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Recent Researches in Communications, Automation, Signal Processing, Nanotechnology, Astronomy & Nuclear Physics

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Preface

This year the 10th WSEAS International Conference on ELECTRONICS, HARDWARE, WIRELESS and OPTICAL COMMUNICATIONS (EHAC '11), the 10th WSEAS International Conference on SIGNAL PROCESSING, ROBOTICS and AUTOMATION (ISPRA '11), the 3rd WSEAS International Conference on NANOTECHNOLOGY (NANOTECHNOLOGY '11), the 6th WSEAS International Conference on OPTICS-ASTROPHYSICS-ASTRONOMY (ICOAA '11) and the 2nd WSEAS International Conference on PLASMA-FUSION-NUCLEAR PHYSICS (IPLAFUN '11) were held in Cambridge, UK, February 20-22, 2011. The conferences remain faithful to their original idea of providing a platform to discuss electronics, hardware engineering, wireless and optical communications, signal processing, robotics, automation, nanomaterials, nanoparticles and colloids, nanomedicine, nanoelectronics, molecular electronics, optics, astrophysics, astronomy, nuclear and plasma sciences, radiation physics etc. with participants from all over the world, both from academia and from industry.

Their success is reflected in the papers received, with participants coming from several countries, allowing a real multinational multicultural exchange of experiences and ideas.

The accepted papers of these conferences are published in this Book that will be indexed by ISI. Please, check it: www.worldses.org/indexes as well as in the CD-ROM Proceedings. They will be also available in the E-Library of the WSEAS. The best papers will be also promoted in many Journals for further evaluation.

Conferences such as these can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors

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Plenary Lecture 1

Nonlinear Effects in Optical Fibers: Limitations and Benefits

Professor Mario F. S. Ferreira
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Abstract: Nonlinear effects in optical fibers impose different limitations on the communications link, and an understanding of such effects is almost a prerequisite for actual lightwave-system designers. On the other hand, they offer a variety of possibilities for all-optical signal processing, amplification and regeneration. The nonlinear effects are enhanced dramatically and new phenomena are observed in the so called photonic crystal fibers. In this talk we review the effects – both detrimental and potentially beneficial – of optical nonlinearities in conventional and in photonic crystal fibers.

Brief Biography of the Speaker: Mario F. S. Ferreira was born in Ovar, Portugal. He graduated in Physics from the University of Porto, Portugal, in 1984. Since then, he became an assistant lecturer, first at the Mathematics Department and afterwards at the Physics Department of the University of Aveiro, Portugal, from which institution he received the Ph.D. degree in Physics in 1992. He is now a Professor at the same Physics Department.
Between 1990 and 1991 he was at the University of Essex, UK, performing experimental work on external cavity semiconductor lasers and nonlinear optical fiber amplifiers. His research interests have been concerned with the modeling and characterization of multi-section semiconductor lasers for coherent systems, quantum well lasers, optical fiber amplifiers and lasers, soliton propagation, polarization and nonlinear effects in optical fibers. He is actually the leader of the Optics and Optoelectronics Group of the I3N – Institute of Nanostructures, Nanomodelling and Nanofabrication. He has written more than 200 scientific journal and conference publications, a book with the title: "Optics and Photonics" (Lidel, 2003, in Portuguese) and another with the title: "Nonlinear Effects in Optical Fibers" (John Wiley & Sons, to appear in August 20010).
He is a member of the Optical Society of America (OSA), SPIE - The International Society for Optical Engineering, The New York Academy of Sciences (NYAS), the American Association for the Advancement of Science (AAAS), the European Optical Society (EOS), the European Physical Society (EPS) and the Portuguese Physical Society.
He served in various committees of the Optical Society of America (OSA) and of SPIE – The International Society for Optics and Photonics, having been also a member of the Telecommunications Committee of the "International Association of Science and Technology for Development" (IASTED). He is a Visiting Lecturer of SPIE – The International Society for Optics and Photonics. He served in the technical committees of various international conferences, being actually one of the Chairs of the Conference "Optical Sensors", which is part of the Symposium "Advanced Photonics: OSA Optics & Photonics Congress", to be held at Karlsruhe, Germany, 21-24 June 2010.
He served as a reviewer of several scientific journals in the area of optics and optoelectronics. He is presently an Associate Editor of "Optical Fiber Technology- Materials, Devices, and Systems" (Elsevier) and a member of the Advisory Board of "Fiber and Integrated Optics" (Taylor & Francis), "Nonlinear Optics, Quantum Optics" (Old City Publishing, Inc.), "Research Letters in Optics" (Hindawi Publishing Corporation), and "International Journal of Optics" (Hindawi Publishing Corporation). He was the Guest Editor of a Special Issue of "Fiber and Integrated Optics", published in 2005, dedicated exclusively to the fiber and integrated optics activity carried out in Portugal.

