Editors: Nicu Gavriluta, Razvan Raducanu, Mihaiela Iliescu,
Hariton Costin, Nikos Mastorakis, Vladimir Olej, Jiri Strouhal

Recent Researches in Computational Techniques, Non-Linear Systems & Control

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Preface

This year the 13th WSEAS International Conference on MATHEMATICAL METHODS, COMPUTATIONAL TECHNIQUES AND INTELLIGENT SYSTEMS (MAMECTIS '11), the 10th WSEAS International Conference on NON-LINEAR ANALYSIS, NON-LINEAR SYSTEMS AND CHAOS (NOLASC '11), the 7th WSEAS International Conference on DYNAMICAL SYSTEMS and CONTROL (CONTROL '11) and the 11th WSEAS International Conference on WAVELET ANALYSIS & MULTIRATE SYSTEMS (WAMUS '11) were held in Iasi, Romania, July 1-3, 2011. The conferences provided a platform to discuss circuits, networks, electronics, microelectronics, nanoelectronics, power systems, quantum mechanics, non-linear systems in engineering, chaos and chaotic behavior, various applications of the non-linear analysis in science and engineering, differential equations, fractals, image compression, fluid dynamics, control, computational intelligence, fault detection, robotics, robotic networks, mechatronics, internet control, construction of wavelets, mathematical wavelet analysis, wavelet transforms 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

Table of Contents

Plenary Lecture 1

Medical Image Processing by Using Soft Computing Methods and Information Fusion

Professor Hariton Costin
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Abstract: Medical images are increasingly being used within healthcare for diagnosis, planning treatment, guiding treatment and monitoring disease progression.
Technically, medical imaging mainly processes uncertain, missing, ambiguous, complementary, inconsistent, redundant contradictory, distorted data and information has a strong structural character. As a general approach, 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 soft computing techniques (e.g. fuzzy logic, genetic algorithms), information fusion and specific domain 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. In this paper we also propose a new method for medical images segmentation in the framework of neutrosophic logic and Dezert-Smarandache Theory, combined with fuzzy k-means algorithm.
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 image analysis.
Another branch of applications of soft-computing is illustrated in image registration and data fusion by using different techniques, e.g. linear transformations and wavelet functions. An useful application was implemented in PET-CT imaging, both for a single PET-CT scanner and for separate PET and CT images. We first applied a mutual information based registration algorithm and then fused the PET and CT images using the 2i-Granular Support Vector Machine. As a general result, the fused image contains the properties of both PET and CT images and is an efficient tool for clinical diagnosis and therapy.

Brief Biography of the Speaker: Prof. dr. eng. Hariton Costin graduated from the Technical University in Iasi, Romania, Faculty of Electronics and Telecommunications (1980). He obtained the Ph.D degree in Applied Informatics and a MBA diploma both from the same university in Iasi, and now is full professor and head of the Biomedical Instrumentation Department at the University of Medicine and Pharmacy, Faculty of Medical Bioengineering, Iasi, Romania, (www.umfiasi.ro ; www.bioinginerie.ro). Also, he is senior researcher at the Romanian Academy – Iasi Branch, Institute of Computer Science, 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.
Prof. Costin's competence areas include: medical electronics, biosignal and image processing and analysis, artificial intelligence (soft-computing, expert systems), hybrid systems, HCI (human-computer interfaces), e-health and telemedicine.
His scientific activity can be resumed by about 100 published papers, 7 books, 4 book chapters, 3 patents, 2 national awards.
His research activity is illustrated by 28 research reports within Romanian Academy, a position of technical manager within EU/FP5/INES 2001-32316 project for a telemedicine application, he is director of the most complex Romanian pilot telemedical centre in Iasi, and director for 8 national granted projects in bioengineering and biomedical image

processing / analysis. He was invited postdoc researcher at the University of Science and Technology of Lille (France, 2002, in medical imaging) and gave invited talks at international conferences.
Prof. Costin is a member of the IEEE - Engineering in Medicine & Biology Society (EMBS) and of other 8 scientific societies.

Plenary Lecture 2

A Fundamental Survey and An Efficient Soft Library for several Basic Models of Artificial Neural Networks

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Abstract:

The neural networks algorithms are related with main chapters of neural networks: supervised learning and unsupervised learning. We use some explicit notations for learning sets, called the input data: $I(x,d), x \in R^n, d \in R^M$ for supervised learning and $I(x), x \in R^n$ for unsupervised learning. The input set contains the vectors $x = x(t), d = d(t)$, where $t = 1, N$. The variable t designates the time when the vector x add / or d arrive in the learning network.

