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Sensors, Signals, Visualization, Imaging, Simulation & Materials

- Proceedings of the 2nd WSEAS International Conference on SENSORS and SIGNALS (SENSIG '09)
- Proceedings of the 2nd WSEAS International Conference on VISUALIZATION, IMAGING and SIMULATION (VIS '09)
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Preface

This year the 2nd WSEAS International Conference on SENSORS and SIGNALS (SENSIG '09), the 2nd WSEAS International Conference on VISUALIZATION, IMAGING and SIMULATION (VIS '09) and the 2nd WSEAS International Conference on MATERIALS SCIENCE (MATERIALS '09) were held in the Morgan State University, Baltimore, USA, November 7-9, 2009. The conferences remain faithful to their original idea of providing a platform to discuss sensors, data acquisition systems, security and encryption, performance measurement, power management, signal processing, multimedia communications, robotics, motion and tracking, image manipulation and compression, machine vision, face and gesture recognition, holographic imaging, mathematical aspects of scientific computing, virtual reality, nanoscale characterization, molecular electronics, semiconductor processing 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

Traffic Monitoring and Rate Allocation in Sensor Networks

Professor Titsa Papantoni-Kazakos
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Abstract: Wireless sensor networks are special purpose structures: their architectures and operations are designed to satisfy pre-specified signal processing objectives. Thus, the overall performance of a wireless sensor network is determined by the satisfaction of the performance criteria that are pertinent to the undertaken signal processing objective. Signal processing objectives are classified as either detection among finite hypotheses, or parameter estimation or estimation of the acting data generating process, and the pertinent performance criteria include decision/estimation accuracy and conve4rgence rate, where detection/estimation accuracy is generally monotonically increasing with the number of observation data processed. When time constraints are imposed on high accuracy detection/estimation, the consequence is increased required overall data rates. At the same time, in wireless sensor networks, observation data are collected and processed by life-limited nodes, whose life -span is a function of the data rates they process. Thus, required overall data rates, in conjunction with rate-dependent node life-spans, necessitate networkarchitecture and network-operations adaptations, so that the nodes' survivability limitations do not interfere with the required network overall performance. Since the network-architecture and network-operations adaptations are functions of the acting data rates, it is eminent that data rates be monitored and that rate changes be detected accurately and rapidly. In this talk, we consider a wireless sensor network whose architecture consists of micro-sensors, microsensor clusters and a backbone network of cluster-heads and a fusion center. The network's purpose is to execute a signal processing operation, while honoring the time constraints and the performance requirements imposed by the application and while adhering to the limited life-spans of the sensors and the cluster-heads. Data rates are time-varying in such a network, mainly due to expiring life-limited nodes. We focus on the problem of dynamic rate allocation, facilitated by a rate monitoring higher level protocol. We present a rate monitoring algorithm and study the stability of the rate allocation/rate monitoring coupled system.

Brief Biography of the Speaker:
P. Papantoni Kazakos was born in Greece. She received the Diploma in Electrical, Mechanical and Industrial Engineering from the National Technical University of Athens, Greece, in 1968; the M.S, degree from Princeton University, Princeton, NJ, in 1970; and the Ph.D. from the University of Southern California, Los Angeles, CA, in 1973, both in Electrical Engineering with specialization in Statistical Communications and with minor in Mathematics. From 1973 to 1978 she was faculty in Electrical Engineering at Rice University, Houston, TX. From September 1978 to August 1986 she was faculty in Electrical Engineering at the University of Connecticut, Storrs, CT, with the final rank of professor. In September 1986, she joined the University of Virginia, Charlottesville, VA, where she was professor of Electrical Engineering and Mathematics, until December 1994. From September 1993 to August 1994, she was the holder of the NSERC/OCRI Industrial Research Chair in High-Speed Networks at the University of Ottawa, Ottawa, Canada, on leave from the University of Virginia. From January 1995 to August 2000 she held the "Larry" Drummond Chair in Computer Engineering at the University of Alabama, Tuscaloosa, AL. Since August 2000 she has been Chair and then Professor of Electrical Engineering at the University of Colorado, Denver, CO. In 1977, she spent one year with Bell Laboratories, Holmdel, NJ, on leave from ice University. In 1981, she spent one year on special assignment as a Scientific Officer and Contract Monitor at the U.S. Office of Naval Research, Arlington, VA, on leave from the University of Connecticut. In the 2006 – 2007 academic year, she worked with the Systems Architecture Laboratory at George Mason University as a senior scientist, on sabbatical from the University of Colorado. Her research interests include Statistical Decision Theory, Distributed Processing and Neural Network Structures, Statistical-Communications, Information Theory, Robust Statistical and Encoding Methods, Stochastic Processes, Computer-Communication Networks, Sensor Networks and organizational networks. She is coeditor and contributor to the book: Nonparametric Methods in Communications (New York, Marcel Dekker, 1977). She is also coauthor of the book: Detection and Estimation (Computer Science Press, 1989). In addition to these books, she has