Plenary Lecture 2

Generalized Approach for Electronic Circuits Optimization

Professor Alexander Zemliak
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Abstract: One of the major challenges of designing large electronic systems is the task of reducing the CPU time for circuits optimization. This problem can be solved on the basis of a generalized approach to optimization of electronic circuits. The generalization of circuit optimization can be done as a problem of minimizing the functional in control theory. A special vector of control serves as a principal tool to redistributing the computer time between circuit analysis and the procedure of parametric optimization. The circuit design process is formulated in this case as a controllable dynamic system. To realize the minimal-time design algorithm we need constructing the optimal structure of the vector of control. Obtaining the optimal sequence of switching points of the vector control in the design process can be based on the intrinsic properties of each optimization strategy. The Lyapunov function of the process of optimization serves as a principal function that separates the perspective strategies for design of circuits. The process of designing electronic circuits is formulated as a dynamic controllable system, while the design corresponds to the transition process to bring the system in steady state. In this case, the main objective of optimum design is defined as the problem of minimizing the transient process of bringing the system in steady state. Stability analysis of each strategy of design based on Lyapunov's direct method revealed a strong correlation between the time of design and the main indicators of the design process, namely the Lyapunov function and its time derivative. The strategies that have the greatest absolute value of the time derivative of Lyapunov function in the initial phase of the trajectory design, exhibit the greatest stability and have the least CPU time. This property is the basis for the constructing a minimal-time algorithm of design.

Brief Biography of the Speaker: Alexander Zemliak received the M.S. degree in electronic engineering from the Kiev Polytechnic Institute (KPI), Kiev, Ukraine, in 1972 and in mathematics from the Kiev University in 1975, and Ph.D. in electronic engineering from KPI in 1976. He is currently a Professor of Physics and Mathematics Department, Autonomous University of Puebla, and a Professor of the National Technical University of Ukraine “KPI” too. His research interests are in computer-aided RF and microwave circuit analysis, optimal design methodologies, computational electromagnetics, numerical techniques in the simulation, analysis and optimization of microwave devices. He has authored of two books, 6 chapters of books and over 250 papers in refereed journals and conference proceedings. From 1986 to 1994 he held some research grants from Ministry of Superior Education of Ukraine and industry. From 1998 to 2010 he held some grants from Mexican National Council of Science and Technology. He is a member of Ukrainian Scientific Society, National System of Investigators of Mexico, Senior Member of IEEE, member of IEICE, WSEAS and New York Academy of Sciences. He was a chairman of some international conferences in Mexico, member of technical program committee of some conferences around the world and invited lecturer of more than 10 international conferences. He obtained best paper award at National SOMI Conference, 1999 (Mexico), International conference IBERCHIP, 2002 (Mexico), International WSEAS Conference, 2009 (Turkey), International Conference IEEE EWDTS, 2010 (Russia). He is Editor-in-Chief of the WSEAS Transactions on Systems, Member of the Editorial Board of the WSEAS Transactions on Circuits and Systems, WSEAS Transactions on Electronics. He was a Reviewer of International Design Automation Conference-DAC, 2001–2003, USA; International Conference on Computing, Communication and Control Technologies-CCCT, 2004–2008, USA; World Multi-Conference on Systemics, Cybernetics and Informatics, 2003–2010, USA.

