers. Although the principle of IPT is similar to that of the general transformer, it is impossible to apply the methods directly because of large air gap. The system must be compensated by resonant circuit due to the large air gap. Consequently, it is difficult to apply numerical formulas to the magnetic design of IPT systems. This paper investigates the magnetic design of a PRT system using three-dimensional magnetic modeling and measurements of the pick-up coupling coefficient and its impedances. In addition, how the use of Litz wire and leakage inductance is related will be observed through experiment and simulation. [J220]

"Effect of dopants on grain boundary decohesion of Ni: A first-principles study"

First-principles density functional theory (DFT) calculations were used to determine decohesion properties of Sigma 5(012)grain boundary of Ni with dopants B, C, S, Cr, and Hf. The relative stability of sites was evaluated and cleavage energies were calculated. Electronic structure was used to understand these properties in terms of changes in bonding with addition of dopants. It was found that strengthening of the Ni grain boundary results from Hf, B, and Cr doping. In contrast, the grain boundary weakens with S and C doping. These results should be useful in the design of next-generation nanostructured Ni-based alloys with improved mechanical behavior. [J221]

"Polarization switching in epitaxial films of BaTiO 3 : A molecular dynamics study"

We use molecular dynamics simulations with a first-principles model Hamiltonian to study polarization switching in ultrathin epitaxial films of BaTiO3sandwiched by ideal electrodes as a function of temperature and epitaxial strain. We find that the coercive fields of polarization switching reduce with tensile epitaxial strain and as temperature increases up to the transition, and depend sensitively on the nature of the epitaxial constraint. Our results should be directly relevant to the design of high frequency ferroelectric random access memories made with ultrathin epitaxial ferroelectric films. [J222]

"Magnetic coupling properties of Mn-doped ZnO nanowires: First-principles calculations"

Based on the density functional theory, we study the magnetic coupling properties of Mn-doped ZnO nanowires. For the nanowires with passivated surfaces, the antiferromagnetic state is found and the Mn atoms have a clustering tendency. When the distance between two Mn atoms is large, the system energetically favors the paramagnetic or spin-glass state. For the nanowires with unpassivated surfaces, the ferromagnetic (FM) coupling states appear between the two nearest Mn atoms, and the zinc vacancies can further stabilize the FM states between them. The electrons with enough concentration possibly mediate the FM coupling due to the negative exchange splitting of conduction band minimum induced by the s-dcoupling, which could be useful in nanomaterial design for spintronics. [J223]

"A generalized, periodic nonlinearity-reduced interferometer for straightness measurements"

Periodic nonlinearity is a systematic error limiting the accuracy of displacement measurements at the nanometer level. However, an interferometer with a displacement measurement accuracy of less than 1nmis required in nanometrology and in fundamental scientific research. To meet this requirement, a generalized, periodic nonlinearity-reduced interferometer, based on three construction principles has been developed for straightness measurements. These three construction principles have resulted in an interferometer with a highly stable design with reduced periodic nonlinearity. Verifications by a straightness interferometer have demonstrated that the periodic nonlinearity was less than 40pm. The results also demonstrate that the interferometer design is capable

of subnanometer accuracy and is useful in nanometrology. [J224]

"A robust volumetric apparatus and method for measuring high pressure hydrogen storage properties of nanostructured materials"

A volumetric apparatus to measure hydrogen adsorption and desorption at room temperature and up to 100atmhas been constructed and studied for accuracy, reproducibility, and stability. The design principles are presented and considerable attention to detail is given to examine the effects of diurnal temperature changes in the manifold and helium adsorption by carbon-based adsorbents during free volume measurement. A heuristic for helium correction is derived from a model with a basis in literature and verified through calculation of adsorbent density. Several materials with well-known hydrogen capacities are studied to examine reproducibility. The microporous carbon AX-21 is studied to examine the effects of pressure step size and approach to equilibrium caused by gas mixing and the Joule-Thomson effect. Hydrogen spillover on a hybrid material, Pt on templated carbon, is examined for several loadings of metal. Kinetics of both physisorption and spillover are compared via the diffusion time constant (D/R2)estimated by fitting models for pore and surface diffusion to time-dependent adsorption profiles. No concentration dependence was found for pore diffusion; however, the surface diffusion time constant was shown to decrease with respect to increasing hydrogen concentration. [J225]

"The Thomson deflectometer: A novel use of the Thomson spectrometer as a transient field and plasma diagnostic"

Laser accelerated proton beams have been used for field characterization in expanding plasmas. The Thomson parabola spectrometer, as a charged particles analyzer, also allows precise measurement of the charged particles' trajectories. The proton's deflections by fast changing plasma fields can be measured with the new design of the Thomson parabola spectrometer and, therefore, it can be applied for proton deflectometry. It is shown that from resulting spectrograms the plasma field dynamics can be reconstructed with high temporal resolution. In a proof-of-principle experiment, a weakly relativistic plasma expansion is studied as an example. [J226]

"Force approximation for a plasma actuator operating in atmospheric air"

A plasma actuator has been studied using a self-consistent multibody system of quiescent air, plasma, and dielectric. Equations governing the motion of charged and neutral species have been solved with Poisson's equation. Based on first principles analysis, a functional relationship between electrodynamic force and electrical and physical control parameters has been approximated and numerically tested for air. The magnitude of approximated force increases with the fourth power of the amplitude of rf potential. Thus, the induced fluid velocity also increases. The induced velocity shows momentum injection very close to the actuator surface. There is, however, a very small increase in the induced velocity with the forcing frequency. For the specific range of operational parameters considered, the proposed force relation may help speed up the plasma actuator design process. [J227]

"Characteristics of a dust trajectory sensor"

Trajectories of cosmic dust particles are determined by the measurement of the electrical signals that are induced when a charged grain flies through a position-sensitive electrode system. A typical dust trajectory sensor has four sensor planes consisting of about 16 wire electrodes each. Two adjacent planes have orthogonal wire directions. The sensor is highly transparent and mechanically robust, provides a large sensitive area, large field of view, and can, at least in principle, achieve unlimited precision. While a sensor model had already undergone limited testing in the dust laboratory, its response as a function of position and angle of incidence of the trajectory and as a function of sensor dimensions was generally unknown. To better understand its characteristics, the operation of a sensor model consisting of three planes and seven wires per plane was simulated using the COULOMB computer program. We show that the response of the reduced model can be applied to a model with more planes and more wires per plane. The effect of a trajectory's position and angle on the signal strength is discussed as well as the influence of geometrical parameters such as wire diameter, distance between wire planes, and wire length. We found a greater effect of the wire diameter on the signal strength, and a lesser effect of the plane distance, than expected. A set of similarity rules is provided for the design of a larger sensor. Finally, we discuss the optimization of the sensor for different applications. [J228]

"Development of eddy current microscopy for high resolution electrical conductivity imaging using atomic force microscopy"

We present a high resolution electrical conductivity imaging technique based on the principles of eddy current

and atomic force microscopy (AFM). An electromagnetic coil is used to generate eddy currents in an electrically conducting material. The eddy currents generated in the conducting sample are detected and measured with a magnetic tip attached to a flexible cantilever of an AFM. The eddy current generation and its interaction with the magnetic tip cantilever are theoretically modeled using monopole approximation. The model is used to estimate the eddy current force between the magnetic tip and the electrically conducting sample. The theoretical model is also used to choose a magnetic tip-cantilever system with appropriate magnetic field and spring constant to facilitate the design of a high resolution electrical conductivity imaging system. The force between the tip and the sample due to eddy currents is measured as a function of the separation distance and compared to the model in a single crystal copper. Images of electrical conductivity variations in a polycrystalline dual phase titanium alloy (Ti-6Al-4V) sample are obtained by scanning the magnetic tip-cantilever held at a standoff distance from the sample surface. The contrast in the image is explained based on the electrical conductivity and eddy current force between the magnetic tip and the sample. The spatial resolution of the eddy current imaging system is determined by imaging carbon nanofibers in a polymer matrix. The advantages, limitations, and applications of the technique are discussed. [J229]

"High-resolution multiwire proportional soft x-ray diagnostic measurements on TCV"

A multiwire proportional x-ray (MPX) detector is used on the TCV tokamak (Tokamak a configuration variable) as a high spatial and temporal resolution soft x-ray emissivity imaging diagnostic. The MPX system consists of 64 vertically viewing channels and has been designed to complement the existing TCV soft x-ray tomography system by enhancing the spatial resolution. The MPX detector is suitable for the measurement of fast and localized phenomena and can be used, for instance, for the observation of magnetohydrodynamic activity, for the characterization of transport barriers or for an improved determination of the electron cyclotron heating power deposition profile. The MPX detector operates in continuous-current mode and measures the plasma soft x-ray emission in the 3-30keVrange with a radial resolution of about 5mm-1% of plasma diameter-and a frequency bandwidth of 50kHz. A detailed description of the MPX detector construction and the principle of its operation are given. The properties of the detector in photon-counting and continuous-current operation modes are studied. The implementation of the system on TCV and experimental results illustrating the potential of the diagnostic are also presented. [J230]

"Compact EЧB mass separator for heavy ion beams"

A compact EЧBmass separator that deflects beam by 30° has been designed and built to prove its principle of operation. The main part of the separator is contained in a shielding box of 11cmlong, 9cmwide, and 1.5cmhigh. An electromagnet of 7cmpole diameter produced variable magnetic field in the mass separation region instead of a couple of permanent magnets which is to be used in the final design. The experimental result agreed well with the theoretical prediction, and larger mass ions is bent with less magnetic field with the aid of the deflection electric field. The reduction in resolving power for mass separation due to the deflection electric field has been investigated experimentally. [J231]

"An LTS-SQUID Based Measurement Tool for Characterization of Superconductive RF Cavities"

This paper presents a new system to measure very low currents in an accelerator environment, using a cryogenic current comparator (CCC). In principle a CCC is a conventional current transformer using the high performance SQUID technology to sense the magnetic fields caused by the beam current. Since the system is sensitive on a pA level, it is an optimum device to detect dark currents of superconducting cavities. The system presented here is designed for the test facilities of the superconducting accelerator modules for the European XFEL at the Deutsches Elektronen-Synchrotron (DESY) in Hamburg. Measurements in a quiet environment showed that an intrinsic noise level of the CCC of 40/radicHz could be achieved. [J232]

"Development and Test of a Superconducting Fault Current Limiter-Magnetic Energy Storage (SFCL-MES) System"

A superconducting fault current limiter-magnetic energy storage (SFCL-MES) system for substation applications is proposed. SFCL-MES system can limit not only the peak fault current, but also the steady fault current. Moreover, it can provide high-quality power for the critical customers of the substation at the same time. A 100 kJ/1000 A/20 kVA SFCL-MES prototype system is developed, and it mainly consists of a NbTi magnet with two coaxial and homocentric solenoids for reducing stray field, a three-half-bridge converter and a current regulator. The principle of SFCL-MES is analysed, the design and experiment results for the SFCL-MES system are described. [J233]

"The 5 m HTS Power Cable Development and Test"

In the Russia's Scientific R&D Cable Institute (VNIIKP) the 5 m cable core sample was produced and tested as a first prototype in preparation for the production of a proposed 30 m 3-phase cable with a design rating of 2 kArms and planned operating voltage 20 kV. The work is done in the framework of the FGC-VNIIKP Project on R&D of HTS power cables, funded by Russia's Federal Grid Company's (FGC) "United Energy Systems". Before starting the full length cable production the extensive technology studies have been performed. These works permitted to develop the proper former and cabling technologies for the long HTS power cables. To verify the calculations and designing principles the first prototype was heavily instrumented to measure current distribution among layers, voltage-current characteristics and other parameters. The details of the design of the cable model and test results are presented and discussed. [J234]

"A New Cooling Technology for the Cooling of HTS Magnets"

For decades, the cooling method of conventional superconducting magnets has been "pool-boiling" in liquid cryogen. The commercial availability of HTS superconductors with an operating temperature in the 20 K region however calls for a new cooling strategy due to cost and availability of the new coolants involved. In this paper an alternative to the traditional bath-cooling of magnets with liquid helium is presented by employing a network of dedicated cooling tube structures capable of satisfying the different operating conditions of the magnet as well as the conductor stability requirements. The proposed closed-loop cooling tube concept based on the thermosiphon principle without loss of coolants and minimizing the coolant inventory while at the same time requiring no operator intervention has been tested. The design and the test results are discussed. [J235]

"Discrepancies in Modeling Magnets Utilizing MgB 2 Conductor With Ferro- and Non-Magnetic Matrix Configurations"

The electromagnetic properties of an MgB2superconductor depend on a matrix metal. Therefore, the design principles of an MgB2magnet are greatly affected by the matrix metal of the conductor. A ferromagnetic matrix requires a complex nonlinear modeling whereas in case of non-magnetic matrix the models developed for LTS magnets can be adopted. In this paper a design analyses of linear and non-linear MgB2coils are compared. Also, feasibility of linear model in non-linear case is studied. As an example a design scheme of a mu-SMES solenoid with MgB2-W/Fe and MgB2-SiC/Nb/AgMg wires is outlined. [J236]

"Assessment of Motion of a Swing Leg and Gait Rehabilitation With a Gravity Balancing Exoskeleton"

The gravity balancing exoskeleton, designed at University of Delaware, Newark, consists of rigid links, joints and springs, which are adjustable to the geometry and inertia of the leg of a human subject wearing it. This passive exoskeleton does not use any motors but is designed to unload the human leg joints from the gravity load over its range-of-motion. The underlying principle of gravity balancing is to make the potential energy of the combined leg-machine system invariant with configuration of the leg. Additionally, parameters of the exoskeleton can be changed to achieve a prescribed level of gravity assistance, from 0% to 100%. The goal of the results reported in this paper is to provide preliminary quantitative assessment of the changes in kinematics and kinetics of the walking gait when a human subject wears such an exoskeleton. The data on kinematics and kinetics were collected on four healthy and three stroke patients who wore this exoskeleton. These data were computed from the joint encoders and interface torque sensors mounted on the exoskeleton. This exoskeleton was also recently used for a six-week training of a chronic stroke patient, where the gravity assistance was progressively reduced from 100% to 0%. The results show a significant improvement in gait of the stroke patient in terms of range-of-motion of the hip and knee, weight bearing on the hemiparetic leg, and speed of walking. Currently, training studies are underway to assess the long-term effects of such a device on gait rehabilitation of hemiparetic stroke patients. [J237]

