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Keynote Lecture 1

Iterative UFIR Filtering of Linear and Nonlinear Models on Optimal Horizons

Professor Yuriy S. Shmaliy (IEEE Fellow)
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Abstract: Recursive Kalman filtering widely used in state estimation of linear time-varying and time-invariant discrete state-space models often faces a problem of unknown noise and initial conditions. The problem complicates if the model and noise covariance matrices are all time-variant. Under the unknown noise statistics and initial error statistics, the Kalman filter can produce large and even unacceptable errors. In this lecture, we show that recently designed the iterative unbiased finite impulse response (UFIR) filter is able to overcome these disadvantages. The UFIR filter completely ignores the noise statistics while providing good estimates on a horizon of optimal Nopt points. We discuss several most common UFIR filtering algorithms associated with fixed-horizon and full-horizon filtering of linear and nonlinear models. In the latter case, we employ the first-order extended UFIR solution called the EFIR filter. A distinctive property of UFIR filtering is that its unbiased estimate converges to optimal in the minimum mean square (MSE) sense by increasing the averaging horizon N. Moreover, if the state model is deterministic, then the white noise variance is reduced by the factor of N which optimal value lies at infinity. Another specific is that the controlled nonlinear models often require full-horizons because the EFIR filter matches such models over a very long baseline. Under such conditions, the UFIR and EFIR filters typically outperform the Kalman filter. Examples are given for tracking, state estimation, and indoor mobile robot localization.

Brief Biography of the Speaker: Dr. Yuriy S. Shmaliy is a full professor in Electrical Engineering of the Universidad de Guanajuato, Mexico, since 1999. He received the B.S., M.S., and Ph.D. degrees in 1974, 1976 and 1982, respectively, from the Kharkiv Aviation Institute, Ukraine. In 1992 he received the Dr.Sc. (technical) degree from the Soviet Union Government. 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. In 1993, he founded and, by 2001, had been a director of the Scientific Center “Sichron” (Kharkiv, Ukraine) working in the field of precise time and frequency. 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 (2009) was published by Nova Science Publ., New York. He also edited a book Probability: Interpretation, Theory and Applications (Nova Science Publ., New York, 2012) and contributed to several books with invited chapters. Dr. Shmaliy has 323 Journal and Conference papers and 80 patents. He is IEEE Fellow; was rewarded a title, Honorary Radio Engineer of the USSR, in 1991; was listed in Marquis Who's Who in the World in 1998; and was listed in Outstanding People of the 20th Century, Cambridge, England in 1999. He is currently an Associate Editor for Recent Patents on Space Technology. He serves on the Editorial Boards of several International Journals and is a member of the Organizing and Program Committees of various Int. Symposia. His current interests include statistical signal processing, optimal estimation, and stochastic system theory.

Plenary Lecture 1

Long-Term Traffic Forecasting in Next Generation Broadband Networks

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Abstract: Very long-term (20+ years) forecasting of broadband traffic in next generation networks requires extrapolations going beyond processing of the past traffic data. Such forecasting is further challenged by the fact that, in 20 years, the current network technologies and architectures will likely be obsolete. The traffic upper-bounds can be obtained by evaluating the limits of human sighting, and then assuming that these limits will be achieved by future services. Alternatively, the contents to be transferred by bandwidth demanding applications can be considered such as those using embedded interactive 3D video streaming. The obtained traffic upper-bounds are a good indication of the peak values, and thus, of the future network capacity demands. In addition, the main drivers of traffic growth will be identified assuming multimedia as well as non-multimedia applications. New disruptive applications and services will be explored that can make good use of large bandwidth provided by next generation networks. These results can be used to identify monetization opportunities of future services, and to map potential revenues for the network operators.

Brief Biography of the Speaker: Pavel Loskot obtained the B.Sc. and M.Sc. degrees in Biomedical Engineering and Radioelectronics from the Czech Technical University, Czech Republic in 1996 and 1998, respectively, and the Ph.D. degree in Wireless Communications from the University of Alberta, Canada in 2008. He has held a number of research positions and visits to Slovenia, Finland, Canada and China, and participated in numerous industrial collaborative research projects since 1996. Currently, he is a Senior Lecturer in Systems and Process Engineering Centre, College of Engineering, Swansea University, United Kingdom. In 2009-2012, he was a co-investigator in the EPSRC/MVCE Green Radio project investigating energy efficiency of the radio access networks. In 2011-2012, he was the principal investigator in the Welsh Government and the British Telecom funded project within the Digital Wales Research Hub investigating traffic and socio-economic modelling of the next generation broadband networks. His main research expertise is in digital and statistical signal processing, and communication and network theory.