All algorithms are written (coded) in C++ computer language. The algorithm presentation is based on matrix utilization method. This approach (in comparison with element by element method) creates an easier algorithm understanding and makes an easier utilization. So, the resulting computer program is more efficient. All algorithms are explained and described in the author's monograph Artificial Neural Networks. Mathematical Foundation, Algorithms and Applications (Nicolae Popoviciu, Floarea Baicu), Bucharest, PRINTECH Editor, 2009, in romanian language).

For each algorithm we have written a C++ computer programs in one or two versions. Each algorithm has a name and the computer program has the same name.

a) The supervised learning.

1. ALGOPSSe (The Perceptron Algorithm, Supervised Learning; the weights modification is based on error $e = d(t) - y(t)$.
2. ALGOPSSd (The Perceptron Algorithm, Supervised Learning; the weights modification is based on the desired value $d(t)$.

Remark. Both algorithms have version 1 (usual version in the literature) and version 2, which contains a test to verify that the initial vector $w0 \in R^n$ is not in the input set. Otherwise the separation hyper-plane could be incorrectly.

3. ALGOADALINE Analytic.
4. ALGOADALINE Sequential
5. ALGOBKPSFid (Algorithm BKP Back Propagation, Supervised Learning).
   Version 1: activation function = identical function $f(s) = s$ and learning rate c = constant.
   Version 2: activation function = identical function $f(s) = s$ and learning rate c = variable.
   Version 3: activation function = identical function $f(s) = s$ and learning rate $c = \frac{1}{t + (N-1)ciclu}$.
6. ALGOBKPSFsigmoidal (Algorithm BKP Back Propagation, Supervised Learning).
   Version 1. activation function= mono-polar sigmoid function; the slope p = constant and learning rate c = constant.
   Version 2. activation function= bi-polar sigmoid function; the slope p = constant and learning rate c = constant.
   Version 3. activation function= general sigmoid function; the slope p = constant and learning rate c = constant.

b) The unsupervised learning.

7. ALGOCOLNUND (Algorithm for Competitive Learning, Non-supervised learning).
   Version 1. Un-normalized data $I(x)$.
   Version 2. Normalized data $I(x)$ and Procedures.
8. ALGOCOLART1NE (Algorithm of type ART 1, Adaptive Resonance Theory, variable 0 and 1, Competitive Learning, Non-supervised).
   Version 1. With Euclidian norm; Krose-Smagt resonance test.
   Version 2. With Norm 1; Krose-Smagt resonance test.
   Version 3. With Norm 1; Jain resonance test.
9. ALGOHOPFIELDSeqStoRec (Algorithm of type Hopfield, Store-Recall; variable -1 and 1. Sequential version; the recall vectors xr are introduced in sequential mode.
10. ALGOHOPFIELDBatchStoRec (Algorithm of type Hopfield, Store-Recall; variable -1 and 1. Batch version; the recall vectors xr are introduced in batch mode.

Brief Biography of the Speaker: Popoviciu Nicolae (born 1943, Ocna Sibiului, Romania) is PhD in mathematics (from 1976, statistics and stochastic processes), professor at Hyperion University of Bucharest, Romania, Faculty of Mathematics-Informatics and the dean of this faculty. His area of competence contains: stochastic processes and Markov decision problems, integral transforms (continuous, discrete, fast Fourier transform, discrete Fourier transform), complex functions, field theory, distribution theory, tensor computation, mathematical programming (linear, multi-objective, quadratic, convex, nonlinear, stochastic, in integer numbers, Boolean), wavelet theory, spline functions, box-spline function, optimization models, artificial neural networks and applications. He published 19 books on mathematics and informatics (university courses and monographs) and he is the first author of 17 books (all in Romanian language) and 104 papers (almost all in English language) and more exactly Popoviciu is the first author of 89 papers. His recently book Artificial Neural Networks. Mathematical Foundation, Algorithms and Applications (2009, Romanian language) is a monograph on the basic algorithms of the artificial neural networks with application. Professor Popoviciu is member of Romanian Society of Mathematics and member of the Romanian Probability and Statistics Society. He has participated to many WSEAS International Conference: plenary speaker, author, co-author, chairman, reviewer etc (Romania, Greece, Turkey, Bulgaria, United Kingdom, USA).