Plenary Lecture 3

An Iterative Kalman-like Algorithm with no Requirements for Noise and Initial Conditions

Professor Yuriy S. Shmaliy
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Abstract: The term "Kalman-like" or "Kalman-type" is commonly used whenever the standard linear Kalman filtering algorithm is modified to estimate state of the nonlinear model, under unknown initial conditions, in the presence of nonwhite or multiplicative noise sources, etc. In such improper applications for the Kalman filter, the Kalman-like one is designed to save the recursive structure, while connecting the algorithm components with the model in different ways. Because there can be found an infinity of the Kalman-like solutions depending on applications, we encounter a number of propositions suggesting some new qualities while saving (or not deteriorating substantially) the advantages of the Kalman filter: accuracy, fast computation, and small memory. The extended and unscented algorithms are among the widely recognized Kalman-like ones suitable for nonlinear problems. Nahi proposed a modification for uncertain observations by including the multiplicative noise component to the measurement matrix. For hidden Markov trees, the efficient restoration Kalman-like algorithm was discussed by Basseville et al. Implying nonlinear modeling for hidden Markov chains, the Kalman filter was modified by Baccarelli and Cusani to have the gain dependent on the observations. Most recently, Ait-El-Fquih and Desbouvries applied the Kalman-like approach to triple Markov chains. We also meet a new Kalman-like tracking algorithm applied to the autoregressive channel process estimation with fading by Stefanatos and Katsaggelos. Different kinds of the Kalman-like algorithms can also be found in the area of control. Becis-Aubrya et al, discussed the two-step one with a switching gain matrix. Carli et al. employed the concept of the centralized Kalman filter for state estimation in the complex sensor networks, and the list of the developments can be extended. There were also proposed the iterative Kalman-like forms for the finite impulse response (FIR) time invariant filters. Han, Kwon, and Kim suggested a relevant algorithm for deterministic control systems and Shmaliy derived an algorithm for the p-shift unbiased FIR estimator.
This lecture introduces readers to the recently developed p-shift general iterative linear Kalman-like FIR estimation algorithm intended for filtering ($p = 0$), prediction ($p > 0$), and smoothing ($p < 0$) of linear discrete time-varying state-space models. The algorithm is designed to have no requirements for noise and initial conditions and thus has strong engineering features. A solution is first found in a batch form and then represented in the computationally efficient iterative Kalman-like one with the following advantages peculiar to FIR structures: guarantied bounded input/bounded output (BIBO) stability, better robustness against temporary model uncertainties and round-off errors, and low sensitivity to noise and initial conditions. It is shown that the estimator proposed overperforms the Kalman one when 1) the noise covariances and initial conditions are not known exactly, 2) the noise constituents are not white sequences, and 3) both the system and measurement noise components need to be filtered out. Otherwise, the Kalman-like and Kalman estimators produce similar errors. A payment for this is a larger operation time featured to averaging. These conclusions are supported by extensive numerical investigations and comparisons with the Kalman smoothing, filtering, and predictive estimates of multistate space models. Examples of applications are taken from signal and image processing, clock synchronization, and control. If one still wonders why the Kalman-like FIR algorithm ignoring noise and initial conditions is able to provide errors similar or even lower than in the Kalman one, then there is no magic. Just recall the rule of thumb of averaging: the estimate variance diminishes as a reciprocal of the averaging interval irrespective of the model.