published over 225 refereed technical papers. Dr. Papantoni is a Fellow of IEEE; for “Contributions to Communication Networks and to Detection and Estimation Theory”, a member of the American Mathematical Society, the Institute of Mathematical Statistics, Eta kappa Nu, Sigma Xi, the Society of Women in Science and the Society of Women in Engineering. She has served as the Secretary to the Board of Governors of the IEEE Information Theory Group, she has been Editor for Random Access Systems of the IEEE Communications Transactions and has been member of the U.S. Army Basic Research Committee of the National Research Council. She has also been a member of the Editorial Board for the Journal of Wireless Networks, as well as the IEEE COMSOC technical committees on Communication Theory and Computer Communications.

Plenary Lecture 2

Methodological Approach for Virtual Sensors design using Artificial Neural Networks

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Abstract: Virtual sensors constitute a novel area of virtual instrumentation, whose principal mission is to perform indirect measurements of process important variables using historical data of the desired variable and some other variable that affects its performance.
Virtual sensors are some times designed for working in parallel with a physical sensor in order to evaluate its performance, but they can also be used for having on-line estimation of the desired measurement.
Virtual sensors are widely used because they are computer programs that can be change or updated when it is necessary. These programs can consist of a mathematical model, heuristic models or intelligent model.
Neural networks have been one of the most used intelligent tool for designing and developing Virtual Sensors due to its accurate, its capability for identifying complex nonlinear dynamical systems, giving appropriate results in different situations, modeling and Identification capabilities and easy for implantation.
This plenary will present some methodological frameworks for designing Virtual Sensors using Artificial Neural Networks. This Methodology is based upon Software Engineering, Knowledge-Based Systems and Neural Networks schemes. It includes both technical and economical feasibility for building the virtual sensors and considers important aspects concerning computational platform, data processing, virtual sensor requirements, among others. It also considers the computational nature of virtual sensors.
It will be also presented some industrial examples.

Brief Biography of the Speaker:
Francklin Rivas-Echeverria Systems Engineer, MSc. in Control Engineering and Applied Science Doctor. Full professor in Control Systems Department, at Universidad de Los Andes, Venezuela. He has been invited professor in the Laboratoire d'Architecture et d'Analyse des Systemes (LAAS, Toulouse-France) and some Venezuelan and international Universities. He has also been technical advisor for “Venezuelan Oil Company” (PDVSA), “Aluminum Venezuelan Company” (VENALUM), “Steel Venezuelan Company” (SIDOR), Trolleybus System in Venezuela (TROLMERIDA). He has created and is the Director of the Intelligent Systems Laboratory and is the head of the University consulting unit (UAPIT-ULA). Over 180 publications in high level conferences and journals: the main topics of his papers are: Artificial Intelligence, Intelligent Control, Automation Systems and Industrial Applications. He has applied his results to many fields: Processes Control and Supervision, Oil production, Steel production processes, among others. Also, has developed several tools for automatic control teaching. He is coauthor of two books concerning Artificial Intelligence and Nonlinear Systems.

Plenary Lecture 3

Z Print Rapid Prototyping Technique and ANSYS Simulation – Major Tools in New Product Design

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Abstract: 3D rapid prototyping is a fast, precise enough and affordable technique of producing prototypes with almost any geometrical complexity. This paper presents the advantages of applying Z Corporation three dimensional printing in obtaining a new product's prototype. A case study is used to illustrate the various stages of the process and to enhance the results. Simulation with ANSYS software, of further processes involved by studied product geometrical characteristics, is important and efficient. Both, rapid prototyping and simulation, techniques resulted in important time and cost savings achieved in the development of the studied product.