"Robot-Aided Neurorehabilitation: A Robot for Wrist Rehabilitation"

In 1991, a novel robot, MIT-MANUS, was introduced to study the potential that robots might assist in and quantify the neuro-rehabilitation of motor function. MIT-MANUS proved an excellent tool for shoulder and elbow rehabilitation in stroke patients, showing in clinical trials a reduction of impairment in movements confined to the exercised joints. This successful proof of principle as to additional targeted and intensive movement treatment prompted a test of robot training examining other limb segments. This paper focuses on a robot for wrist rehabilitation designed to provide three rotational degrees-of-freedom. The first clinical trial of the device will enroll 200 stroke survivors. Ultimately 160 stroke survivors will train with both the proximal shoulder and elbow MIT-MANUS robot, as well as with the novel distal wrist robot, in addition to 40 stroke survivor controls. So far 52 stroke patients have completed the robot training (ongoing protocol). Here, we report on the initial results on 36 of these volunteers. These results demonstrate that further improvement should be expected by adding

additional training to other limb segments. [J238]

"A Multiscale Framework for Spatial Gamut Mapping"

Image reproduction devices, such as displays or printers, can reproduce only a limited set of colors, denoted the color gamut. The gamut depends on both theoretical and technical limitations. Reproduction device gamuts are significantly different from acquisition device gamuts. These facts raise the problem of reproducing similar color images across different devices. This is well known as the gamut mapping problem. Gamut mapping algorithms have been developed mainly using colorimetric pixel-wise principles, without considering the spatial properties of the image. The recently proposed multilevel gamut mapping approach takes spatial properties into account and has been demonstrated to outperform spatially invariant approaches. However, they have some important drawbacks. To analyze these drawbacks, we build a common framework that encompasses at least two important previous multilevel gamut mapping algorithms. Then, when the causes of the drawbacks are understood, we solve the typical problem of possible hue shifts. Next, we design appropriate operators and functions to strongly reduce both haloing and possible undesired over compression. We use challenging synthetic images, as well as real photographs, to practically show that the improvements give the expected results. [J239]

"Design of a Grating-Assisted Lateral Directional Coupler by Impurity-Induced Quantum-Well Intermixing of InGaAs/GaAs"

An asymmetric waveguide grating-assisted coupler, which is suitable for a coarse wavelength division multiplexing system, based on a quantum-well intermixing process in InGaAs/GaAs, has been designed. The proposed device processing is similar to that used in nominal microelectronics processing. The device has been modeled from the first principle of refractive- index change due to F-implantation and anneal. The coupler has been analyzed by quasi-static effective index as well as finite difference methods in conjunction with an orthonormal-mode beam propagation method. A power-coupling ratio of ~90% at a wavelength of 1.51 mum with a coupled wavelength bandwidth of ~22 nm has been obtained. The coupler lengths are within a few millimeters, and the device is suitable for multiwavelength integration. [J240]

"Magnetization Modeling of Twisted Superconducting Filaments"

This paper presents a new finite element numerical method to analyse the coupling between twisted filaments in a superconducting multifilament composite wire. To avoid the large number of elements required by a 3D code, the proposed method makes use of the energy balance principle in a 2D code. The relationship between superconductor critical current density and local magnetic flux density is implemented in the program for the Bean and modified Kim models. The modeled wire is made up of six filaments twisted together and embedded in a low-resistivity matrix. Computations of magnetization cycle and of the electric field pattern have been performed for various twist pitch values in the case of a pure copper matrix. The results confirm that the maximum magnetization depends on the matrix conductivity, the superconductor critical current density, the applied field frequency, and the filament twist pitch. The simulations also lead to a practical criterion for wire design that can be used to assess whether or not the filaments are coupled. [J241]

"On Achieving Fairness in the Allocation of Scarce Resources: Measurable Principles and Multiple Objective Optimization Approaches"

Equity principles are embedded within a multiple objective framework for obtaining optimal solutions to a generic allocation problem, such as the fair distribution of water, energy, or other types of key resources among users in society. Because of the great import of fresh water as a scarce and diminishing resource within and among many nations of the world, the equity concepts are used in the allocation of water rights and subsequent water transfers or trades among users to improve the economic efficiency of water utilization. More specifically, water allocation is formulated as a generalized multiple objective problem and then the measurable fairness principles are used in the development of two approaches for equitable water rights allocation. In particular, the proposed priority-based maximal multiperiod network flow programming method has a social aggregation function satisfying the monotonicity and priority principles, and thus is a priority equitable allocation approach. The lexicographic minimax water shortage ratios method, which satisfies the principles of monotonicity, impartiality, and equitability, generates perfectly equitable solutions. The priority ranks and weights used in the two proposed approaches, respectively, are designed to achieve fair treatment of all the competitors for access to limited water resources and constitute important parameters. The capabilities of the approaches are tested and demonstrated in applications to the Aral Sea Basin in Central Asia and the South Saskatchewan River Basin in Western Canada. [J242]

"Exact variational nonlocal stress modeling with asymptotic higher-order strain gradients for nanobeams"

This article presents a complete and asymptotic representation of the one-dimensional nanobeam model with nonlocal stress via an exact variational principle approach. An asymptotic governing differential equation of infinite-order strain gradient model and the corresponding infinite number of boundary conditions are derived and discussed. For practical applications, it explores and presents a reduced higher-order solution to the asymptotic nonlocal model. It is also identified here and explained at length that most publications on this subject have inaccurately employed an excessively simplified lower-order model which furnishes intriguing solutions under certain loading and boundary conditions where the results become identical to the classical solution, i.e., without the small-scale effect at all. Various nanobeam examples are solved to demonstrate the difference between using the simplified lower-order nonlocal model and the asymptotic higher-order strain gradient nonlocal stress model. An important conclusion is the discovery of significant over- or underestimation of stress levels using the lower-order model, particularly at the vicinity of the clamped end of a cantilevered nanobeam under a tip point load. The consequence is that the design of a nanobeam based on the lower-order strain gradient model could be flawed in predicting the nonlocal stress at the clamped end where it could, depending on the magnitude of the small-scale parameter, significantly over- or underestimate the failure criteria of a nanobeam which are governed by the level of stress. [J243]

"An Exact Algorithm for Optimal MAE Stack Filter Design"

We propose a new algorithm for optimal MAE stack filter design. It is based on three main ingredients. First, we show that the dual of the integer programming formulation of the filter design problem is a minimum cost network flow problem. Next, we present a decomposition principle that can be used to break this dual problem into smaller subproblems. Finally, we propose a specialization of the network Simplex algorithm based on column generation to solve these smaller subproblems. Using our method, we were able to efficiently solve instances of the filter problem with window size up to 25 pixels. To the best of our knowledge, this is the largest dimension for which this problem was ever solved exactly [J244]

"A coupled finite-element, boundary-integral method for simulating ultrasonic flowmeters"

Today's most popular technology of ultrasonic flow measurement is based on the transit-time principle. In this paper, a numerical simulation technique applicable to the analysis of transit-time flowmeters is presented. A flowmeter represents a large simulation problem that also requires computation of acoustic fields in moving media. For this purpose, a novel boundary integral method, the Helmholtz integral-ray tracing method (HIRM), is derived and validated. HIRM is applicable to acoustic radiation problems in arbitrary mean flows at low Mach numbers and significantly reduces the memory demands in comparison with the finite-element method (FEM). It relies on an approximate free-space Green's function which makes use of the ray tracing technique. For simulation of practical acoustic devices, a hybrid simulation scheme consisting of FEM and HIRM is proposed. The coupling of FEM and HIRM is facilitated by means of absorbing boundaries in combination with a new, reflection-free, acoustic-source formulation. Using the coupled FEM-HIRM scheme, a full three-dimensional (3-D) simulation of a complete transit-time flowmeter is performed for the first time. The obtained simulation results are in good agreement with measurements both at zero flow and under flow conditions [J245]

"Multihop Ad Hoc Networking: The Theory"

This article reviews the basic principles behind mobile ad hoc networks (MANET) and critically discusses approximately ten years of research in this field. We summarize the main achievements and point out the limits of MANET research. This research was conducted under the assumption that the networks mainly will be used for large-scale general consumer applications, and nodes would be ubiquitous, thus reasonably dense and active. Both assumptions do not reflect reality and certainly would not be true in an initial phase of deployment. A lack of realism regarding the objective of MANET coupled with a lack of realism during the design of MANET are the main causes of MANET running a high risk of failure [J246]

"Admission Control in Multiservice IP Networks: Architectural Issues and Trends"

The trend toward the integration of current and emerging applications and services in the Internet has launched new challenges regarding service deployment and management. Within service management, admission control has been recognized as a convenient mechanism to keep services under controlled load and ensure the required QoS levels, bringing consistency to the services offered. In this context, this article discusses the role of AC in multiservice IP networks, and surveys current and representative AC approaches. We address and compare the architectural principles of these AC approaches and their main features, virtues, and limitations that have an

impact on the quality control of network services. We identify important design aspects that contribute to the successful deployment of flexible and scalable AC solutions in multiservice networks [J247]

"Feasibility Study of SOA-Based Noise Suppression for Spectral Amplitude Coded OCDMA"

We investigate the benefits of employing a saturated semiconductor optical amplifier (SOA) to reduce the optical noise in an incoherent light optical code division multiple access (OCDMA) system. In the context of spectrum slicing, SOA-based noise suppression has shown significant potential in enhancing the signal quality of noisy light. In this paper, we evaluate the viability of the technique for spectral amplitude coded OCDMA and show that the benefits of SOA-based noise suppression do not extend readily to this application due to post-SOA optical-filtering effects at the receiver. However, appreciable performance improvements can in principle be realized through optimized system and decoder design [J248]

"Being Sensitive to Uncertainty"

Predictive modeling's effectiveness is hindered by inherent uncertainties in the input parameters. Sensitivity and uncertainty analysis quantify these uncertainties and identify the relationships between input and output variations, leading to the construction of a more accurate model. This survey introduces the application, implementation, and underlying principles of sensitivity and uncertainty quantification [J249]

"Dynamic resource allocation in OFDM systems: an overview of cross-layer optimization principles and techniques"

Recently, a lot of research effort has been spent on cross-layer system design. It has been shown that cross-layer mechanisms (i.e., policies) potentially provide significant performance gains for various systems. In this article we review several aspects of cross-layer system optimization regarding wireless OFDM systems. We discuss basic optimization models and present selected heuristic approaches realizing cross-layer policies by means of dynamic resource allocation. Two specific areas are treated separately: models and dynamic approaches for single transmitter/receiver pairs (i.e., a point-to-point communication scenario) as well as models and approaches for point-to-multipoint communication scenarios (e.g., the downlink of a wireless cell). This article provides basic knowledge in order to investigate future OFDM cross-layer-optimization issues [J250]

"Design and Testing of a Superconducting Rotating Machine"

We have designed, constructed and tested an eight-pole superconducting rotating machine, based on an unconventional topology that could potentially lead to a significant increase in power density. Calculations have been carried out in two steps: estimation of the magnetic scalar potential from a Coulomb formulation using the Markov chain Monte Carlo (MCMC) method, and the calculation of the flux density by derivation of the potential using a regularization method. The use of the MCMC method enables the calculation of the magnetic scalar potential in selected regions of the discrete geometry, which is an important factor to minimize the computation time. The principle of the operation has been validated by a successful testing of the motor showing this novel configuration of an electrical motor as very promising [J251]

"An Immune Algorithm for Protein Structure Prediction on Lattice Models"

We present an immune algorithm (IA) inspired by the clonal selection principle, which has been designed for the protein structure prediction problem (PSP). The proposed IA employs two special mutation operators, hypermutation and hypermacromutation to allow effective searching, and an aging mechanism which is a new immune inspired operator that is devised to enforce diversity in the population during evolution. When cast as an optimization problem, the PSP can be seen as discovering a protein conformation with minimal energy. The proposed IA was tested on well-known PSP lattice models, the HP model in two-dimensional and three-dimensional square lattices', and the functional model protein, which is a more realistic biological model. Our experimental results demonstrate that the proposed IA is very competitive with the existing state-of-art algorithms for the PSP on lattice models [J252]

"Product Development Cost Estimation in Mass Customization"

The ultimate goal of mass customization is to achieve economies of both scope and scale. This goal implies a conflict between customization and economy of scale (or mass production) in the traditional manufacturing paradigm. However, recent developments in computer and Internet communication technologies, concurrent engineering, and modular design methodology provide concepts, methods and technology infrastructure for realizing mass customization. One of the findings from numerous research efforts on mass customization is the use of e-commerce technologies to manage a product development chain that links customers, suppliers and

manufacturers together to approach concurrently customized products in a short time and at the low cost level of mass production, i.e., mass customization. To ensure the success of mass customization in a product development chain, a rapid, automatic yet accurate cost estimate and control system is needed. This paper presents a cost index structure, which is a novel data structure, together with two novel cost estimate methods, viz. the generative cost estimate method and the variant cost estimate method, for the development of a semi or fully automatic computer-aided cost estimate and control system in mass customization. Finally, an industrial case is reported in the paper to illustrate the principles and feasibility of the proposed data structure, methods and system framework [J253]

"How Small and Medium Enterprises Effectively Participate in the Mass Customization Game"