Brief Biography of the Speaker: Dr. Yuriy S. Shmaliy is Full Professor of Electrical and Electronics Engineering of the University of Guanajuato (DICIS campus in Salamanca), Mexico. He received the B.S., M.S., and Ph.D. degrees in 1974, 1976 and 1982, respectively, from the Kharkiv Aviation Institute, Ukraine, all in Electrical Engineering. In 1992 he received the Doctor of Technical Sc. degree from the Kharkiv Railroad Institute. In March 1985, he joined the Kharkiv Military University. He serves as Full Professor beginning in 1986 and has a certificate of Professor from the Ukrainian Government in 1993. Since 1993 to 1999, he has been a director-collaborator of the Scientific Center "Sichron" (Kharkiv, Ukraine) working in the field of precise time and frequency. Since 1999 to 2009, he has been with the Kharkiv National University of Radio Electronics, and, since November 1999, he has been with the Guanajuato University of Mexico. His books Continuous-Time Signals (2006) and Continuous-Time Systems (2007) were

published by Springer, New York. His book GPS-based Optimal FIR Filtering of Clock Models was published by Nova Science Publ., New York. He also contributed to several books with invited chapters. Dr. Shmaliy has 262 Journal and Conference papers and 80 patents. He was rewarded a title, Honorary Radio Engineer of the USSR, in 1991; was listed in Marquis Who's Who in the World in 1998; was listed in Outstanding People of the 20th Century, Cambridge, England in 1999; and was listed in The Contemporary Who's Who, American Bibliographical Institute, 2003. He is Senior Member of IEEE and belongs to several other professional Societies. He is currently an Associate Editor of Recent Patents on Space Technology. He is a member of the Organizing and Program Committees of various Int. Symposia. He is a founder and organizer of the Int. Symposium on Precision Oscillators in Electronics and Optics. He was multiply invited to give tutorial, plenary, and seminar lectures. His current interests include statistical signal processing, optimal estimation, and stochastic system theory.

Plenary Lecture 4

From Droplets and Particles to Hierarchical Spatial Organization: Nanotechnological Challenges for Microfluidics

Professor Michael Kohler
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Abstract: The compartimentation of fluids in the microliter, nanoliter and picoliter range lead recently to many applications of microfluidics in material development, in diagnostics and biological screenings. Droplet-based microfluidics allows the improvement of nanoparticle homogeneity and the tuning of particle properties. It supports combinatorial synthesis of inorganic as well as organic substances and can be applied for the cultivation and screening of bacteria, eucaryotic cells and embryos. The well-ordered handling and the addressing of microfluids segments improves the information transfer between chemical, biological and electronic systems. Despite this remarkable technical progress, there is a particular importance of microfluidics for futural nanotechnological solutions. The hierachical spatial organization of liquids, particles and gels in microfluidics represents a fundamental biomimetic principle which overcomes the limits of planar technology and opens the gate for realizing complex structured threedimensional nanoarchitectures. Recent applications of microstructured fluids in chemistry and biology and concepts for future developments will be discussed.

Brief Biography of the Speaker: J. Michael Kohler (born 1956) studied chemistry at the universities of Halle/S. and Jena. After dissertation on electrochemical effects in microfabrication (1986), he lead projects on submicron photolithography at the Institute of Physical Technology in Jena. During a research stay 1991 in Dortmund (MPG) he dealt with chemical waves in gels. He get the habilitation for general and physical chemistry of the university of Jena in 1992. In the same year, he become the head of the microfabrication department, in 1994 the head of the microsystem department of the Institute of Physical High Technology in Jena. Since 2001, he is a full professor for Physical Chemistry and Micro Reaction Technology at the Technical University of Ilmenau. His research activities are focussed on the connection between chip reactors, cell screening in microfluidic systems, biomolecular technologies, nanomaterials and nanotechnology.

