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RECENT ADVANCES in MATHEMATICAL and COMPUTATIONAL METHODS in SCIENCE and ENGINEERING

Proceedings of the 10th WSEAS International Conference on MATHEMATICAL and COMPUTATIONAL METHODS in SCIENCE and ENGINEERING (MACMESE'08)

Mathematics and Computers in Science and Engineering
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Preface

This book contains the proceedings of the 10th WSEAS International Conference on MATHEMATICAL and COMPUTATIONAL METHODS in SCIENCE and ENGINEERING (MACMESE'08) which was held in Bucharest, Romania, November 7-9, 2008. This conference aims to disseminate the latest research and applications in Differential Equations, FEM, BEM, Variotional Calculus, Stochastic Systems, Wavelets, Circuits, Systems, Electronics, Microelectronics, Nanoelectronics, Power Systems and other relevant topics and applications.

The friendliness and openness of the WSEAS conferences, adds to their ability to grow by constantly attracting young researchers. The WSEAS Conferences attract a large number of well-established and leading researchers in various areas of Science and Engineering as you can see from **http://www.wseas.org/reports**. Your feedback encourages the society to go ahead as you can see in **http://www.worldses.org/feedback.htm**

The contents of this Book are also published in the CD-ROM Proceedings of the Conference. Both will be sent to the WSEAS collaborating indices after the conference: **www.worldses.org/indexes**

In addition, papers of this book are permanently available to all the scientific community via the WSEAS E-Library.

Expanded and enhanced versions of papers published in this conference proceedings are also going to be considered for possible publication in one of the WSEAS journals that participate in the major International Scientific Indices (Elsevier, Scopus, EI, ACM, Compendex, INSPEC, CSA .... see: www.worldses.org/indexes) these papers must be of high-quality (break-through work) and a new round of a very strict review will follow. (No additional fee will be required for the publication of the extended version in a journal). WSEAS has also collaboration with several other international publishers and all these excellent papers of this volume could be further improved, could be extended and could be enhanced for possible additional evaluation in one of the editions of these international publishers.

Finally, we cordially thank all the people of WSEAS for their efforts to maintain the high scientific level of conferences, proceedings and journals.

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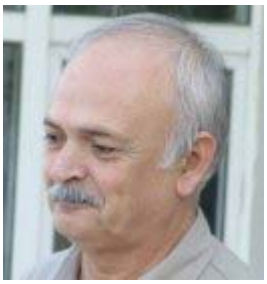
Keynote Lecture

A One Node Fluctuation Suppressing Univariate Integration via Deviation Removals between Power Means and Mean Powers.



Professor Metin Demiralp
Istanbul Technical University, Informatics Institute,
Group for Science and Methods of Computing,
Istanbul, TURKIYE

Abstract: This work attempts to develop a one node quadrature which gives better results than standard Gauss Quadrature by using just one node. This is based on a coordinate transformation in such a way that the resulting integral's weight becomes the multiplication of the original weight by a nonnegative function which is in fact the square of a finite linear combination of a given basis set for the Hilbert space where the integration is performed. The basis set can be chosen as a set of polynomials which are orthonormals under the weight and over the interval of the integration. In that case certain drastic simplifications appear in the matrix representations of integration variable powers as it occurs in the Gauss quadrature. However it is not mandatory to use these polynomials. Depending on the nature of the integrand various sets of functions with more complicated structures can be taken into consideration as basis set. It is just a matter of expertise. Presentation keeps the basis set general without specifying its structure in the conceptual part and uses orthogonal polynomials in illustrative implementations.

An n–node Gauss quadrature uses a linear combination of the function's values at the nodes with positive combination coefficients which are called weight parameters. The nodal values and the weight parameters are universal. That is, they are not depending on the function although they may vary with the interval and the weight function of the integration. According to Fluctuationlessness Theorem these entities are chosen in such a way that the deviation of the (1, 1) element of the n dimensional matrix representation of, say, j–th power of the independent variable from the j–th power of the (1, 1) element of the independent variable's matrix representation is set equal to zero. The basis set should be an orthogonal polynomial set due the construction philosophy of Gauss quadrature. The nodes are the eigenvalues of the matrix representation of the independent variable in the space spanned by first n orthonormal polynomials and the weight parameters are the squares of the first elements of the corresponding eigenvectors. The construction of the nodal values and the weight parameters annihilates the first $2n-1$ deviations mentioned above leaving remaining infinite number of deviations nonzero.