It is increasingly more evident that mass customization (MC) has become a key strategy for those companies operating in markets where offering customers more choice is the only remaining differentiator. However, the impact on small and medium enterprises (SMEs) is not always clear as the resources required to implement such a strategy in an SME often falls beyond what is considered to be acceptable risk. The purpose of this paper is to discuss the issue of whether SMEs truly know how to effectively operate in an environment driven by customization. This paper introduces and demonstrates, through two case studies, how the principles of MC have been adopted by SMEs within the context of manufacturing agility and product flexibility. The paper explores the issues of product configuration, component similarity and the set of tools and measures of performance developed to steer the MC implementation process. The paper examines how the reuse of common components in product families can reduce internal variety. Coefficients that measure the similarity of products within a family are presented. These consider the factors of product structure, cost, volume and contribution. The "product-component matrix" is introduced to represent product families and calculate the similarity coefficients [J254]

"Design, Fabrication, and Test of a Superconducting Dipole Magnet Based on Tilted Solenoids"

It can be shown that, by superposing two solenoid like thin windings that are oppositely skewed (tilted) with respect to the bore axis, the combined current density on the surface is "cos-theta" like and the resulting magnetic held in the bore is a pure dipole. As a proof of principle, such a magnet was designed, built and tested as part of a summer undergraduate intern project. The measured field in the 25 mm bore, 4 single strand layers using NbTi superconductor, exceeded 1 T. The simplicity of this high field quality design, void of typical wedges end-spacers and coil assembly, is especially suitable for insert-coils using High Temperature Superconducting wire as well as for low cost superconducting accelerator magnets for High Energy Physics. Details of the design, construction and test are reported. [J255]

"Fast Global Kernel Density Mode Seeking: Applications to Localization and Tracking"

Tracking objects in video using the mean shift (MS) technique has been the subject of considerable attention. In this work, we aim to remedy one of its shortcomings. MS, like other gradient ascent optimization methods, is designed to find local modes. In many situations, however, we seek the global mode of a density function. The standard MS tracker assumes that the initialization point falls within the basin of attraction of the desired mode. When tracking objects in video this assumption may not hold, particularly when the target's displacement between successive frames is large. In this case, the local and global modes do not correspond and the tracker is likely to fail. A novel multibandwidth MS procedure is proposed which converges to the global mode of the density function, regardless of the initialization point. We term the procedure annealed MS, as it shares similarities with the annealed importance sampling procedure. The bandwidth of the procedure plays the same role as the temperature in conventional annealing. We observe that an over-smoothed density function with a sufficiently large bandwidth is unimodal. Using a continuation principle, the influence of the global peak in the density function is introduced gradually. In this way, the global maximum is more reliably located. Since it is imperative that the computational complexity is minimal for real-time applications, such as visual tracking, we also propose an accelerated version of the algorithm. This significantly decreases the number of iterations required to achieve convergence. We show on various data sets that the proposed algorithm offers considerable promise in reliably and rapidly finding the true object location when initialized from a distant point [J256]

"Design of WDM Cross Connect Based on Interleaved AWG (IAWG) and a Phase Shifter Array"

A general design rule for interleaved arrayed waveguide gratings (IAWGs) is derived. A 1timesN WDM switch that is based on a phase shifter array, which is sandwiched between two N-IAWGs, is systematically analyzed. A practical design example of a 1times4 nonblocking wavelength division multiplexing (WDM) switch is detailed to illustrate the design steps and the required phase assignment of each phase shifter for various output states. Based on the reciprocity principle, a simplified structure of the 1timesN WDM switch is proposed, which requires

only one N-IAWG with total reflection implemented at the end of each phase shifter. This type of NtimesN WDM switch can be used as a fundamental building block to construct the nonblocking WDM all-optical switch that will be indispensable for future all-optical networks. [J257]

"Piezoelectric transformer structural modeling-a review"

A review on piezoelectric transformer structural modeling is presented. The operating principle and the basic behavior of piezoelectric transformers as governed by the linear theory of piezoelectricity are shown by a simple, theoretical analysis on a Rosen transformer based on extensional modes of a nonhomogeneous ceramic rod. Various transformers are classified according to their structural shapes, operating modes, and voltage transforming capability. Theoretical and numerical modeling results from the theory of piezoelectricity are reviewed. More advances modeling on thermal and nonlinear effects also are discussed. The article contains 167 references. [J258]

"Intrinsic lattice thermal conductivity of semiconductors from first principles"

We present an ab initio theoretical approach to accurately describe phonon thermal transport in semiconductors and insulators free of adjustable parameters. This technique combines a Boltzmann formalism with density functional calculations of harmonic and anharmonic interatomic force constants. Without any fitting parameters, we obtain excellent agreement (5%difference at room temperature) between the calculated and measured intrinsic lattice thermal conductivities of silicon and germanium. As such, this method may provide predictive theoretical guidance to experimental thermal transport studies of bulk and nanomaterials as well as facilitating the design of new materials. [J259]

"High friction interface with pseudoelastic NiTi"

The purpose of this letter is to introduce a mechanism that relies on a stress induced phase transformation to generate a large static friction coefficient (mu f). Tribological principles were used to design a frictional interface with pseudoelastic nickel titanium (NiTi) and stainless steel with etched features. At loads large enough to form stress induced martensite increasing the applied load increased mu fvalues. This indicates that mechanical friction instead of adhesive friction may be the dominant mechanism. Using a mechanical model combined with experimental mechanical data, the authors we estimate that mu f=0.7is achievable without substantial plastic deformation. [J260]

"Magnetoelectric laminate composite based tachometer for harsh environment applications"

This study reports the design, fabrication, and characterization of a tachometer utilizing magnetoelectric (ME) laminate composites with sandwich structure consisting of Pb(Zr,Ti)O3(PZT) and Galfenol. High temperature characterization of Galfenol shows that it can sustain the magnetic property over 500°C. The Curie temperature of PZT compositions was in the range of 325-340°C. The magnitude of the ME coefficient was found to scale with the dimensionless ratio (d g/S), where dis the piezoelectric strain constant, gis the piezoelectric voltage constant, and Sis the elastic compliance. The tachometer design is based on the principle that when ME composite is exposed to oscillating magnetic field, it generates voltage with the same frequency. [J261]

"Ultrastiff carbides uncovered in first principles"

The authors have computationally designed ultraincompressible materials, namely, rhenium carbide, in the WC and NiAs structures with a very high shear modulus. The corresponding calculated bulk modulus is comparable with that of diamond. Especially for the WC-typed rhenium carbide (ReC), the incompressibility along the caxis is demonstrated to exceed the linear incompressibility of diamond. The unique mechanical properties would make it suitable for applications under extreme conditions. [J262]

"Micromachined optical well structure for thermo-optic switching"

This letter demonstrates the thermo-optic switching function using an adjustable optical well structure, which is constructed by a thin air gap sandwiched between two micromachined hemicylindrical prisms. The device is etched on a silicon-on-insulator wafer within a footprint of 400Ч400mcm2. In experiment, it measures an extinction ratio of 30.2dBand a switching time of 2.2mu s. Compared with the other demonstrated switches that have optical barrier structures, this device is unique in the working principle and optical design, and shows various merits such as high extinction ratio, fast speed, low power consumption, and small size. [J263]

"Device physics and guiding principles for the design of double-gate tunneling field effect transistor

with silicon-germanium source heterojunction"

The device physics and guiding principles for the design of the double-gate tunneling field-effect transistor with silicon-germanium (SiGe) heterojunction source are discussed. Two dimensional device simulations were employed to study the influence of the position of the SiGe/Siheterojunction on band-to-band tunneling and device performance. It is established that band-to-band tunneling occurs at a distance of 4nmfrom the gate edge in the source region. In order for the narrower bandgap of SiGe to play a dominant role, the overlap between the SiGe region and the gate should be such that the whole tunneling path of the electrons is located in SiGe. To harness the maximum benefits of the high band-to-band tunneling rate in SiGe, an overlap of 2nmbetween the SiGe region and the gate would be required. [J264]

"Novel liquid flow sensor based on differential pressure method"

In this article, a novel liquid flow sensor which is composed of a special structure conduit main body and a differential pressure sensor was designed, fabricated, and calibrated. The conduit main body includes an inlet channel section with a branch conduit connecting one end of the pressure sensor, a throat channel section, and an outlet channel section with a branch conduit connecting another end of the pressure sensor. The basic principle is to employ a differential pressure sensor to measure the pressure difference between the inlet channel and outlet channel of the conduit main body when fluid passes through it. The pressure difference between the two ends of the differential pressure sensor (i.e., the two branch conduits located in the inlet and outlet channel sections) is of either forward or backward flow and directly interrelates with the volume flow rate (mass flow rate or flow velocity) via the conduit main body, so the volume flow rate or mass flow rate or flow velocity can be calculated and the flow direction can be determined from the detected pressure difference. This liquid flow sensor is characterized by using only one differential pressure sensor of a simple structure, the error of which is less than 1%. [J265]

"Development of an isothermal heat-conduction photocalorimeter"

Assessing photostability (particularly of pharmaceuticals) is of growing importance, but hampered by a lack of reliable, rapid experimental testing protocols and instrumentation. In particular, most approaches require irradiation of the sample separately from the analytical measurement, which increases both experimental complexity and the number of assumptions that must be made when calculating stability. One technique that may obviate this is photocalorimetry, principally because the reporter of change (heat) is measured directly as a sample is irradiated. Although not a new idea, the design challenges of photocalorimeters are complex, primarily because light power is being introduced to the calorimeter which can thus both saturate the amplifiers and swamp the response of the sample. Careful instrument design is thus paramount. The aim of this work was to develop a robust, compact, and easy to use photocalorimeter with the immediate focus of developing photostability assays for pharmaceuticals. The final instrument design, arrived at through a series of iterative design modifications, is based on a twin differential heat-conduction principle and achieves an average base line deflection of -0.04±0.11mu Wwith light irradiating the sample cell. The performance capabilities of the instrument were demonstrated using a model system; the photodegradation of 2-nitrobenzaldehyde in solution. [J266]

"Time interval measurement device based on surface acoustic wave filter excitation, providing 1 ps precision and stability"

This article deals with the time interval measurement device, which is based on a surface acoustic wave (SAW) filter as a time interpolator. The operating principle is based on the fact that a transversal SAW filter excited by a short pulse can generate a finite signal with highly suppressed spectra outside a narrow frequency band. If the responses to two excitations are sampled at clock ticks, they can be precisely reconstructed from a finite number of samples and then compared so as to determine the time interval between the two excitations. We have designed and constructed a two-channel time interval measurement device which allows independent timing of two events and evaluation of the time interval between them. The device has been constructed using commercially available components. The experimental results proved the concept. We have assessed the single-shot time interval measurement precision of 1.3psrms that corresponds to the time of arrival precision of 0.9psrms in each channel. The temperature drift of the measured time interval on temperature is lower than 0.5ps/K, and the long term stability is better than ±0.2ps/h. These are to our knowledge the best values reported for the time interval measurement device. The results are in good agreement with the error budget based on the theoretical analysis. [J267]

"Theoretical analysis for the design of the French watt balance experiment force comparator"

This paper presents a preliminary analysis for designing a force comparator to be used in the French watt balance experiment. The first stage of this experiment consists in a static equilibrium, by means of a mechanical

beam balance, between a gravitational force (a weight of an artefact having a known mass submitted to the acceleration due to the gravity) and a vertical electromagnetic force acting on a coil driven by a current subject to the magnetic induction field provided by a permanent magnet. The principle of the force comparison in the French experiment is explained. The general design configuration of the force balance using flexure strips as pivots is discussed and theoretical calculation results based on realistic assumptions of the static and dynamic behaviors of the balance are presented. [J268]

"Invited Article: An improved double-toroidal spectrometer for gas phase (e,2e) studies"

A new spectrometer is described for measuring the momentum distributions of scattered electrons arising from electron-atom and electron-molecule ionization experiments. It incorporates and builds on elements from a number of previous designs, namely, a source of polarized electrons and two high-efficiency electrostatic electron energy analyzers. The analyzers each comprise a seven-element retarding-electrostatic lens system, four toroidal-sector electrodes, and a fast position-and-time-sensitive two-dimensional delay-line detector. Results are presented for the electron-impact-induced ionization of helium and the elastic scattering of electrons from argon and helium which demonstrate that high levels of momentum resolution and data-collection efficiency are achieved. Problematic aspects regarding variations in collection efficiency over the accepted momentum phase space are addressed and a methodology for their correction presented. Principles behind the present design and previous designs for electrostatic analyzers based around electrodes of toroidal-sector geometry are discussed and a framework is provided for optimizing future devices. [J269]

"Cryogenic pellet launcher adapted for controlling of tokamak plasma edge instabilities"

One of the main challenges posed recently on pellet launcher systems in fusion-oriented plasma physics is the control of the plasma edge region. Strong energy bursts ejected from the plasma due to edge localized modes (ELMs) can form a severe threat for in-vessel components but can be mitigated by sufficiently frequent triggering of the underlying instabilities using hydrogen isotope pellet injection. However, pellet injection systems developed mainly for the task of ELM control, keeping the unwanted pellet fueling minimized, are still missing. Here, we report on a novel system developed under the premise of its suitability for control and mitigation of plasma edge instabilities. The system is based on the blower gun principle and is capable of combining high repetition rates up to 143 Hz with low pellet velocities. Thus, the flexibility of the accessible injection geometry can be maximized and the pellet size kept low. As a result the new system allows for an enhancement in the tokamak operation as well as for more sophisticated experiments investigating the underlying physics of the plasma edge instabilities. This article reports on the design of the new system, its main operational characteristics as determined in extensive test bed runs, and also its first test at the tokamak experiment ASDEX Upgrade. [J270]

"Improved instrumentation for blood flow velocity measurements in the microcirculation of small animals"