Plenary Lecture 3

Applied Statistics when Studying Turning Process Parameters Interdependence for S12Mn2Si Metallized Coating

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Abstract: Statistical methods, as well as specialized software do represent successful means to be used when studies of important aspects in real engineering processes have to be done. This paper presents some relevant aspects of the research carried out in order to determine regression models of process functions specific to exterior cylindrical turning – for a special metallized coating, S12Mn2Si . The models refer to the dependence of cutting tool durability on cutting speed, cutting feed, cutting depth and cutting tool wear.

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, 2009 and, also published in WSEAS Journals. Was invited Plenary Speaker in WSEAS Conferences, like Venice - November, 2008 ; Cambridge - February, 2009; Baltimore - November 2010. Has performed organizing activities for WSEAS Conferences in Bucharest, in June and, specially, in November, 2008 - when was General Chairman.

Plenary Lecture 4

Boundary Value 1D and nD Linear Control Systems

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Abstract: Linear one-dimensional (1D) acausal systems, i.e. systems with boundary conditions have been introduced in state space representation by A.J. Krener [12], [13], in connection with the modeling of boundary value regulation. M.B. Adams, A.S. Willsky and B.C. Levy [1], [2] have obtained important results in the linear estimation of stochastic processes governed by time varying systems with boundary conditions.
T. Kailath has tackled this topic in an input-output approach in a series of papers on linear estimation theory [11]. H. Bart, I. Gohberg and M.A. Kaashoek have come to linear systems with boundary conditions motivated by the analysis of Wiener-Hopf integral equation and related convolution equations [4], [5]. The theory of systems with boundary conditions has been developed by I. Gohberg and M.A. Kaashoek in a series of papers [7], [8], [9], [10]. They have brought this theory to the level of the classical theory of the causal linear systems. For instance, the characterization of the classes of irreducible and minimal systems has been obtained and it has been emphasized that these classes and the class of controllable and observable systems are different (whereas in the case of causal systems they coincide).
In the same time, in the framework of Systems Theory, different state space models of two-dimensional 2D systems has been proposed by Roesser [19], Fornasini and Marchesini [6], Attasi [3] and others. The study of 2D (and nD) systems has known an important development in the last three decades due to their significant applications in various areas as image processing, seismology, geophysics or computer tomography. The above mentioned papers and the subsequent ones have studied the causal systems, i.e.
systems whose states and outputs are determined by the inputs and the initial states.
In this paper we present the extension of these results (see [14]-[18]) to multidimensional (nD, n?2) boundary-value systems, by introducing a class of systems which represents the continuous-time time-varying counterpart of Attasi's discrete-time 2D model [3]. The state-space representation of the considered nD boundary-value systems is given, including well-posed boundary conditions. The formulas of the state and of the input-output map of the nD boundary-value systems are obtained, by means of a suitable variation-of-parameters formula.
Generalized nD separable kernels are associated to these systems. The realization problem is discussed for nD separable kernels and necessary and sufficient conditions for minimality are presented.
The adjoints of nD boundary-value systems are introduced and the input-output maps of the adjoint systems are derived. Two inner products are defined and they are used to obtain the relationship between the input-output operators of the boundary-value systems and their adjoints.

Brief Biography of the Speaker: Valeriu Prepelita graduated from the Faculty of Mathematics-Mechanics of the University of Bucharest in 1964. He obtained Ph.D. in Mathematics at the University of Bucharest in 1974. He is currently Professor at the Faculty of Applied Sciences, the University Politehnica of Bucharest, Head of the Department Mathematics-Informatics. His research and teaching activities have covered a large area of domains such as Systems Theory and Control, Multidimensional Systems, Functions of a Complex Variables, Linear and Multilinear Algebra, Special Functions, Ordinary Differential Equations, Partial Differential Equations, Operational Calculus, Probability Theory and Stochastic Processes, Operational Research, Mathematical Programming, Mathematics of Finance.
Professor Valeriu Prepelita is author of more than 100 published papers in refereed journals or conference proceedings and author or co-author of 12 books. He has participated in many national and international grants. He is member of the Editorial Board of some journals, member in the Organizing Committee and the Scientific Committee of several international conferences, keynote lecturer or chairman of some sections of these conferences. He is a reviewer for five international journals. He received the Award for Distinguished Didactic and Scientific Activity of the Ministry of Education and Instruction of Romania.