Plenary Lecture 2

Constrained Problems in Optimization: The Augmentability Approach

Professor Javier F. Rosenblueth
Applied Mathematics and Systems Research Institute
National Autonomous University of Mexico
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Abstract: The main purpose of this talk is twofold. First, we shall review the main aspects of the theory of augmentability in the study of constrained minimum problems. This theory yields, in contrast with the assumption of regularity usually used, a simple derivation of the first and second order Lagrange multiplier rules. It also leads a method of multipliers for finding numerical solutions of the constrained minimum problems in hand. On the other hand, in this talk we intend to show how this theory can be successfully generalized to certain classes of optimal control problems involving mixed equality and/or inequality constraints in the state and control functions.

Brief Biography of the Speaker: Dr Rosenblueth holds a BSc in Mathematics from the National Autonomous University of Mexico and a PhD in Control Theory from the Imperial College of Science, Technology and Medicine, London, UK. He worked as a researcher in the Centre for Research in Mathematics, Guanajuato, Mexico and, since 1989, joined the Applied Mathematics and Systems Research Institute of the National Autonomous University of Mexico of which he is Full Professor and currently the Head of the Mathematical Physics Department. He has more than 60 refereed papers, has spent sabbatical visits at the Weizmann Institute of Science, Rehovot, and Technion Israel Institute of Technology, Haifa, Israel, and has participated in numerous international conferences. His main research interests are in optimal control theory, variational analysis and optimization.

Plenary Lecture 3

Design Techniques of Low Power RF IC for Wireless Communication

Professor Ahmed El Oualkadi
Laboratoire des Technologies de l'Information et de la Communication
Ecole Nationale des Sciences Appliquées de Tanger
Université Abdelmalek Essaadi
Morocco
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Abstract: The wireless communication market is undergoing a major expansion with the deployment of new technologies and standards opening the prospect of significant impacts in many application areas. In this context, the growing demands of wireless and mobile application products needs highly integrated, low cost and low power RFICs for modern transceivers. The emerging wireless technologies require architectures with reduced complexity, cost and power consumption; however, they require specific circuits with more accuracy and best performance. The CMOS technology which is the dominating technology for most wireless products below 10 GHz, is characterized by reliability, maturity, low manufacturing cost and low power consumption compared to traditional semiconductor technologies based on III-V compound materials such as SiGe and GaAs. In addition, CMOS is the most suitable technology for designing system-on-chip, since it enables integration of the analog RF circuits with the digital signal processing and baseband circuits in the lowest possible chip area, which leads to a lower cost and more compact solution. Today, CMOS technology is becoming the strong candidate for implementing low cost and less power consuming transceivers. Indeed, the interest on designing CMOS circuits and systems is growing rapidly offering a fertile ground for innovation. Despite the advantages of CMOS technology, the design of building blocks RF transceivers exhibits several challenges and difficulties that the designers must overcome. This lecture gives a review about the trends and challenges of RFIC design for low power wireless communication. The different design trade-offs will be discussed to optimize the proliferation of circuits and systems for the emergent wireless applications.