Microcirculation is the generic name of vessels with internal diameter less than 100mcmof the circulatory system, whose main functions are tissue nutrition and oxygen supply. In microcirculatory studies, it is important to know the amount of oxyhemoglobin present in the blood and how fast it is moving. The present work describes improvements introduced in a classical hardware-based instrument that has usually been used to monitor blood flow velocity in the microcirculation of small animals. It consists of a virtual instrument that can be easily incorporated into existing hardware-based systems, contributing to reduce operator related biases and allowing digital processing and storage. The design and calibration of the modified instrument are described as well as in vitro and in vivo results obtained with electrical models and small animals, respectively. Results obtained in in vivo studies showed that this new system is able to detect a small reduction in blood flow velocity comparing arteries and arterioles (p 0.002)and a further reduction in capillaries (p 0.0001). A significant increase in velocity comparing capillaries and venules (p 0.001)and venules and veins (p 0.001)was also observed. These results are in close agreement with biophysical principles. Moreover, the improvements introduced in the device allowed us to clearly observe changes in blood flow introduced by a pharmacological intervention, suggesting that the system has enough temporal resolution to track these microcirculatory events. These results were also in close conformity to physiology, confirming the high scientific potential of the modified system and indicating that this instrument can also be useful for pharmacological evaluations. [J271]

"Confining P diffusion in Si by an As-doped barrier layer"

The miniaturization of Si-based devices requires control of doping profile, which makes the understanding of dopant interaction and diffusion in Si critical. The authors have studied the effect of As doping on P diffusion in Si using first-principles calculations. The authors found a form of As-vacancy complex is energetically favorable, allowing As to consume the vacancy so as to prohibit the vacancy-mediated P diffusion. Also, in the vicinity of

As, the vacancy-mediated P diffusion barrier is increased, decreasing further the P mobility. The results provide useful guidance for designing As-doped barriers to block P diffusion in Si wafer processing and metal oxide semiconductor field-effect transistor device fabrication. [J272]

"Hydrodynamic model for spin-polarized electron transport in semiconductors"

We extend the hydrodynamic model of the Boltzmann equation by taking into account the spin of the nonequilibrium carriers injected into semiconducting systems. This spin-resolved hydrodynamic description goes beyond the usual drift-diffusion type approaches in a way that the temporal derivatives of the current densities are considered. This allows us to investigate the transient dynamics of spin-polarized packets in the diffusive and ballistic transport regimes. We have properly included the spin-polarized carriers from doping by solving our set of continuity equations and the Poisson equation self-consistently. We determine the spin-polarization landscapes (time and position) of the carrier density (n↑-n↓)/(n↑+n↓)and the current density (j↑-j↓)/(j↑+j↓). While in the uniformly doped system the carrier spin polarization has a slow decay, in the nonuniformly doped system it shows a drastic suppression in the interface. In contrast the current spin polarization exhibits an enhancement in this region. It can in principle be useful in designing submicron spintronic devices. [J273]

"Electromagnetic Metamaterials: Physics and Engineering Explorations (Engheta, N. and Ziolkowski, R.W.; 2006) [JBook Review]"

This book is excelland and consists of 27 contributing authors. It maximizes written descriptions based on standard basic electronic-engineering principles and uses mathematics in a concise format in order to impress the core basis upon which each major concept presented is predicated. As with most multi-authored texts on a single topic, the book contains some material that is repeated across several chapГ‚В¬ters. However, the repetition is minimal, and at times aids the reader by giving different perspectives on the same topic. This book is produced to a very high standard, with numerous color illustrations that allow the reader to rapidly assimilate the informaГ‚В¬tion that they are designed to convey. [J274]

"MEMs for Aerospace Navigation"

The MEMS aerospace market has its own specificities in terms of market size, standards, and performance characteristics (very long term stability, reliability, and safety levels). Improvements are needed for future applications. THALES Avionics has a twenty-year experience in quartz and silicon MEMS design and manufacturing and is recognized as a leader by the French MOD in this field. MEMS pressure sensors and accelerometers are manufactured in large volume and used for safety-critical applications. THALES technology policy focused on planar architecture, die vacuum packaging, and deep reactive ion etching (DRIE) allowing good characteristics for sensors in development. A Silicon Vibrating Beam Accelerometer single chip is now under development. Its operating principle is described with two resonators in push-pull configuration. A tuning fork planar rate gyro is also developed with exactly the same technology for industrial efficiency. Performance results will be addressed. The development and industrialization road-map of theses inertial products is described for the following five years. Gyro-compassing grade inertial sensors would be available during the next decade allowing low-cost, high-grade navigators using simultaneously GNSS receivers and inertial MEMS navigators. [J275]

"Channel-Aware Scheduling for QoS and Fairness Provisioning in IEEE 802.16/WiMAX Broadband Wireless Access Systems"

In the last few years, standardization activities within the IEEE 802.16 Working Group have resulted in the publication of specifications for an air interface of Fixed broadband wireless access systems. WiMAX is the commercial name of products compliant with the approved IEEE 802.16 standard. Although the standard suggests the main principles in designing a QoS architecture to support multimedia broadband services, implementation details are left to manufacturers. This article addresses a channel-aware scheduling algorithm conceived for a point-to-multipoint WiMAX architecture. It aims at enabling downlink traffic delivery with differentiated service treatment, even in nonideal channel conditions. A technique to compensate for channel errors is proposed to preserve QoS and fairness of a WF2Q+ based scheduling algorithm. The performance behavior of the proposed algorithm is confirmed by the outputs of a comprehensive simulation campaign. [J276]

"Towards autonomic management of communications networks"

As communications networks become increasingly dynamic, heterogeneous, less reliable, and larger in scale, it becomes difficult, if not impossible, to effectively manage these networks using traditional approaches that rely on human monitoring and intervention to ensure they operate within desired bounds. Researchers and

practitioners are pursuing the vision of autonomic network management, which we view as the capability of network entities to self-govern their behavior within the constraints of business goals that the network as a whole seeks to achieve. However, applying autonomic principles to network management is challenging for a number of reasons, including: (1) A means is required to enable business rules to determine the set of resources and/or services to be provided. (2) Contextual changes in the network must be sensed and interpreted, because new management policies may be required when context changes. (3) As context changes, it may be necessary to adapt the management control loops that are used to ensure that system functionality adapts to meet changing user requirements, business goals, and environmental conditions. (4) A means is required to verify modeled data and to add new data dynamically so that the system can learn and reason about itself and its environment. This article provides an introduction to the FOCALE autonomic network management architecture, which is designed to address these challenges. [J277]

"Polarization-Independent Magneto-Optical Waveguide Isolator Using TM-Mode Nonreciprocal Phase Shift"

A polarization-independent magneto-optical waveguide isolator using nonreciprocal phase shift for a TM mode is proposed. The isolator is a Mach-Zehnder interferometer (MZI) that is composed of transverse electric (TE)-transverse magnetic (TM) polarization converters and nonreciprocal phase shifters. The MZI induces a phase difference between the reciprocal TE and nonreciprocal TM modes that are converted to each other by the polarization converter. Since the design uses a nonreciprocal phase shift only for the TM mode, it allows fabrication of an integrated structure. This paper describes the principle of operation and its design. [All rights reserved Elsevier]. [J278]

"Three dimension analysis of EЧB mass separator"

Three dimension modeling is used to design an EЧBmass separator. After the perpendicular separating principle and basic properties are analyzed in three dimensions, an EЧBmodel is built and optimized to obtain a homogeneous field with negligible fringing. An example of 30keVSi+ions is given to show its mass resolution, ion motion trajectory, and achromatic aberration in both collimated and crossover modes. Results show that the improved separator can operate in both modes in a nanometer optical column, but has better performance using a crossover mode. [J279]

"Squeeze film effect for the design of an ultrasonic tactile plate"

Most tactile displays currently built rely on pin-based arrays. However, this kind of tactile device is not always appropriate when we need to give the illusion of finely textured surfaces. In this paper, we describe the squeeze film effect between a plate and a finger, and we use this effect to design an ultrasonic tactile plate. The plate is actuated by piezoelectric ceramics. Ultrasonic vibrations are thus produced and are capable of generating the squeeze film effect. This enables us to simulate variable friction on the surface of the plate. In order to identify the squeeze film phenomenon, this study considers the case where a finger, with a planar bottom surface and with epidermal ridges, is placed on a rapidly vibrating plate. The overpressure is calculated and the result enables us to assess the relative coefficient of friction as a function of the vibration amplitude of the plate. Based on this principle, and using both analytic and FE method studies, and given ergonomic and stimulation (squeeze film) requirements, we show that it is possible to design a tactile plate which is capable of giving programmable tactile sensations. We conclude by comparing the results obtained from our simulations with experimental results. [J280]

"Self-assembled magnetic nanowire arrays"

Different self-assembled magnetic nanowire arrays were achieved with 100%trapping rate on templates with nanomagnet arrays under a low external magnetic field (10Oe). The principles of magnetic charge matching and dimension matching between the magnetic nanowires to be assembled and the gaps between two nanomagnets were proposed and demonstrated to be crucial for achieving low magnetostatic energy and high trapping rate. This templated self-assembly technique and the proposed template design principles have great potential for nanomanufacturing of regular arrays of magnetic nanostructures. [J281]

"Electrostatic characteristics of tether atoms in connecting organic molecules to the surface of silicon"

In this letter, the authors analyze the electrostatic characteristics of the tether atoms connecting organic molecules onto silicon (100)-2Ч1surfaces, which is a key factor in the design of molecular devices for information processing and biomolecular sensing. Design principles for silicon surfaces with required electrostatic

functionality are presented. [J282]

"Permanent-magnet longitudinal fields for magnetostrictive devices"

This paper discusses a technique for improving the homogeneity of the magnetic field of tube-like permanent magnets designed for magnetostrictive devices. The high homogeneity of the magnetic field along the tube is achieved by gradually changing shape or remanence of combined short rings. The analysis of the field in the magnet is performed using the magnetic charge principle and axial magnetic field equations are deduced. An example of design of a longitudinal uniform field for a magnetostrictive rod with large length to diameter ratio is presented. [J283]

"Ab initio design of coherent thermal sources"

Emission of thermal light from a hot body has been considered for a long time as broadband and quasi-isotropic. Today, we know that this paradigm is wrong and it has been shown that many micro- and nanostructured materials are able to radiate in narrow spectral bands and around specific directions of space. However, so far, only heuristic strategies based on trial and error have been followed for engineering such sources. Here, we present a general method for the ab initio design of coherent thermal sources by using only the first principles of optics. Our results pave the way toward the inverse design of new composite emitting structures for high performance applications in optics. [J284]

"Multitone large-signal analysis of superconducting transition-edge sensors for astronomy"

A simple transition-edge sensor (TES) is governed by two coupled, nonlinear equations, which when solved give the behavior of the device given the initial conditions. The two equations describe the full electrical and thermal characteristics of the device and the way in which the device interacts with the external electrical and thermal circuits. To date these coupled nonlinear equations have been solved analytically in the small-signal limit, by linearizing the equations about some operating point. The resulting coupled linear equations contain a wealth of interesting physics, and form the principal tool by which all detectors are currently designed and modeled. In this article we describe a numerical technique for solving the coupled nonlinear equations rigorously, without any assumptions about the magnitudes of the various signals and parameters that determine the behavior of a device. The technique is based on a harmonic balance algorithm that searches, in the frequency domain, for voltage, current, and temperature wave forms that are consistent with the solid-state physics of the device. Indeed, both the small and large signal limits can be simulated, and the full harmonic content of the system retrieved. In this article, we will outline the principal features of the algorithm, and show various results such as I-Vcurves, saturation when signal power is modulated, impedance response when the bias current is modulated and signal power kept constant, and pulsed signal power analysis that shows the dynamics of a device. Numerous extensions of this fundamental technique are now possible including multitone nonharmonic analysis, large-signal impedance calculation, modeling of complicated thermal circuits, noise models, and frequency-domain multiplexing. We believe that our algorithm will become the principle technique for analyzing the large-signal behavior of all TES detectors and on that basis we are developing computer aided design software. [J285]

"Hard Magnetic Dots for Flux Bias of DC SQUIDs"

In this paper, we demonstrate that perpendicularly magnetized sub- and micrometer-sized magnetic dots, with a high coercivity and nearly complete remanence, can be used to provide the flux bias for dc superconducting quantum interference devices (SQUIDs). The radius of a submicrometer Co-Pd magnetic dot has been optimized with respect to the surrounding superconducting circuitry to generate the phase shift of approximately pi/2 in it. In this way, it is possible to bias a dc SQUID to the steepest part of its voltage-flux characteristic without using an additional coil and current source. Furthermore, it has been shown that the flux bias can also be achieved using a micrometer-sized Co-Pd dot, upon saturation, by placing a dc SQUID on top of the dot. Given that the underlying principles of flux biasing do not require any particular superconducting pairing scheme (s- or d-wave), these hybrid superconductor/ferromagnet structures can be used as to design a dc SQUID with a complete flux self-biasing [J286]

"The design and evaluation of a generic method for generating mosaicked multispectral filter arrays"

The technology of color filter arrays (CFA) has been widely used in the digital camera industry since it provides several advantages like low cost, exact registration, and strong robustness. The same motivations also drive the design of multispectral filter arrays (MSFA), in which more than three spectral bands are used. Although considerable research has been reported to optimally reconstruct the full-color image using various demosaicking algorithms, studies on the intrinsic properties of these filter arrays as well as the underlying design principles

have been very limited. Given a set of representative spectral bands, the design of an MSFA involves two issues: the selection of tessellation mechanisms and the arrangement/layout of different spectral bands. We develop a generic MSFA generation method starting from a checkerboard pattern. We show, through case studies, that most of the CFAs currently used by the industry can be derived as special cases of MSFAs generated using the generic algorithm. The performance of different MSFAs are evaluated based on their intrinsic properties, namely, the spatial uniformity and the spectral consistency. We design two metrics, static coefficient and consistency coefficient, to measure these two parameters, respectively. The experimental results demonstrate that the generic algorithm can generate optimal or near-optimal MSFAs in both the rectangular and the hexagonal domains [J287]

"Increased Logic Functionality of Clocked Series-Connected RTDS"