Plenary Lecture 5

Noble Metal Nanoparticles: From Mass Production to Applications

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Abstract: In this presentation a general introduction in the unique optical properties of noble metal nanoparticles will be given. It will be shown, how the ultrafast electron dynamics in the nanoparticles can be exploited to precisely tailor their morphology and, hence, their optical properties. Afterwards, different synthesis techniques are explained and a variety of applica-tions of noble metal nanoparticles will be discussed.
After the introduction in the unique optical properties of noble metal nanoparticles, three dif-ferent physical preparation techniques are presented. For example, a new route for mass fabri-cation of metal nanoparticles with monodisperse shape and narrow size distribution in pure water [1]. For this purpose, we have combined pulsed laser ablation with the technique of selective laser tailoring. I demonstrate that we can easily narrow the width of the initially broad size distribution of the generated nanoparticles from ó = 32% to ó = 20% in a single irradiation step and without a significant change of the mean nanoparticle radius [1].
In the second part of my talk, I demonstrate the preparation and tailoring of noble metal nanoparticles on substrates. Such tailored nanoparticles have a wide range of applications, for example in biosensing, confocal microscopy, or for surface enhanced spectroscopy tech-niques. Examples, were tailored gold and silver nanoparticles have been successfully applied for surface enhanced Raman spectroscopy will be given [2].
Finally, experiments aiming at a parallel generation of sub-diffraction sized nanostructures in fused silica will be presented. The key point of these experiments is the electromagnetic near field in the vicinity of highly ordered triangular nanoparticles on substrates, prepared by nanosphere lithography. The near field is exploited to overcome locally the abla-tion threshold of the fused silica sub-strate. For this purpose, supported trian-gular gold nanoparticle arrays have been irradiated with a single 35 fs pulse of a Ti:sapphire multipass amplifier (ë = 790 nm). Depending on the laser fluence and polarisation direction, sub-diffraction sized nanostructures have been gener-ated [3]. An example of such a structure is displayed in figure 2. It shows nano-channels with a mean depth of 5 nm, a width of 95 nm, but with a length of up to 10 im.

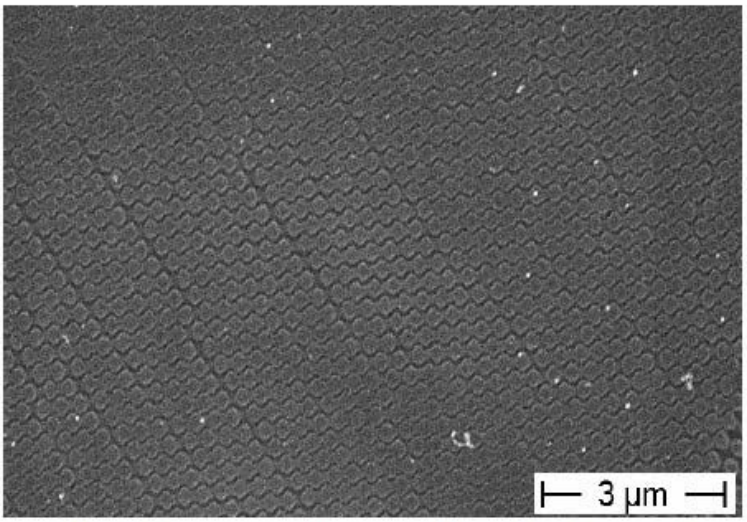

Fig. 1. SEM image of the generated nanochannels.

Brief Biography of the Speaker: PD Dr. Frank Hubenthal studied initially engineering and afterwards physics at the university of Kassel in Germany. He did his diploma work under supervision of Prof. Dr. G. Kraft, in the biophysics group at the center for heavy ion research in Darmstadt, Germany.
After receiving the diploma in 1997, he switched the topic and investigated anisotropic thin magnetic films under the supervision of Prof. Dr. K. Roll. In 2001 he received his PhD from the university of Kassel.
After a short stay in an engineering group, Frank Hubenthal gets in 2001 a position as a junior scientific researcher in the group of Prof. Dr. F. Trager, again at the university of Kassel, Germany. He investigated, among others, the ultrafast electron dynamics of noble metal nanoparticles and received in this field his habilitation in 2007. Also in 2007 he was elected as a Privatdozent (private lecturer/assistant professor) at the university of Kassel.
In the last years Frank Hubenthal extended his research and investigated possible applications of tailored noble metal nanoparticles as biochemical detection systems. This includes the detection of molecules by surface enhanced Raman spectroscopy (SERS) and the detection of molecule binding using the metal nanoparticles as surface plasmon resonance sensors. In addition, he investigated the effect of heavy ion bombardment induced strand breaks of DNA, by extended scanning probe microscopy (SPM) measurements. The obtained results are a first step, to explain the high efficiency of heavy ion bombardment in cancer therapy.
In recent years, Frank Hubenthal has been published a variety of papers in quiet different fields, such as ultrafast electron dynamics of noble metal nanoparticles, tailoring and mass production of noble metal nanoparticles, stresses in thin films, SERS, and ion induced damages of DNA. Furthermore, he is the author of a book chapter with the title: Noble Metal Nanoparticles: Synthesis and Optical Properties. (to appear in: Comprehensive Nanoscience and Technology, Elsevier), and co-organizer of the workshop: "Photophysics of Nanoscale Systems", held during the international conference: "Fundamentals of Laser Assisted Micro– & Nanotechnologies, FLAMN 10", 05. – 08.06.2010 in St. Petersburg, Russia.