Brief Biography of the Speaker: Ahmed El Oualkadi received Ph.D. degree in electronics from the University of Poitiers, France, in 2004. From 2000 to 2003, he was a research assistant in the Laboratoire d'Automatique et d'Informatique Industrielle - Ecole Supérieure d'Ingénieurs de Poitiers, Electronics & Electrostatics Research Unit, University of Poitiers, France. In 2004, he was an assistant professor at University Institute of Technology, Angoulême, France. During this period, he worked, in collaboration with EADS-TELECOM, on various European projects which concern the nonlinear analysis & RF circuit design of switched- capacitor filters for radio-communication systems. In 2005, he joined the Université Catholique de Louvain, Microelectronics Laboratory, Louvain-la-Neuve, Belgium, where he worked on the analog and mixed design of low power high temperature circuits and systems, in SOI technology, for wireless communication. During this period, he has managed and participated in several European and regional projects in the areas of wireless communication and sensor networking. Currently, he is an assistant professor in the Abdelmalek Essaadi University, National school of applied sciences of Tangier, Morocco. His main research interest is the analog IC, mixed-signal and RFIC design for wireless communication, embedded system applications and information technology. He is author/co-author of more than 40 publications and communications in recognized journals and international conferences. He is a member of EuMA and an active IEEE volunteer member associated to the Circuits & Systems Society where he is a reviewer of IEEE CAS systems journals (TCAS I & TCAS II) and many conferences on circuits and systems (ISCAS, ICECS…). He is a member of the scientific and technical committee of WCECS and WASET, a member of the editorial board of Journal of Multimedia Processing and Technologies and during 2007-2011, he was an editorial board member of Recent Patents on Electrical Engineering Journal edited by Bentham Science Publishers.

Plenary Lecture 4

Stochastic MIMO Channel Modelling Using Split-ANFIS Framework With GA Optimization

Professor Kandarpa Kumar Sarma
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Gauhati University
Assam, India
E-mail: kandarpaks@gmail.com

Abstract: Multiple input multiple output (MIMO) wireless technology has been accepted as the backbone of ever expanding, high data rate mobile communication networks despite its channel estimation offering considerable challenges. MIMO channel is full of uncertainty and random behaviour due to interference and correlation among propagation paths and related variations. Though traditional methods of modelling the MIMO channels have already proven their worth, soft-computational approaches can be appended to this list of techniques already known. The primary consideration behind such a possibility is the fact that soft-computational techniques due to their abilities to learn from the environment can use the knowledge acquired for subsequent processing. Here, we propose such an approach based on fuzzy systems and recurrent neural network (RNN). Fuzzy systems are useful for modelling uncertainty, provide expert-level decision making and are also capable of tracking subtle variations in the applied patterns. These attributes make them suitable options for applications with MIMO channel modelling. RNN is a form of feed-forward artificial neural network (ANN) which due to the presence of multiple feedback loops can track time-dependent variations in input patterns. These considerations catalyze the formation of a hybrid set-up formed as an adaptive neuro-fuzzy inference system (ANFIS) constituted by fuzzified RNN (FRNN) blocks so as to model MIMO channel characteristics. The proposed architecture has two ANFIS blocks to deal with in-phase and quadrature components of received signal separately. The output of these two split-ANFIS blocks are combined by a Self Organizing Map (SOM) which generates the most suitable form of the predicted output. During the fuzzification stage, a genetic algorithm (GA) based optimizer is used to select the best set of parameters (centre, slop and spread) for the bell-membership function considered. The GA assisted fuzzification adds to the precision of the system. Each of the FRNN blocks receives a Kalman Filter estimated copy of the immediately next form of the received signal which is used as reference during the short training phase. The experimental results derived show superior ability of such an architecture compared to traditional approaches with lower bit error rate (BER) values and processing speed while generating greater precision during recovery of transmitted data through severely faded MIMO channels. The suggested system can be a part of upcoming adaptive receiver models optimized for high data rate systems.

Brief Biography of the Speaker: Kandarpa Kumar Sarma currently is with the Department of Electronics and Communication Technology, Gauhati University, Guwahati, India as Assistant Professor with around 16 years of teaching experience. He has completed MSc in Electronics from Gauhati University in 1997. He also completed MTech in Signal Processing from IIT Guwahati, Guwahati, India in 2005 with specialization in Soft-computation and Pattern Recognition. Later, he completed PhD from IIT Guwahati in 2011 in the area of Mobile Communication and Soft-Computation.

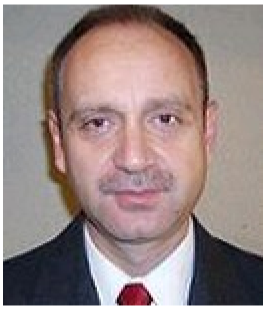
He has authored five books, ten book chapters, 91 journal and 132 conference proceedings papers. He has attended about twenty two national and international conferences and have been reviewer of several international journals and around fifty international/national conferences. He also serve as guest editor of two Interscience journals namely IJICT and IJCVR.