The augmentation of transistor technologies with resonant tunnelling diodes (RTDs) has demonstrated improved circuit performance. The negative differential resistance exhibited by these devices can be exploited to increase the functionality implemented by a single gate in comparison to transistor-only technologies. Complex threshold gates (TGs) are efficiently realized by resorting to the operation principle of the clocked series connection of a pair of RTDs (MOBILE). This paper focuses the implementation of logic blocks using RTDs and transistors which further increase the functionality of previously reported topologies. Multithreshold-threshold gates (MTTGs) is the logic concept underlying the proposed realizations. The MOBILE principle is extended to three or more RTDs in series which allows us to implement MTTGs. Novel and extremely compact realizations of programmable gates using the MTTG topology are presented. A number of logic blocks useful for digital design are shown and their operation is verified through simulation with extensively validated models for actual devices [J288]

"Antiresonant reflecting optical waveguides polarization beam splitters"

Three different configurations of polarization beam splitters based on antiresonant reflecting optical waveguide (ARROW) structures are proposed. The polarization splittings are attained by utilizing various characteristics of basic ARROW and/or ARROW-B. In comparison with conventional waveguides, ARROW structures utilizing antiresonant reflection as the guiding mechanism can have large core sizes compatible with single-mode fibers and, thus, provide better coupling. Design principles and characteristics of these ARROW polarization beam splitters are discussed in detail, and the simulation results show that all these devices have good polarization discrimination with crosstalk <-20 dB [J289]

"Source-optimized irregular repeat accumulate codes with inherent unequal error protection capabilities and their application to scalable image transmission"

The common practice for achieving unequal error protection (UEP) in scalable multimedia communication systems is to design rate-compatible punctured channel codes before computing the UEP rate assignments. This paper proposes a new approach to designing powerful irregular repeat accumulate (IRA) codes that are optimized for the multimedia source and to exploiting the inherent irregularity in IRA codes for UEP. Using the end-to-end distortion due to the first error bit in channel decoding as the cost function, which is readily given by the operational distortion-rate function of embedded source codes, we incorporate this cost function into the channel code design process via density evolution and obtain IRA codes that minimize the average cost function instead of the usual probability of error. Because the resulting IRA codes have inherent UEP capabilities due to irregularity, the new IRA code design effectively integrates channel code optimization and UEP rate assignments, resulting in source-optimized channel coding or joint source-channel coding. We simulate our source-optimized IRA codes for transporting SPIHT-coded images over a binary symmetric channel with crossover probability p. When p=0.03 and the channel code length is long (e.g., with one codeword for the whole 512Ч512 image), we are able to operate at only 9.38% away from the channel capacity with code length 132380 bits, achieving the best published results in terms of average peak signal-to-noise ratio (PSNR). Compared to conventional IRA code design (that minimizes the probability of error) with the same code rate, the performance gain in average PSNR from using our proposed source-optimized IRA code design is 0.8759 dB when p=0.1 and the code length is 12800 bits. As predicted by Shannon's separation principle, we observe that this performance gain diminishes as the code length increases. [J290]

"Electrical design optimization of single-mode tunnel-junction-based long-wavelength VCSELs"

We present principles for tunnel-junction (TJ) design optimization for use in intracavity contacted long-wavelength vertical-cavity surface-emitting lasers (LW-VCSELs). Using the WKB approximation, we find that layer thicknesses of 10 nm on the n++ side and 10 nm on the p++ side are large enough to maximize quantum tunneling probability and small enough to yield low optical free-carrier absorption loss. We also conjecture that our experimental test structures and actual devices have far lower active acceptor concentration than we expect

based on an analytical model. Finally, we calculate the necessary doping levels to enable single-mode operation of LW-VCSELs and incorporate these conditions into a complete optimized model of our VCSELs. Based on optimal I-V curves, we can expect an increase in single-mode output power from 2 to 3.5 mW [J291]

"Uniform wavelength spacing Mach-Zehnder interferometer using phase-generating couplers"

A theoretical and experimental study of an optical interferometer circuit with a uniform wavelength spacing is presented. The operating principle of the filter and a phase-generating coupler (PGC) that can transform a conventional filter into a uniform-wavelength-spaced optical filter is described. As an example, a transformation method is applied to a conventional Mach-Zehnder interferometer (MZI), and the PGC variables are optimized to obtain an MZI with a constant channel spacing of 20 nm. Furthermore, the designed MZI is fabricated using 1.5%-Delta silica-based planar lightwave circuit technology and a 20-nm-spaced MZI is realized with a wavelength displacement that was less than plusmn1.2% of the wavelength period. The fabrication tolerance of the MZI in relation to the PGC design variables is discussed. It is shown that a certain PGC design can increase the fabrication tolerance [J292]

"Optical-signal-processing device based on waveguide-type variable delay lines and optical gates"

In this paper, an optical-signal-processing device mainly designed for time-slot switching is demonstrated. The device is composed of variable delay-line arrays fabricated by planar lightwave circuit technology and high-speed optical gates. The variable delay-line arrays consist of transversal-form or lattice-form optical circuits. The operating principle is based on serial-to-parallel conversion, adjustment of the delay time between the parallel signals, and the gating of the optical bits or packets in the optical region. The device does not require any interaction between lightwaves through optical nonlinear effects or filter banks for code matching. As an example of its operation, label-processing functions are demonstrated, specifically the label swapping of optical return-to-zero pulses. The merits of the proposed device are described and problems that must be solved are also discussed. [J293]

"Polarization-agile antennas"

A polarization-agile antenna is a type of antenna the polarization state of which can be changed dynamically, i.e., it can have either linear (vertical or horizontal) or circular polarization (left hand or right hand), depending on the requirements of its specific application. This special characteristic offers great flexibility for antenna systems, because a single antenna could be used to satisfy the different requirements of several systems. This paper gives a comprehensive review of polarization-agile antennas. The basics of polarization in antennas and polarization-agile antennas are explained. Various examples of recent developments are then provided, and the antenna configurations and design principles are illustrated and discussed. Finally, the future development of polarization-agile antennas for wireless systems is discussed [J294]

"The Doherty power amplifier"

In this article, we show that the Doherty amplifier is capable of delivering the stringent requirements of the base station power amplifiers. We explain the operation principles, including both linearity and efficiency improvements, and the basic circuit configuration of the amplifier. Advanced design methods to operate across wide bandwidth and improve the linearity are also described. For verification, the Doherty amplifier is implemented using laterally diffused metal oxide semiconductor (LDMOS) transistors and measured using a WCDMA 4FA signal. These results show that the Doherty amplifier is a promising candidate for base station power amplifiers with wide bandwidth, high efficiency, and linearity [J295]

"Tailoring Chirp Characteristics of Waveguide Bragg Gratings Using Tapered Core Profiles"

We propose and demonstrate the design principle of tapered core profiles for tailoring the chirp characteristics of waveguide Bragg grating (WBG) devices with uniform grating periods. Based on both numerical and experimental approaches, we establish the dependence of the modal effective index on the core width. We then design and fabricate polymeric WBG devices with a taper profile optimized for a linear group delay and those with a linear taper as well. Although they exhibit high ripples in their spectral responses due to incomplete structures, their chirp characteristics fit well the expected group delay curves [J296]

"Loss reduction of arrayed waveguide grating with mode converters designed by wavefront matching method"

Mode converters have been designed that reduce mode transition losses in arrayed waveguide grating (AWG) multi/demultiplexers using the authors' recently proposed wavefront matching method. The designed mode

converters are very compact and easy to fabricate. AWGs were fabricated equipped with the authors' mode converters. The loss reduction principle was confirmed experimentally [J297]

"Noninvasive field measurement of low-frequency ultrasonic transducers operating in sealed vessels"

This paper describes a noninvasive technique utilizing the acousto-optic effect, laser interferometry, and tomographic principles that have been implemented to measure the acoustic fields generated by low-frequency ultrasonic transducers operating into sealed, water-loaded vessels commonly used in industrial processing applications. A customized scanning frame, incorporating both linear and rotational stages, has been developed to facilitate manipulation of the laser head and vessel under evaluation. First, transmitted pressure profiles in air are predicted from surface displacement data acquired directly by laser measurement of the vibrating aperture. These profiles were then used to verify the measured fields obtained via conventional tomographic scanning procedures, coupled with laser interferometry, applied within a draft-proof scanning facility under free-field conditions. Next, the finite element code PZFlex was employed for the prediction of pressure fields within cylindrical cell configurations. Finally, precise manipulation of the laser firing angle and position was implemented in order to compensate for the effects of refraction at the cell wall boundaries, and to re-establish the projections required for the reconstruction algorithm. The experimental results demonstrate good corroboration with the PZFlex predictions, validating its application of ultrasound as a virtual prototyping tool for the design of high power ultrasonic test vessels [J298]

"Modeling of plasmon-polariton refractive-index hollow core fiber sensors assisted by a fiber Bragg grating"

The theoretical model of a new hollow core fiber sensor based on the specific properties of the surface plasmon polariton (SPP) excited with a fiber Bragg grating is proposed and comprehensively investigated. The main principle of operation of this new device is based on the efficient energy transfer between the fiber waveguide mode (FWM) and the SPP provided by a properly designed short-period fiber Bragg grating imprinted into a waveguide fiber layer of a specially designed hollow core optical fiber. The waveguide fiber layer is the dielectric layer of the fiber with the highest refractive index. The FWM is a fiber mode oscillating in this layer and exponentially decaying in all other fiber layers. Presented for the cylindrical (fiber) geometry, the scheme without loss of generality can be applied to the planar geometry. The simulations are based on the coupled mode theory and performed for well-developed telecom wavelength ranges [J299]

"Embedded Multiple Description Coding of Video"

Real-time delivery of video over best-effort error-prone packet networks requires scalable erasure-resilient compression systems in order to 1) meet the users' requirements in terms of quality, resolution, and frame-rate; 2) dynamically adapt the rate to the available channel capacity; and 3) provide robustness to data losses, as retransmission is often impractical. Furthermore, the employed erasure-resilience mechanisms should be scalable in order to adapt the degree of resiliency against transmission errors to the varying channel conditions. Driven by these constraints, we propose in this paper a novel design for scalable erasure-resilient video coding that couples the compression efficiency of the open-loop architecture with the robustness provided by multiple description coding. In our approach, scalability and packet-erasure resilience are jointly provided via embedded multiple description scalar quantization. Furthermore, a novel channel-aware rate-allocation technique is proposed that allows for shaping on-the-fly the output bit rate and the degree of resiliency without resorting to channel coding. As a result, robustness to data losses is traded for better visual quality when transmission occurs over reliable channels, while erasure resilience is introduced when noisy links are involved. Numerical results clearly demonstrate the advantages of the proposed approach over equivalent codec instantiations employing 1) no erasure-resilience mechanisms, 2) erasure-resilience with nonscalable redundancy, or 3) data-partitioning principles [J300]

"A Physical Compact Model for Electron Transport Across Single Molecules"

Prediction of current flow across single molecules requires ab initio electronic structure calculations along with their associated high computational demand, and a means for incorporating open system boundary conditions to describe the voltage sources driving the current. To date, first principle predictions of electron transport across single molecules have not fully achieved a predictive capability. The situation for molecular electronics may be compared to conventional technology computer-aided design (TCAD), whereby various approximations to the Boltzmann transport equation are solved to predict electronic device behavior, but in practice are too time consuming for most circuit design applications. To simplify device models for circuit design, analytical but physically motivated models are introduced to capture the behavior of active and passive devices; however,

similar models do not yet exist for molecular electronics. We follow a similar approach by evaluating an analytical model achieved by combining a mesoscopic transport model with parameterizations taken from quantum chemical calculations of the electronic structure of single molecule bonded between two metal contacts. Using the model to describe electron transport across benzene-1,4-dithiol and by comparing to experiment, we are able to extract the coupling strength of the molecule attached to two infinite metal electrodes. The resulting procedure allows for accurate and computationally efficient modeling of the static (dc) characteristics of a single molecule, with the added capability of being able to study the physical model parameter variations across a range of experiments. Such simple physical models are also an important step towards developing a design methodology for molecular electronics [J301]

"PAMELA: a useful tool for the study of leaky-wave modes in strip-loaded open dielectric waveguides"

A software tool is presented to help in the teaching of the electromagnetic theory of open dielectric waveguides. The study of the modal spectrum of canonical closed waveguides is a basic topic in any course of electromagnetics or microwave engineering. However, surface-wave modes and leaky-wave modes in open waveguides are not yet so well known in the academic environment. Nevertheless, this study is necessary, since novel open dielectric waveguides have been proposed for millimeter-wave and optical electronics in order to reduce the conductor losses. Therefore, the comprehension of the phenomenon of leaky-wave modes and behavior is indispensable for any future microwave engineer, who has to work with the new millimeter-wave and optical technologies. This program constitutes the first tool explicitly conceived to help the teaching of the working principles of open dielectric guides loaded with printed circuits, and the associated practical leaky-wave antennas (LWAs). The code can be a very good supplement to understand how practical leaky-wave antennas work, after a basic theoretical understanding of leaky waves has been first obtained. From the appearance of leaky-wave modes in open waveguides to the design of a backward-to-forward leaky-wave antenna, some simple and very clarifying step-by-step exercises are presented to illustrate these not-so-well-known concepts. Although the program refers to a specific type of open dielectric guides (laterally-shielded, top-open, stub-loaded, rectangular dielectric waveguides with planar perturbations), the results are applicable to any open dielectric guide, helping to teach the basic theory and topics relating to leaky- and surface-wave modes in uniform and periodic structures [J302]

"Arrayed waveguide grating based on group-index modification"