Brief Biography of the Speaker:
Has graduated in 1989, "POLITEHNICA" Institute of Bucharest, ROMANIA and in1989 – 1991 worked as an engineer – in the Design Department of a Romanian peripheral equipment factory, FEPER.
Since 1991 has been working, as a teacher in "POLITEHNICA" University of Bucharest, ROMANIA – Manufacturing Department, in 2004, being Associate professor. The Doctoral Thesis, in 2000 – was on Quality and Machinability of Thermal Sprayed Layers.
Teaches courses and works into the fields of: Applied Statistics for Engineers; Metal Forming; Manufacturing Technologies; Injection Moulding, being scientific researcher, in about 30 Research Projects and Grants. First-author or, co-author, of about 95 studies and papers - published to International/National Conferences, Sessions, Workshops, Platform Meetings etc; of 12 books on Statistics, Manufacturing Technology, Geometrical Precision Inspection. Member of some professional associations, as Plastics Industry Producers Association – ASPAPLAST, ROMANIA, Rapid Manufacturing Association – RAPIMAN; has some international awards as: Best Innovation Award - at Brussels INNOVA Fair, 2007, Golden Medal – in INVENTIKA –2008, Bucharest, Romania.
Has papers presented in WSEAS Conferences, in 2008 and, also published in WSEAS Journals. Has done organizing activities for WSEAS Conferences in Bucharest, in June and, specially, in November, 2008.

Plenary Lecture 4

Biomedical Image Processing and Analysis by Using Artificial Intelligence and Information Fusion

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Abstract: Medical imaging mainly manages and processes missing, ambiguous, complementary, redundant and distorted data and information has a strong structural character. The understanding of any image involves the matching of features extracted from the image with pre-stored models. The production of a high-level symbolic model requires the representation of knowledge about the objects to be modeled, their relationships, and how and when to use the information stored within the model.
This presentation reports new (semi)automated methods for the segmentation and classification of images of cerebral structures using an information fusion technique based on soft computing (fuzzy logic) and specific knowledge. Fuzzy logic acts as a unified framework for representing and processing both numerical and symbolic information ("hybridization"), as well as structural information constituted mainly by spatial relationships in biomedical imaging. Our applications are mainly for the segmentation of brain structures for magnetic resonance (MR) and CT (computer tomography) images, based both on atlas and real data. Promising results show the superiority of this knowledge-based approach over best traditional techniques in terms of segmentation errors. The classification of different cerebral structures is made by implementing rules yielded both by domain literature and by medical experts. Though the proposed methodology has been implemented and successfully used for model-driven in the domain of MR and CT imaging, the deployed methods are generic and applicable to any structure that can be defined by expert knowledge and morphological images.
Another branch of applications of soft-computing and data fusion is represented by medical image registration, e.g. for PET and CT images. We first apply a mutual information based registration algorithm and then fuse the PET and CT images (taken separately or yielded by a PET-CT scanner) by using the 2v-Granular Support Vector Machine. The fused image contains the properties of both PET and CT images and is an efficient tool for image registration.

Brief Biography of the Speaker:
Prof. dr. eng. Hariton Costin, BS in Electronics and Telecommunications (1980), Ph.D. in Applied Informatics, MBA diploma, is full professor and chief of the Medical Electronics Department at the University of Medicine and Pharmacy / Faculty of Medical Bioengineering, Iasi, Romania, (www.umfiasi.ro). Also, he is senior researcher at the Romanian Academy, Institute for Computer Science – Iasi Branch, within the Image Processing and Pattern Recognition Lab, (http://www.iit.tuiasi.ro/personal/h_costin.html), where he studies image processing and analysis by using Artificial Intelligence methods and data fusion.
Competence areas include: medical electronics, biosignal and image processing and analysis, artificial intelligence (soft-computing, expert systems), hybrid systems, HCI (human-computer interfaces), telemedicine and e-health.
Scientific activity can be resumed by about 95 published papers (26 in Romania and 69 abroad), 5 books, 4 book chapters in foreign publishing houses, 3 patents, 2 national awards.
Research activity: 28 research reports, technical manager within FP5/INES 2001-32316 project, for a telemedicine application (www.euroines.com ; „Medcare" project); responsible for the first Romanian pilot telemedical centre in Iasi, (CEEX programme – research of excellence - www.mct-excelenta.ro and for the National Programme for R&D 2007-2013, www.cnmp.ro), director for 5 national granted projects in bioengineering and (biomedical) image processing / analysis, invited postdoc researcher at the University of Science and Technology of Lille (France, 2002, medical imaging), invited talks at international conferences.
Prof. Costin is a member of the I.E.E.E./Engineering in Medicine & Biology Society (EMBS) and of other 8 scientific societies.