His areas of interest are Soft-Computation and its applications, Mobile Communication, Antenna Design, Speech Processing, Document Image Analysis and Signal Processing applications in High Energy Physics, Neuro-computing and Computational Models for Social-Science Applications.

He is a senior member of IEEE. He is also a life member of CSI (India), IETE (India), ISTE (India), Instrument Society of India and Assam Science Society. He is also the Placement Officer of Gauhati University since 2006. Presently he is also the HoD ic of a new department named Electronics and Communication Engineering started from 2009 under Faculty of Technology offering BTech and MTech programmes of Gauhati University which is the largest institution of higher education in the north-eastern part of India.

Plenary Lecture 5

Diagnosis of Complex Industrial Artificial Social Systems



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Abstract: A manufacturing system includes a set of machines performing different operations, linked by a material handling system. A major consideration in designing a manufacturing system is its availability. When a machine or any other hardware component of the system fails, the system reconfiguration is often less than perfect. It is shown that, if these imperfections constitute even a very small percent of all possible system faults, the availability of the system may be considerably reduced. A state is operational when its performance is better than a threshold value. In order to calculate the availability of a manufacturing system, its states (each corresponding to an acceptable system level) are determined. A system level is acceptable when its production capacity is satisfied. To analyze the system with failure/repair processes, Petri nets and Markov models are often used. As a manufacturing system includes a large number of components with failure/repair processes, the system-level discrete event model becomes computationally intractable. Our approach for the analysis of manufacturing systems implies that the systems are decomposed in manufacturing cells. We focus on the diagnosis of the performance characteristics of workflows cells modelled with stochastic Petri net (SPN). This goal is achieved using a new model for Artificial Social Systems (ASOSs) behaviours, and by introducing equivalent transfer functions for SPN.
ASOSs exist in practically every multi-agent system, and play a major role in the performance and effectiveness chart of the agents. This is the reason why we introduce a suggestive model for ASOSs. To model complex systems, such as flexible manufacturing ones, a class of Petri nets is developed, and briefly introduced.
This allows representing the flow of physical resources and control information data of the ASOS's components. In the analysis of SPN we use simulations in respect to timing parameters in a generalized semi-Markov process (GSMP). By using existing results on perturbation analysis (e.g., delays in supply with raw materials, equipment failure, etc.), and by extending them to new physical interpretations we address unbiased sensitivity estimators correlated with practical solutions in order to attenuate the perturbations.
The novelty of the approach is that the construction of large Markov chains is not required. Using a structural decomposition, the construction system is divided into cells. We can simplify the structure of the SPN using the presented approach, which is useful when we deal with complex Petri nets, and we need to simplify these structures (e.g. graphs) in order to analyze them properly. For each cell a Markov model was derived and the probability was determined of at least Ni working machines in cell i, for i = 1,2,..,n and j , where j=1, ..., m, working material handling system (MHS) at time t, where Ni and j satisfy the system production capacity requirements. Intuitively, bottleneck (BN) of a production line is understood as a machine that impedes the system performance in the strongest manner. Identification of BNs and their optimal capacity for avoiding the machines downtime is considered as one of the most important problems in manufacturing systems. Some examples illustrate this approach.

Brief Biography of the Speaker:
• Academic Positions: Assoc. Professor Ph.D. Eng., Dept. of Automatics and Computers, Faculty of Electrical Engineering and Computer Science, "Stefan cel Mare" University of Suceava, Romania.
• Fields of Scientific Activities: Discrete Event Systems, Complex Measurement Systems, Reliability and Diagnosis of Control Systems, Environmental Management.
• He published 12 books and over 160 scientific papers in conference proceedings and journals.
• Honor Member of the Romanian Society of Electrical & Control Engineering - Member of the Romanian Technical Experts Corp.
• Technical Expert of the Romanian Ministry of Justice.
• President of the Romanian Society of Electrical & Control Engineering, Suceava Branch.
• He is a member of the editorial boards of several international scientific journals and conferences of control systems and electric engineering science. He was designated chairmen at 18 international conferences.