The authors propose a new wavelength-dispersive principle based on waveguide group-index modification and apply this principle in a new type of arrayed waveguide dispersive element based on modified group index. The element is composed by an array of waveguides consisting of two sections with different group indexes. We deduce the applicable dispersion formula and demonstrate that the group-index modification can be used for controlling or enhancing device wavelength dispersion. Two device examples are provided. First, dispersive properties of a waveguide array with silicon on insulator (SOI) straight waveguides with group index modified by waveguide widening are calculated. Then, the authors show that by placing the element with modified group index in a phased array of a conventional arrayed waveguide grating (AWG) device, the dispersive properties of the AWG are markedly enhanced. Dispersion-enhancement factor of up to 60 is calculated for a compact demultiplexer designed for SOI platform with group index modified by photonic-bandgap effect [J303]

"Updating and downdating matrix factorizations: a change in plans"

We seldom get it right the first time. Whether we're composing an email, seasoning a stew, painting a picture, or planning an experiment, we almost always make improvements on our original thought. The same is true of engineering design; we draft a plan, but changes are almost always made. Perhaps the customer changes the performance specifications, or perhaps a substitution of building materials leads to a redesign. In this homework assignment, we consider numerical methods that make it easier to reanalyze the design after small changes are made. For definiteness, we focus on truss design, but the same principles apply to any linear model [J304]

"Low-subthreshold-swing tunnel transistors"

A formula is derived, which shows that the subthreshold swing of field-effect interband tunnel transistors is not limited to 60 mV/dec as in the MOSFET. This formula is consistent with two recent reports of interband tunnel transistors, which show lower than 60-mV/dec subthreshold swings and provides two simple design principles for configuring these transistors. One of these principles suggests placing the gate adjacent to the tunnel junction. Modeling of this configuration verifies that sub-60-mV/dec swing is possible. [J305]

"Single-chip multiple-frequency VHF low-impedance micro piezoelectric resonators"

This letter reports on the design, fabrication, and testing a new class of low-impedance multiple-frequency micromechanical resonator using piezoelectric transduction mechanism. The resonator is fabricated out of a 3-μm-thick silicon layer on a silicon-on-insulator wafer with a low-temperature post-CMOS compatible process. Two types of low-impedance resonators using the same design principle are presented here. The center frequency of the novel resonator is set by the lithographically defined in-plane dimension of the device (width of bar or radius of disk). The 200-μm-diameter disk-shaped resonator is measured to have an impedance of 1.6 kΩ at the resonant frequency of 45.4 MHz, with a quality factor of 1100. The bar-type resonator is measured to have an impedance of 920 Ω at 60 MHz, exhibiting a Q factor of 1400. [J306]

"Theoretical analysis of micro-machined ultrasonic transducer using a simple 1-D model"

Micro-machined ultrasonic transducers (MUT) appear as an attractive alternative to standard bulk transducers mainly based on PZT ceramic actuators. However, the simulation of these new devices requires one to take correctly into account their operating conditions. Particularly, most of the MUT structures are periodic, associating a very large number of elementary actuators excited in phase. Furthermore, the development of an equivalent to the Mason model for MUTs would help in the promotion of this new kind of transducers. In this work, we propose a very simple model based on the material resistance theory to describe the flexural motion of a MUT. It is associated with a periodic Green's function development to take into account radiation in water. Basic working principles of MUT then are deduced from computing results, which coincides with already published data on that topic. [J307]

"Ethical values of IT professionals: evidence from Hong Kong"

In the wake of recent scandals involving information technology (IT) professionals, the ethics of this profession deserve more attention. This paper reports on the first phase of an initiative to research the ethics of IT professionals. The ethical values of the IT profession in Hong Kong were investigated using an instrument designed to reflect the stages of moral reasoning present in Kohlberg's theory of Cognitive Moral Development. The vast majority of respondents espoused ethical values consistent with both a high level of reasoning and the prevailing societal culture. At the same time, many respondents exhibited considerable uncertainty in their ethical reasoning, indicating a dynamic tension between high and low moral principles. The implications of these findings for research and practice are discussed. [J308]

"Torsional vibrations of circular elastic plates with thickness steps"

This paper presents a theoretical study of torsional vibrations in isotropic elastic plates. The exact solutions for torsional vibrations in circular and annular plates are first reviewed. Then, an approximate method is developed to analyze torsional vibrations of circular plates with thickness steps. The method is based on an approximate plate theory for torsional vibrations derived from the variational principle following Mindlin's series expansion method. Approximate solutions for the zeroth- and first-order torsional modes in the circular plate with one thickness step are presented. It is found that, within a narrow frequency range, the first-order torsional modes can be trapped in the inner region where the thickness exceeds that of the outer region. The mode shapes clearly show that both the displacement and the stress amplitudes decay exponentially away from the thickness step. The existence arid the number of the trapped first-order torsional modes in a circular mesa on an infinite plate are determined as functions of the normalized geometric parameters, which may serve as a guide for designing distributed torsional-mode resonators for sensing applications. Comparisons between the theoretical predictions and experimental measurements show close agreements in the resonance frequencies of trapped torsional modes. [J309]

"High-frequency ultrasound annular array imaging. Part II: digital beamformer design and imaging"

This is the second part of a two-paper series reporting a recent effort in the development of a high-frequency annular array ultrasound imaging system. In this paper an imaging system composed of a six-element, 43 MHz annular array transducer, a six-channel analog front-end, a field programmable gate array (FPGA)based beamformer, and a digital signal processor (DSP) microprocessor-based scan converter will be described. A computer is used as the interface for image display. The beamformer that applies delays to the echoes for each channel is implemented with the strategy of combining the coarse and fine delays. The coarse delays that are integer multiples of the clock periods are achieved by using a first-in-first-out (FIFO) structure, and the fine delays are obtained with a fractional delay (FD) filter. Using this principle, dynamic receiving focusing is achieved. The image from a wire phantom obtained with the imaging system was compared to that from a prototype ultrasonic backscatter microscope with a 45 MHz single-element transducer. The improved lateral resolution and depth of field from the wire phantom image were observed. Images from an excised rabbit eye sample also were obtained, and fine anatomical structures were discerned. [J310]

"Programmable spectral design using a simple binary Bragg-diffractive structure"

We present the binary supergrating (BSG), a digital approach to spectral engineering that permits the near-arbitrary control of optical amplitude and phase in a wavelength-dependent manner. The BSG is a guided-wave technology that consists of an aperiodic sequence of binary elements, leading to a simple, robust and practical form. This sequence, determined through the process of BSG synthesis, encodes an optical program that defines device functionality. Our approach to synthesis builds on existing knowledge in the design of "analog" gratings through a two-step process: first, exploit the best analog-domain methods, then transform the resulting structure into binary form. Accordingly, we explore the notion of diffractive structure transformation and introduce the principle of "key information". We assemble such key information for Bragg-regime structures, and employ it in the design of grating quantizers based on an atypical form of Delta-Sigma modulation. We illustrate this approach through the synthesis of a complex dense-wavelength division-multiplexed telecom filter featuring 50-GHz channel spacing, -40-dB stopbands, and 25-GHz-wide passbands that are flat to within 0.2 dB. [J311]

"Design and Electromagnetic Analysis of a Superconducting Diamagnetic Motor"

{no data available} [J312]

"ATLAS End Cap Toroid Cold Mass and Cryostat Integration"

The ATLAS experiment at LHC (CERN) will utilize a large, superconducting, air-cored toroid magnet system with a long Barrel Toroid and two End Cap Toroids. Each End Cap Toroid will contain eight racetrack coils mounted as a single cold mass in a cryostat vessel of approximately 10 m diameter. This paper presents the design principles and realization of the cold mass assembly. The procedures for integration of the full cold mass, 120 tonnes, into the vacuum cryostat are described. The overall status of toroid magnet integration and planning for test and installation is reviewed [J313]

"Voltage Rating Reduction of Magnet Power Supplies Using a Magnetic Energy Recovery Switch"

A new concept of magnet power supplies that can reduce voltage ratings of the power supplies is proposed. Circuit diagram and operation principles of magnetic energy recovery switch (MERS) are described. MERS consists of a capacitor and four semi-conductor devices such as MOSFETs and IGBTs. It is connected in series to a power supply and a coil. MERS is a switch module and it has no power supply in itself. Because MERS generates a voltage required for the inductance of the coil, the power supply only has to supply a voltage required for the resistance of the coil. Therefore, using MERS can reduce voltage rating and capacity of the power supply. Two types of power supply using MERS and voltage rating reduction are discussed. Comparatively small power supplies for high-repetition pulsed magnets and alternating magnetic field coils can be designed. Some experiments were carried out and confirmed that MERS can reduce voltage ratings of power supplies [J314]

"A Pulsed HTS Coil Cooled by Heat Pipes as Part of a Pre-Polarizer Magnet System"

Future magnetic-resonance imaging (MRI) systems for medical diagnosis may work on the principle of pre-polarization. This requires a strong local magnetic field which can be ramped up and down in milliseconds. Such fields can be generated efficiently by compact coils made with high-temperature superconductors (HTS). Copper conductors would be too bulky; low-Tcsuperconductors would give high AC loss at 4 K. We have designed, constructed and tested an HTS double-pancake coil which generates 0.3 T of pulsed field in a 200 mm inner bore. An operating temperature of 30 K was chosen as a compromise between efficient cooling and optimum use of the HTS tape. The coil is cooled by a single GM refrigerator via a heat-pipe system filled with liquid Neon. The heat pipes and supporting structure were designed for minimum eddy-current loss in the pulsed field. The design process had to account also for AC loss in the superconductor, heat transfer from the coil to the cooling fluid and Lorentz forces on the HTS tape. Initial experiments validated the winding process for the mechanically weak Bi-2223/Ag tape, and the glued connections under thermal contraction of the materials. The production process of the coil aimed at ensuring optimum thermal contact between winding and heat pipes. The critical current at 77 K proved that there was no degradation of the HTS material. In tests at 30 K, the coil carried 250 A, 1 Hz pulsed current during up to 20 minutes. Thus the coil fulfilled the design specs [J315]

"An ultrasonic Gaussian transducer and its diffraction field: theory and practice"

In this paper, the authors present a novel way to describe the diffraction field for a Gaussian source, which becomes a Gaussian itself. It is described by the Rayleigh surface integral based on the Huygens' theorem. The derivation does not require the parabolic approximation used by previous authors. An improved spherical button Gaussian transducer design also is presented to verify the theory. A theoretical principle of this design based on

electromagnetic theory is developed. Both megahertz and kilohertz experimental results show that the sound fields generated by Gaussian transducers of this design agree very well with the theoretical predictions [J316]

"High efficiency class-F RF/microwave power amplifiers"

This article provides a tutorial and review of recent developments in high-efficiency class F RF/ microwave PAs. The principles of class-F RF PAs are explained first. Recent progress in their theory and in design techniques is then presented. Different approaches of class-F PA designs are explained, and some examples of practical designs are illustrated. Finally, an attempt is made to discuss the future developments of class-F RF/microwave PAs. [J317]

"Flexible piezopolymer ultrasonic guided wave arrays"

Ultrasonic guided wave technology is being applied to a variety of gas and liquid transmission pipeline inspection applications. There are a variety of promising transduction techniques used to excite longitudinal, torsional, and flexural modes in pipe. Some of the more common methods include electromagnetic-acoustic, magnetostrictive, and piezoceramic array transducers. The objective of the work presented in this paper was to develop an array design that is simpler to manufacture and attach to pipelines compared to the current piezoceramic design. The design considerations for a flexible piezopolymer-based array are discussed in this paper along with the basic principles behind the selection of the array element width and spacing. The performance of a piezoceramic and piezopolymer array, with identical element spacing and width, are compared at four different frequencies. Tests were undertaken on a carbon steel pipe with a simulated defect. Evaluation of the different arrays was performed in terms of the defect response, in terms of amplitude, of the lower-order axisymmetric modes. It is shown that while the piezopolymer array provides comparable sensitivity to the piezoceramic array, the amplitude of the signals reflected from the simulated defect are 30 dB lower compared to those generated using the piezoceramic array. [J318]

"Node clustering in wireless sensor networks: recent developments and deployment challenges"

The large-scale deployment of wireless sensor networks (WSNs) and the need for data aggregation necessitate efficient organization of the network topology for the purpose of balancing the load and prolonging the network lifetime. Clustering has proven to be an effective approach for organizing the network into a connected hierarchy. In this article, we highlight the challenges in clustering a WSN, discuss the design rationale of the different clustering approaches, and classify the proposed approaches based on their objectives and design principles. We further discuss several key issues that affect the practical deployment of clustering techniques in sensor network applications. [J319]

"Advances in artificial immune systems"

During the last decade, the field of artificial immune system (A1S) is progressing slowly and steadily as a branch of computational intelligence (CI). There has been increasing interest in the development of computational models inspired by several immunological principles. In particular, some are building models mimicking the mechanisms in the biological immune system (BIS) to better understand its natural processes and simulate its dynamical behavior in the presence of antigens/pathogens. Most of the AIS models, however, emphasize designing artifacts-computational algorithms, techniques using simplified models of various immunological processes and functionalities. Like other biologically-inspired techniques, such as artificial neural networks, genetic algorithms, and cellular automata, AISs also try to extract ideas from the BIS in order to develop computational tools for solving science and engineering problems. Although still relatively young, the artificial immune system (AIS) is emerging as an active and attractive, field involving models, techniques and applications of greater diversity [J320]

"Short pulse laser produced energetic electron and positron measurements"

Very energetic (MeV)electrons are commonly produced from ultraintense (1019W/cm2)laser-solid interactions. Diagnosing these so-called hot electrons is of fundamental importance in understanding the detailed laser plasma physics present in these interactions, as well as in potential applications. Interestingly, positrons can also be produced in these interactions if the number and effective temperature of hot electrons exceed a threshold value. This additional information may help to better determine the effective electron temperature that exists in these targets. We have designed and constructed a compact spectrometer that can simultaneously measure the energy spectra of both electrons and positrons. Presented here are the principles of the spectrometer together with its experimental results obtained on the ultraintense (1019W/cm2)lasers at Lawrence Livermore National Laboratory and the Rutherford Appleton Laboratory Vulcan petawatt laser. [J321]