Plenary Lecture 5

Scientific Visualization for 3-Dimensional Geometric Design of Highways

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Abstract: Scientific visualization is an interdisciplinary branch of science primarily concerned with the visualization of three dimensional (3D) phenomena (engineering, architectural, meteorological, medical, biological, etc.), where the emphasis is on realistic renderings of volumes, surfaces, illumination sources, and so forth, perhaps with a dynamic (time) component. In this presentation we demonstrate the application of scientific visualization for 3D geometric design of highways. Typically, roads are designed by combining horizontal and vertical roadway alignments, to allow for adequate sight distance for driver comfort and safety. The traditional process of checking for adequate sight distance ahead of a driver is manual as it is performed by a manual check along the horizontal and vertical roadway alignments. Further, conventional horizontal and vertical alignment design follow a sequential process, i.e., design of horizontal and vertical alignments is carried out in separate stages; typically horizontal alignment is obtained first and a vertical alignment is subsequently fitted which may lead to inaccurate sight distances along the roadway. For example, a section of a road with a vertical crest curve and a sharp horizontal curve together will lead to an illusion of the availability of a larger sight distance when driving. With the proposed visualization methodology the sight distance is calculated using a 3-dimensional (3D) road surface, a solid cone, and a rectangular plane. The 3D cone with its vertex at a height ‘h' from the road surface and line of height parallel to the tangent of the road centreline is moved along the roadway at regular intervals. The intersection of the road surface with the cone is used to obtain the intersected surface. The variation of the tangents along the intersected surface is used to obtain the profile of the intersected road surface centreline. A variable rectangular plane is used over the intersected road surface to calculate the sight distance. Given the 3D road centreline, a visualization-based method is described to establish the road surface. Mathematical formulations to calculate the 3D surface and sight distance are presented and the method is applied in an example study. The presentation concludes with the discussion of the application of the proposed visualization method for full-scale efficient roadway sight distance measurement as well as directions for future research.

Brief Biography of the Speaker:
Dr. Manoj K. Jha is Associate Professor and Founding Director of the Center for Advanced Transportation and Infrastructure Engineering Research (CATIER) in the department of civil engineering at the Morgan State University, Baltimore, MD, USA. He obtained a Ph.D. in Civil Engineering with transportation specialization from the University of Maryland, College Park in 2000; a M.S. degree in Mechanical Engineering from the Old Dominion University in 1993; and a B.E. degree in Mechanical Engineering from the National Institute of Technology, Durgapur, India in 1991. He also attended the Rensselaer Polytechnic Institute during 1993-94 as a Ph.D. student in Mechanical Engineering and Virginia Tech.'s National Capital campus as a post doctoral fellow during 2000-2001.
Dr. Jha's research interests are in investigating mathematic foundation of artificial intelligence-based optimization algorithms, and highway route optimization and visualization. For his scholastic and research achievements Dr. Jha has received several awards, among which are the 2007 National Science Foundation (NSF) Small Technology Transfer Research (STTR) award; 2005 and 2006 United Negro College Funds Special Program/Department of Defense (UNCFSP/DoD) Faculty Development Award; 2005 Department of Homeland Security (DHS) Summer Faculty Research award by the Study of Terrorism and Responses to Terrorism (START) Center of Excellence, University of Maryland, College Park, and 2005 NSF-PASI-TS (National Science Foundation's Pan-American Advanced Study Institute on Transportation Sciences) award by the Rensselaer Polytechnic Institute. He is a registered Professional Engineer in the State of Maryland since 1997.
Dr. Jha has served as a PI, Co-PI, or collaborator with other researchers on numerous research project totaling over $4 million. The key sponsoring agencies of his research projects include Army Research Lab., Maryland State Highway Administration, Federal Highway Administration, National Science Foundation, and several Baltimore area

consulting firms. Dr. Jha has authored (or co-authored) more than 90 articles in journals, books, and conference proceedings in the highway design, optimization, and transportation literature. He has also co-authored 2 books on road design entitled "Intelligent Road Design" and "Fundamentals of Road Design."