The theory of fluctuation free integration matches Gauss quadrature when its basis set is chosen as the basis set of the Gauss quadrature. However, there is no limitation on the basis set of the fluctuation free integration except the orthonormality and the spanning of the whole Hilbert space where integration is performed. This means more flexibility in this case. The problem is to use this flexibility efficiently. If this is done then it is possible to get results better in precision than Gauss quadrature.

According to mean value theorem of integration it is always possible to find a unique function value which is the image of an interior point of the domain interval under the function, such that, the integral of this function over its domain is equal to this value times the integration interval length as long as the function under consideration is continuous over integration interval. This implies that it is possible to construct an appropriate one node quadrature to get, at least approximately, this point. Gauss quadrature somehow does this. However, integration variable transformation may change the integral in such a way that a better value can be produced for this new integral. The presentation focuses on these aspects of the issue.

Brief Biography of the Speaker: Metin Demiralp was born in Turkey on 4 May 1948. His education from elementary school to university was all in Turkey. He got his BS, MS, and PhD from the same institution, Istanbul Technical University. He was originally chemical engineer, however, through theoretical chemistry, applied mathematics, and computational science years he is working on methodology for computational sciences. He has a group (Group for Science and Methods of Computing) in Informatics Institute of Istanbul Technical University (he is the founder of this institute).

He collaborated with the Prof. H. A. Rabitz's group at Princeton University (NJ, USA) at summer and winter semester breaks during the period 1985--2003 after his 14 months long postdoctoral visit to same group in 1979--1980.

Metin Demiralp has roughly 70 papers in well known scientific journals and is the full member of Turkish Academy of Sciences ince 1994. He is also a member of European Mathematical Society and the chief--editor of WSEAS Transactions on Mathematics currently. He has also two important awards of Turkish scientific establishments.

Plenary Lecture I

Computer Modelling of Granular Flow

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Technical University of Łódz,
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Abstract: Processes of granular flow are still hard to model although many well-developed computational tools are available. When, for instance, the finite element method formulated in purely Lagrangian format is used, the large distortions of the analysed granular material and the element mesh in the sequel lead to numerical inaccuracies or even make the analysis impossible. To overcome these numerical difficulties, the material point method is utilised, which is a variant of the finite element method formulated in an arbitrary Lagrangian-Eulerian description of motion. The motion of material (Lagrangian) points is traced with respect to a computational (Eulerian) mesh which is not subject to distortions. As the material points are defined independently of the computational mesh, the method is also classified as a point-based (mesh-free) method.

Examples of granular flow during the processes of filling and discharging silos will be presented including the doming phenomenon which can appear in the case of slightly cohesive material. The flow of the granular material on a revolving pan and some dynamic problems of geomechanics with large strains will also be presented. The granular material is described by the use of the elastic-viscoplastic constitutive model with the Drucker-Prager yield condition.

Brief Biography of the Speaker:

Education:

1974–1979 Technical University of Łód´z, Department of Civil and Architectural Engineering, M.Sc. in civil engineering.

1987 Ph.D. Thesis: “Duality in finite element method and its applications to some linear and nonlinear problems of mechanics of composite materials”, Technical University of Łód´z.

2000 Dr.Sc. Thesis (Habilitation Thesis): “Application of the finite element method to some non-linear problems of solid mechanics.” Technical University of Łód´z.

Professional experience:

1979–1989 Junior Assistant (1979–1980), Assistant (1980–1981), Senior Assistant (1981–

1987), Assistant Professor (1988–2004), Institute of Civil Engineering, Technical University of Łódz, Poland.

1990–2004 Assistant Professor, Chair of Mechanics of Materials, Technical University of Łódz, Poland.

2001–2008 Head of Chair of Mechanics of Materials, Technical University of Łódz, Poland.

2005–2008 Associate Professor, Chair of Mechanics of Materials, Technical University of Łódz, Poland.

1992–1994 Visiting Researcher, Division of Structural Mechanics, Lulea University of Technology, Sweden.