"The TOFOR neutron spectrometer and its first use at JET"

A time-of-flight neutron spectrometer (TOFOR) has been developed to measure the 2.45MeVd+d→3He+nneutron emission from D plasmas. The TOFOR design features the capability to operate at high rates in the 100kHzrange, data collection with fast time digitizing and storing, and monitoring of the signals from the scintillation detectors used. This article describes the principles of the instrument and its installation at JET and presents preliminary data to illustrate the TOFOR performance as a neutron emission spectroscopy diagnostic. [J322]

"New reflectometer design for density profile measurements on JET"

New transmission lines and antennas recently installed at Join European Torus (JET) under the European Fusion Development Agreement enhancement project millimeter wave access meet the performance requirements of broadband reflectometry for density profile measurements. A fast swept frequency modulation continuous wave [H. Bottollier, Curtet-etal, Rev. Sci. Instrum. 58, 539 (1987); F. Simonet etal, ibid. 56, 664 (1985); A. Silva etal, ibid. 70, 664 (1999); S. Hacquin etal, ibid. 75, 3834 (2004)] using coherent detection of the reflected signal was developed to probe the midplane plasma in the X-mode polarization in the 50-75GHzfrequency range, aiming at measuring the edge density profile in the JET advanced scenarios with an axial magnetic field of 2.4T. The operating principles of the new system are described and some preliminary results obtained with it are presented. Special attention is given to the capability of operating on bistatic antenna arrangements over long waveguides using a local generated reference, as these will be the conditions proposed for the ITER reflectometers. [J323]

"Design consideration for high-energy-resolution neutron spectrometer based on associated particle detection using proton recoil telescope and time-of-flight technique for ITER"

For ion temperature measurement in the ITER high power operation phase, we propose a promising high-energy-resolution neutron spectrometer based on the associated particle detection using a proton recoil telescope and a time-of-flight spectrometer. To verify the operational principle and the basic performance of this system, we have set up a prototype system through Monte Carlo simulations and carried out a preliminary experiment with a deuterium-tritium (DT) neutron beam at the Fusion Neutronics Source, JAEA. The results have demonstrated that the energy resolution could be achieved around 3.3% (in full width at half maximum) for DT neutrons. In addition, the design consideration of this system for an application to ITER is given on the detection efficiency, the applicable range in the ITER operation, and the detector lifetime. [J324]

"Superconducting quantum interference device instruments and applications"

Superconducting quantum interference devices (SQUIDs) have been a key factor in the development and commercialization of ultrasensitive electric and magnetic measurement systems. In many cases, SQUID instrumentation offers the ability to make measurements where no other methodology is possible. We review the main aspects of designing, fabricating, and operating a number of SQUID measurement systems. While this article is not intended to be an exhaustive review on the principles of SQUID sensors and the underlying concepts behind the Josephson effect, a qualitative description of the operating principles of SQUID sensors and the properties of materials used to fabricate SQUID sensors is presented. The difference between low and high temperature SQUIDs and their suitability for specific applications is discussed. Although SQUID electronics have the capability to operate well above 1MHz, most applications tend to be at lower frequencies. Specific examples of input circuits and detection coil configuration for different applications and environments, along with expected performance, are described. In particular, anticipated signal strength, magnetic field environment (applied field and external noise), and cryogenic requirements are discussed. Finally, a variety of applications with specific examples in the areas of electromagnetic, material property, nondestructive test and evaluation, and geophysical and biomedical measurements are reviewed. [J325]

"Novel nanoscale thermal property imaging technique: The 2omega method. I. Principle and the 2omega signal measurement"

In this and the following companion articles, the authors present the 2omega method, a novel ac mode local thermal property imaging technique with nanoscale spatial resolution. To demonstrate the use of the thermoelectric probe as an active one that can function as both a heater and a temperature sensor, the authors develop and implement the 2omega signal measurement technique, which can extract thermoelectric signals from a thermocouple junction while electrically heating it simultaneously. The principle of the 2omega signal measurement technique is explained by a steady periodic electrothermal analysis. The authors use a specially designed test pattern to experimentally verify that the 2omega signal is caused by the temperature oscillation

induced by Joule heating. In addition, based on the results from an experiment using a cross-shaped pattern, the measurement accuracy of the 2omega method depends on the junction size of the thermoelectric probe. The 2omega method is implemented and compared with other methods in the following companion paper. [J326]

"Correlated-intensity velocimeter for arbitrary reflector for laser-produced plasma experiments"

A laser-based technique, called correlated-intensity velocimeter for arbitrary reflector (CIVAR), is described for velocity measurement of reflecting surfaces in real time. Velocity versus time is an important measurement in laser-produced high-energy density plasma experiments because the motion of the surface depends on both the equation of the state of the surface material and laser-produced plasma. The physics and working principle of CIVAR are the same as those of a previous concept that resolves Doppler shift of plasma light emission using a pair of narrow passband interference filters. One unique feature of CIVAR is that a reflected laser beam is used instead of plasma emission. Therefore, CIVAR is applicable to both emitting and nonemitting reflecting surfaces. Other advantages of CIVAR include its simplicity, lower cost, and unambiguous data analysis that can be fully automated. The design of a single-point CIVAR is described in detail with emphasis on laser wavelength selection and signal-to-noise ratio. The single-point CIVAR system can be expanded into a multiple-point system straightforwardly. It is possible to use CIVAR concept to construct a two-dimensional imaging system for a nonuniform velocity field of a large reflecting surface; such a velocity imaging system may have applications beyond laser-produced plasma experiments, for example, in shock compression of condensed matter. [J327]

"Methods of determining the contact between a probe and a surface under scanning electron microscopy"

Based on the charging effect common to various kinds of electron microscopy, we have developed novel methods of determining "when" and "where" a probe starts to contact an electrically isolated surface. The touchdown of an electrically grounded probe leads to an acute change in the imaging contrast of the contacted surface, which also causes a rapid jump (ranging from a few to tens of picoamperes) of the grounding current. Thus, the detection of contact can be carried out in both qualitative and quantitative manners, providing a basis for establishing relevant standard procedures. In addition, we have achieved the spatial mapping of the contact point(s) using a specially designed lithographical pattern with two mutually vertical sets of parallel conductive lines. The precision of this mapping technique is simply determined by the pitch of parallel lines, which can be as small as the capability achievable in e-beam lithography. A possible "one-probe" version of the electrical characterization is also discussed with the same underlying principle, which may turn out to be indispensable for various studies and applications of nanostructures. Further development along this track is promising to realize an instrumentally simple version of "scanning electron spectroscopy" with various modes. [J328]

"Real-time detection of ambient aerosols using photothermal interferometry: Folded Jamin interferometer"

Work in our laboratory has been directed at the development of a new class of instrumentation that can directly measure ambient aerosol absorption through photothermal interferometry. The hallmark of this approach is its ability to directly measure aerosol absorption without interference from aerosol scattering since the signal originates from the thermal dissipation of the spectrally absorbed energy. While the principle of the photothermal technique for the detection of aerosols was demonstrated in the mid-1980s, this interferometric technique remains a laboratory technique largely due to sensitivity to mechanical vibrations and other environmental factors that result in unwanted signal interference and commensurate reduction in detection sensitivity. In order to realize its application outside the laboratory, a folded Jamin interferometer design has replaced both the traditional Mach-Zehnder and unfolded Jamin configurations. The folded Jamin affords many advantages, which include high degree of common mode noise rejection, insensitivity to rotation and translation of optical components, inherent double pass configuration, and compact size. In this article, we report on the performance of this optical configuration and present representative data for both absorbing and nonabsorbing aerosols. [J329]

"Microplates-based rheometer for a single living cell"

We developed a new versatile micron-scale rheometer allowing us to measure the creep or the relaxation function (time analysis), as well as to determine the dynamical complex modulus (frequency analysis) of a single living cell. In this setup, a microscopic sample can be stretched or compressed uniaxially between two parallel microplates: one rigid, the other flexible. The flexible microplate is used as a nanonewton force sensor of calibrated stiffness, the force being simply proportional to the plate deflection. An original design of the microplates allows us to achieve an efficient feedback control of either strain or stress applied to the cell. Controlling the flexible plate deflection with a typical precision of less than 200nm, we are able to apply stresses ranging from a few pascals to thousands of pascals with a precision better than 2%. The control of the flexible

plate deflexion is achieved by direct imaging of the plate tip on a photosensitive detector mounted on the phototube of an inverted microscope. Thus, the detection principle is suitable to all usual microscopes and very easy to set up. Beyond the creep function, already analyzed in detail in a previous work, we report here the first measurement of the relaxation function, as well as of the storage and the loss dynamic moduli [G'(f)and G"(f), franging from 0.02to10Hz] for an isolated living cell. Eventually, the rheometer we built is not limited to cell stretching. It should also be a powerful tool to study the rheology of micron sized samples such as microgels or vesicles, as well as to perform shear experiments. [J330]

"Piezoelectric trace vapor calibrator"

The design and performance of a vapor generator for calibration and testing of trace chemical sensors are described. The device utilizes piezoelectric ink-jet nozzles to dispense and vaporize precisely known amounts of analyte solutions as monodisperse droplets onto a hot ceramic surface, where the generated vapors are mixed with air before exiting the device. Injected droplets are monitored by microscope with strobed illumination, and the reproducibility of droplet volumes is optimized by adjustment of piezoelectric wave form parameters. Complete vaporization of the droplets occurs only across a 10°Cwindow within the transition boiling regime of the solvent, and the minimum and maximum rates of trace analyte that may be injected and evaporated are determined by thermodynamic principles and empirical observations of droplet formation and stability. By varying solution concentrations, droplet injection rates, air flow, and the number of active nozzles, the system is designed to deliver-on demand-continuous vapor concentrations across more than six orders of magnitude (nominally 290fg/lto1.05mu g/l). Vapor pulses containing femtogram to microgram quantities of analyte may also be generated. Calibrated ranges of three explosive vapors at ng/l levels were generated by the device and directly measured by ion mobility spectrometry (IMS). These data demonstrate expected linear trends within the limited working range of the IMS detector and also exhibit subtle nonlinear behavior from the IMS measurement process. [J331]

"Advanced testing of adhesion and friction with a microtribometer"

To optimize the tribological performance of miniaturized systems, adequate experimental means are needed. Current microtribometers suffer from inability to ensure parallel flat-on-flat contact and often experience metrological problems related to the geometry of the force sensing element. The present work demonstrates how these limitations can be removed in either homemade or commercial microtribometers by using a self-aligning system of specimen holders and an improved force sensor based on a symmetric design principle. Preliminary tests conducted on a polyvinylsiloxane/glass tribopair confirm the satisfactory operation of the setup and show no effect of applied load on pull-off force and friction coefficient. [J332]

"Phase modulation atomic force microscope with true atomic resolution"

We have developed a dynamic force microscope (DFM) working in a novel operation mode which is referred to as phase modulation atomic force microscopy (PM-AFM). PM-AFM utilizes a fixed-frequency excitation signal to drive a cantilever, which ensures stable imaging even with occasional tip crash and adhesion to the surface. The tip-sample interaction force is detected as a change of the phase difference between the cantilever deflection and excitation signals and hence the time response is not influenced by the Qfactor of the cantilever. These features make PM-AFM more suitable for high-speed imaging than existing DFM techniques such as amplitude modulation and frequency modulation atomic force microscopies. Here we present the basic principle of PM-AFM and the theoretical limit of its performance. The design of the developed PM-AFM is described and its theoretically limited noise performance is demonstrated. Finally, we demonstrate the true atomic resolution imaging capability of the developed PM-AFM by imaging atomic-scale features of mica in water. [J333]

"New diamond cell for single-crystal x-ray diffraction"

A new design for a high-precision diamond cell is described. Two kinematically mounted steel disks are elastically deflected to generate pressure. This principle provides higher precision in the diamond anvil alignment than most sliding piston-cylinder or guide-pin devices at significantly lower cost. With this new diamond cell conical diamond anvils with an x-ray aperture of 85° were successfully tested to over 50GPausing helium as a pressure medium. Anvil thickness of less than 1.4mmprovides high x-ray transmission and low background, a significant improvement compared to beryllium or diamond-disk backing plates. Because the diamond anvils are supported by tungsten carbide seats, samples and pressure media can be annealed by external or laser heating to provide hydrostatic pressure conditions. [J334]

"Device for in situ cleaving of hard crystals"

Cleaving crystals in a vacuum chamber is a simple method for obtaining atomically flat and clean surfaces for

materials with a preferential cleaving plane. Most in situ cleavers use parallel cutting edges that are applied from two sides on the sample. We found in ambient experiments that diagonal cutting pliers, where the cleavage force is introduced in a single point instead of a line, work very well also for hard materials. Here, we incorporate the diagonal cutting plier principle in a design compatible with ultrahigh-vacuum requirements. We show optical microscopy (millimeter scale) and atomic force microscopy (atomic scale) images of NiO(001)surfaces cleaved with this device. [J335]

"Dynamical response of the Galileo Galilei on the ground rotor to test the equivalence principle: Theory, simulation, and experiment. I. The normal modes"

Recent theoretical work suggests that violation of the equivalence principle might be revealed in a measurement of the fractional differential acceleration eta between two test bodies-of different compositions, falling in the gravitational field of a source mass-if the measurement is made to the level of eta 10-13or better. This being within the reach of ground based experiments gives them a new impetus. However, while slowly rotating torsion balances in ground laboratories are close to reaching this level, only an experiment performed in a low orbit around the Earth is likely to provide a much better accuracy. We report on the progress made with the "Galileo Galilei on the ground" (GGG) experiment, which aims to compete with torsion balances using an instrument design also capable of being converted into a much higher sensitivity space test. In the present and following articles (Part I and Part II), we demonstrate that the dynamical response of the GGG differential accelerometer set into supercritical rotation-in particular, its normal modes (Part I) and rejection of common mode effects (Part II)-can be predicted by means of a simple but effective model that embodies all the relevant physics. Analytical solutions are obtained under special limits, which provide the theoretical understanding. A simulation environment is set up, obtaining a quantitative agreement with the available experimental data on the frequencies of the normal modes and on the whirling behavior. This is a needed and reliable tool for controlling and separating perturbative effects from the expected signal, as well as for planning the optimization of the apparatus. [J336]