Plenary Lecture 6

Solid-core and Hollow Nanostructures: Synthesis, Physicochemical Characterizations and Biological Applications

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Abstract: In the past decade, the synthesis of nanostructures of various geometries, chemical and physical behaviour has been intensively developed not only for its fundamental scientific interest but also for many technological, biosensing and medical applications, such as contrast increase of MRI, in bioaffinity assays, and targeted drug delivery. These structures have also unusual optical, electrical and catalytic properties, which allow for their potential and exciting applications in the above areas. In this respect we will focus on two types of representatives of such structures, namely: the magnetic ferrite nanoparticles and hollow polymeric nanocapsules. For the first type of nanostructures, we will discuss on the attachment of monomolecular adlayers to the surface of various types of nanoferrites for the purpose of their stabilisation, changing the hydrophilic/hydrophobic balance or to provide their surface with suitable functional groups ready for further modifications and tailoring, e.g., for targeted drug delivery. Especially, we will discuss the covalent adlayer growth, which can be easily adapted to allow for the formation of hydrophobic and hydrophilic regions stacked at predetermined distance from the magnetic core, providing also the colloidal nanoferrites with functional groups capable of further modifications with, e.g. drug molecules. For the case of the second type of nanostructures, a considerable stress is laid on synthesis and characterization of hollow polymeric structures in which different molecules or particles can be entrapped or encapsulated. We have recently developed several new methods of preparation of polymeric micro- and nanocapsules using gaseous, liquid or solid particles that template growth of 3D structures The role of the capsule is to provide the proper environment for the molecules and nanoparticles and to protect them from degradation when they travel through the tissues to the targeted site. Moreover, the capsules allow much higher loading densities of the drug molecules when compared to e.g. covalent grafting on nanoparticle surface. Additionally, polymer shells influence the antifouling characteristics of the nanoparticles and also contribute to their effective hydrodynamic size, one of the key factor in avoiding the response by the ReticuloEndothelial System (RES).

Brief Biography of the Speaker: Prof. Pawel Krysinski is a Professor of Chemistry in the Faculty of Chemistry, University of Warsaw, Poland, since 2004. His scientific career is bound with his Alma Mater from 1979, when he received his PhD and later, in 1991 – habilitation. His research interest covers the area of charge transfer, energy transduction and molecular electronics in molecular film assemblies, including cell membranes, self-assembled monolayers on a conducting support, hybrid alkanethiol/phospholipid bilayers, bilayer lipid membranes (BLMs) and phospholipid bilayers tethered to a conducting support. Later on he became involved in synthesis and surface functionalisation of magnetic nanoparticles and hollow polymeric nanostructures. The goal is to design, characterize and demonstrate specialized interfacial structures where a number of biomolecules (e.g., transmembrane proteins) can be incorporated or attached to, while retaining their biological activity. Such interfacial structures can be tailored to serve both as matrices for the immobilization of biomolecules and as stable and electronically conducting molecular junctions contacting these biomolecules with conducting supports. He has published more than 50 high-impact journal papers, reviews and monographs. He has served as coordinator in national and international research grants and received several honors and awards for scientific achievements.