"Excitons in electrostatic traps"

We consider in-plane electrostatic traps for indirect excitons in coupled quantum wells, where the traps are formed by a laterally modulated gate voltage. An intrinsic obstacle for exciton confinement in electrostatic traps is an in-plane electric field that can lead to exciton dissociation. We propose a design to suppress the in-plane electric field and, at the same time, to effectively confine excitons in the electrostatic traps. We present calculations for various classes of electrostatic traps and experimental proof of principle for trapping of indirect excitons in electrostatic traps. [J337]

"Modulating the thickness of the resist pattern for controlling size and depth of submicron reversed domains in lithium niobate"

In this letter the electric field overpoling is used in combination with two-dimensional resist gratings exhibiting modulated topography and obtained by moire interference lithography. The technique allows one to fabricate shallow submicron domains with lateral size and depth modulated according to the resist profile. Simulations of the electric field distribution in the crystal, in this specific poling configuration, are performed to interpret the mechanism leading to the formation of those surface domains. The results show that in principle complex domain structures could be designed for applications in the field of photonic crystals. [J338]

"Standing-wave spectrometer"

A standing-wave sensor was developed which facilitates the miniaturization of Fourier spectrometers down to the micrometer scale. The spectrometer concept is based on sampling a standing wave by an ultrathin and partially transmissive sensor. The active region of the sensor has a thickness of 30nm-40nm. The standing wave is created in front of a tunable mirror. Varying the position of the mirror results in a phase shift of the standing wave, a modulation of the intensity profile within the ultrathin sensor, and thus, in a modulation of the photocurrent. The spectral information of the incoming light can be determined by the Fourier transform of the sensor signal. The operation principle of the spectrometer is described and the influence of the device design on the spectral resolution of the spectrometer is discussed. Due to the simple linear setup of the sensor and the tunable mirror, the realization of one- and two-dimensional spectrometer arrays is feasible. [J339]

"Integrated tunneling sensor for nanoelectromechanical systems"

Transducers based on quantum mechanical tunneling provide an extremely sensitive sensor principle, especially for nanoelectromechanical systems. For proper operation a gap between the electrodes of below 1nmis

essential, requiring the use of structures with a mobile electrode. At such small distances, attractive van der Waals and capillary forces become sizable, possibly resulting in snap-in of the electrodes. The authors present a comprehensive analysis and evaluation of the interplay between the involved forces and identify requirements for the design of tunneling sensors. Based on this analysis, a tunneling sensor is fabricated by Si micromachining technology and its proper operation is demonstrated. [J340]

"Nonconductive polymer microresonators actuated by the Kelvin polarization force"

The authors present a method, based on the Kelvin polarization force, to actuate nonconductive polymer microstructures. A proof of principle was conducted by finite element simulations. Microresonators made of SU-8 were fabricated and characterized under resonant conditions at applied ac voltage of 5Vpp. A quality factor of Q=87in vacuum and a square dependence of the force on the applied voltage were obtained. The presented actuator design and fabrication do not require additional electrodes on the movable structure for actuation and thus allow for the full exploration of the exceptional variety of polymer materials for microscaled actuators and sensors. [J341]

"Above-room-temperature 3-12 mcm Si emitting arrays"

The design and parameters are presented for 16-element infrared (IR, 3-12mcm) emitting arrays based on Si p+in+structures and above-room-temperature (300K T 480K)operated by the contact double injection. The device principle is in modulation of thermal emission beyond the fundamental absorption edge by controlling free charge carrier concentration in a base. Nearly 1.0mWoutput power and 420Kapparent temperature of IR radiation could be achieved with 0.8%external power efficiency. This represents the longer wavelengths, higher operating temperatures, and output power from Si spontaneous emitters ever reported. [J342]

"Microfabricated rubber microscope using soft solid immersion lenses"

We show here a technique of soft lithography to microfabricate efficient solid immersion lenses (SIL) out of rubber elastomers. The light collection efficiency of a lens system is described by its numerical aperture (NA), and is critical for applications as epifluorescence microscopy [B. Herman, Fluorescence Microscopy (BIOS Scientific, Oxford/Springer, United Kingdom, 1998). While most simple lens systems have numerical apertures less than 1, the lenses described here have NA=1.25. Better performance can be engineered though the use of compound designs; we used this principle to make compound solid immersion lenses (NA=1.32). An important application of these lenses will be as integrated optics for microfluidic devices. We incorporated them into a handheld rubber microscope for microfluidic flow cytometry and imaged single E. Coli cells by fluorescence. [J343]

"Three-way electrical gating characteristics of metallic Y-junction carbon nanotubes"

Y-junction based carbon nanotube (CNT) transistors exhibit interesting switching behaviors, and have the structural advantage that the electrical gate for current modulation can be formed by any of the three constituent branches. In this letter, we report on the gating characteristics of metallic Y-CNT morphologies. By measuring the output conductance and transconductance we conclude that the efficiency and gain depend on the branch diameter and is electric field controlled. Based on these principles, we propose a design for a Y-junction based CNT switching device, with tunable electrical properties. [J344]

"First-principles study of low compressibility osmium borides"

Using first-principles total energy calculations we investigate the structural, elastic, and electronic properties of OsB2and OsB, respectively. The calculated equilibrium structural parameters of OsB2are in agreement with the available experimental results. The calculations indicate that OsB in tungsten carbide is more energetically stable under the ambient condition than the metastable cesium chloride phase of OsB. Results of bulk modulus show that they are potential low compressible materials. The hardness of OsB2is estimated by employing a semiempirical theory. The results indicate that OsB2is an ultraincompressible material, but not a superhard material. The method designing superhard materials is different from one creating ultraincompressible materials. [J345]

"A measurement of electron-wall interactions using transmission diffraction from nanofabricated gratings"

Electron diffraction from metal coated freestanding nanofabricated gratings is presented, with a quantitative path integral analysis of the electron-grating interactions. Electron diffraction out to the 20th order was observed indicating the high quality of our nanofabricated gratings. The electron beam is collimated to its diffraction limit

with ion-milled material slits. Our path integral analysis is first tested against single slit electron diffraction, and then further expanded with the same theoretical approach to describe grating diffraction. Rotation of the grating with respect to the incident electron beam varies the effective distance between the electron and grating bars. This allows the measurement of the image charge potential between the electron and the grating bars. Image charge potentials that were about 15% of the value for that of a pure electron-metal wall interaction were found. We varied the electron energy from 50to900eV. The interaction time is of the order of typical metal image charge response times and in principle allows the investigation of image charge formation. In addition to the image charge interaction there is a dephasing process reducing the transverse coherence length of the electron wave. The dephasing process causes broadening of the diffraction peaks and is consistent with a model that ascribes the dephasing process to microscopic contact potentials. Surface structures with length scales of about 200nmobserved with a scanning tunneling microscope, and dephasing interaction strength typical of contact potentials of 0.35eVsupport this claim. Such a dephasing model motivated the investigation of different metallic coatings, in particular Ni, Ti, Al, and different thickness Au-Pd coatings. Improved quality of diffraction patterns was found for Ni. This coating ma- de electron diffraction possible at energies as low as 50eV. This energy was limited by our electron gun design. These results are particularly relevant for the use of these gratings as coherent beam splitters in low energy electron interferometry. [J346]

"Response to "Comment on 'Contact mechanisms and design principles for alloyed Ohmic contacts to n-Ga N '" [JJ. Appl. Phys. 95, 7940 (2004)]"

Response to Yow-Jon Lee's comments on our article [J. Appl. Phys. 95, 7940 (2004)] describing the relative influence of thermionic emission and tunneling on the low contact resistivity of annealed Ti/n-GaNcontacts under the influence of band gap narrowing and/or image force lowering has been presented. [J347]

"Sensitive detector for a passive terahertz imager"

We report progress in developing a sensitive detector for terahertz radiation, based on a semiconductor quantum dot (QD) capacitively coupled to a metallic single electron transistor (SET). A charge polarization of the QD induced by the absorption of individual photons is detected by the voltage-biased SET. We investigate the sensitivity of the detector to broadband radiation, over a range of QD barrier heights, and find that there is a measurable photo-signal over wide range of gate voltages defining the QD. This is an improvement on previous designs of terahertz detector based on the QD/SET principle, and makes the new detector a candidate for use in an imaging device. [J348]

"Magnetoresistive playback heads for bit-patterned medium recording applications"

This work examines playback characteristics of common magnetoresistive heads applied in magnetic recording systems based on bit-patterned medium. Playback for different head designs is evaluated using the reciprocity principle. Analytical solution for a pointlike reader is used to elucidate the playback resolution limits for a given patterned medium morphology. Various recording system design parameters including recording layer design (thickness, bit geometry, and bit-to-bit spacing), exchange/buffer layer thickness, soft underlayers, and fly height are examined. Differential readers are shown to offer significantly higher spatial resolution, higher signal amplitude, and the weakest dependence on fly-height variations and bit geometry. For example, for a 1Tb/in2reader design considered, D50 is 1.46 and 2.64Tb/in2for shielded and differential readers, respectively; differential readers have more than 35% higher playback amplitude than equivalent shielded readers. The loss in playback amplitude can be as high 18% due to bit-corner rounding (lithography imperfections) for shielded readers; differential readers exhibit only a weak dependence on bit-corner rounding (±2%-3%). Pseudodifferential readers with a single-sensor element are shown to offer advantages similar to the advantages of conventional double-sensor differential readers while addressing manufacturability issues. [J349]

"Comment on "Contact mechanisms and design principles for alloyed Ohmic contacts to n-Ga N " [JJ. Appl. Phys. 95, 7940 (2004)]"

The contact mechanism and design principles for alloyed Ohmic contacts to n-GaNwere investigated in Mohammad's paper [J. Appl. Phys. 95, 7940 (2004)]. Mohammad's study demonstrated that both tunneling and thermionic emission were equally important for low resistivity at the metals/n-GaNinterfaces. As regards this Comment, we point out the fundamental errors of this interpretation. In addition, we find that the results shown in Figs. 3-6 of Mohammad's paper are incorrect because the lower effective barrier height (BH) of less than 0eV(due to the induced BH reduction by image force lowering or band gap narrowing) and a variable (c1)were neglected by the author. [J350]

"Heterogeneous porous media as multiscale structures for maximum flow access"

Natural porous structures are heterogeneous with multiple scales that are distributed nonuniformly. Few large pores (fissures, channels, and cracks) are accompanied by numerous finer channels. Can this type of flow architecture be attributed to a principle of maximization of global flow access? Features similar to those of multiscale porous structures are exhibited by tree-shaped flow structures. Trees have been deduced from the maximization of flow access between a point and a volume, a point and an area, and a point and a curve (e.g., circle). In this paper we invoke the same principle and consider fundamentally the question of how to bathe with minimal flow resistance a microchannel structure that globally behaves as a porous medium. We develop completely multiscale configurations that guide the flow from one side of the porous structure to the other (line to line and plane to plane) and show analytically the advantages of tree structures over the usual stacks of parallel microchannels. The "porous medium" that has tree-shaped labyrinths is heterogeneous, with multiple scales that are distributed nonuniformly. These features justify comparisons with the design of natural porous structures. [J351]

"The role of geometry in the friction generated on the colonic surface by mucoadhesive films"

One of the main challenges in designing diagnostic devices able to move along the colon is their locomotion method. Generating friction without applying high normal forces is a key requirement in order to eliminate the risk of tissue damage. One possible solution is to generate friction by means of adhesive forces. For this reason, the device can be covered with mucoadhesive films, which are able to stick on the colonic surface. This paper identifies that the friction of mucoadhesive films depends strongly on their geometry. It seems therefore feasible to adapt the level of the friction to the properties of the colonic surface by altering the geometry of the films covering the device. Moreover, an eventual influence of the film geometry on the generated friction can reveal film shapes which create high grip despite their small size, leading to a decrease in the overall size of the device. The aim of the paper is to test in vitro the relationship between film geometry and generated friction, to fit the experimental findings in a simplified but generic macroscopic theoretical model able to predict the behavior of various geometries, and to embed those findings in the principles of the design implementation. [J352]

"Constructal theory of generation of configuration in nature and engineering"

Constructal theory is the view that the generation of flow configuration is a physics phenomenon that can be based on a physics principle (the constructal law): "For a finite-size flow system to persist in time (to survive) its configuration must evolve in such a way that it provides an easier access to the currents that flow through it" [A. Bejan, Advanced Engineering Thermodynamics, 2nd ed. (Wiley, New York, 1997); Int. J. Heat Mass Transfer, 40, 799 (1997)]. This principle predicts natural configuration across the board: river basins, turbulence, animal design (allometry, vascularization, locomotion), cracks in solids, dendritic solidification, Earth climate, droplet impact configuration, etc. The same principle yields new designs for electronics, fuel cells, and tree networks for transport of people, goods, and information. This review describes a paradigm that is universally applicable in natural sciences, engineering and social sciences. [J353]

"Dynamical response of the Galileo Galilei on the ground rotor to test the equivalence principle: Theory, simulation, and experiment. II. The rejection of common mode forces"

"Galileo Galilei on the ground" (GGG) is a fast rotating differential accelerometer designed to test the equivalence principle (EP). Its sensitivity to differential effects, such as the effect of an EP violation, depends crucially on the capability of the accelerometer to reject all effects acting in common mode. By applying the theoretical and simulation methods reported in Part I of this work, and tested therein against experimental data, we predict the occurrence of an enhanced common mode rejection of the GGG accelerometer. We demonstrate that the best rejection of common mode disturbances can be tuned in a controlled way by varying the spin frequency of the GGG rotor. [J354]

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