1997–1998 Post-doctoral Fellow, Department of Mechanical Engineering, Korea Advanced Institute of Science and Technology, Taejon, Republic of Korea.

09–10.2004 Visiting Professor, Department of Mechanical Engineering, Korea Advanced Institute of Science and Technology, Taejon, Republic of Korea.

2006–2008 Visiting Professor, several 3–week visits, Institute of Geotechnical Engineering, University of Stuttgart, Germany.

Research areas: computational methods in mechanics especially the finite element method; equilibrium model of the finite element method; material point method (arbitrary Lagrangian- Eulerian formulation of the finite element method); a posteriori error estimation for approximate solutions to boundary value problems of mechanics; theory of plasticity and viscoplasticity; mechanics of composite materials; finite element modelling of motion of granular material in a silo; large strain engineering problems; gradient and stress fields recovery.

Plenary Lecture II

Annealing Hybrid Algorithms Strategies for NP Class Problems

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Abstract: One of the main objectives of Computer Science is to develop algorithms for helping human beings to solve their difficult and important problems with speed and quality. Among the more difficult computational problems are those belonging to the NP Hard class; examples of these problems are: Satisfiability Problem (SAT), Scheduling (including the allocation of tasks in operating systems and robotics), planning and most problems related with bioinformatics such as phylogenetic trees construction, Folding problems and many others. There are many stochastic approaches proposed for these problems but none of them is always the best solution. A very good approach is to use Simulated Annealing hybridised (i.e. mixed) with other approaches. Among these approaches we can find the very formal ones as Mechanical Statistical, Markov Models, semi-formal as Support Vector Machines and Neural Networks, and very informal as Golden Ratio. In this presentation the main hybridization approaches, applications and challenges for future research are presented.

Brief Biography of the Speaker: Ph.D. in Electrical Engineering, Institut National Polytechnique de Grenoble & Ecole Central de Lyon (France). He is full professor at Technologico de Monterrey Campus Cuernavaca where he is the leader of Combinatorial Optimization Research Group. He has published many papers related with hybrid optimization methods such as Simulated Annealing, Genetic algorithms, Tabu Search, Support Vector Machines, and Linear Programming with applications to Scheduling, Bioinformatics, Satisfiability, Data Mining and many others. His main interest is to develop better algorithms for NP-Hard problems.

Plenary Lecture III

From the Real World to Models and Paradigms in Parallel Scientific Computing

Assoc. Prof. Ion Carstea
University of Craiova,
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Abstract: The people are not isolated actors on the world scene. They enter in competition and co-operation. This real scenario is the basis of the parallel computing and finally, the basis of the parallel computers. The work in the team with the principal characteristics, the co-operation and the collaborative competition, is an education model. Cooperation and collaborative competition must be the basis of the educational process from universities, aspects that are often ignored in educational politics from Romania. The nature models are the starting points in many human projects like the parallel processing of data. The nature models must be the starting points of the educational process with emphasis on the inter-human relations.

The real world offers a lot of models and paradigms for engineers in the area of the computer science and engineering. In a high- performance education we can not ignore the large computing power of the advanced computers as the parallel computers. To ignore the high-level information technology is an anti-social act in any university. Unfortunately, many professors are the slaves of an old-fashioned mode of understanding the education in engineering. It is not a good practice to solve a problem in any way; we must solve a problem with a good performance in terms of the limited physical and abstract resources of the world. An extrapolation of this idea can be done for computers where the physical resources and the abstract resource (as the processing time) are of the great importance for the engineers.

We shall present some models and paradigms in parallel scientific computing starting from the real world models. The old Latin concept divide et impera is a good approach for the development of large engineering projects, for analysis and synthesis of the large-scale systems. The manager-workers paradigm is another paradigm for many parallel algorithms in engineering and business and the performance evaluation of the programs based on this paradigm is developed and presented.

Engineering education from Romanian universities is analysed in context of the reconstruction process of the Romanian school. Some aspects of the politics in the area of human resources and infrastructure from universities are presented using target examples. The effects of the reform in engineering education are analysed in the context of the last decades and educational reform from Romania.

Brief Biography of the Speaker: The speaker is an Assoc. Professor at the Computer Engineering and Communications Department, Faculty of Automatics, Computers and Electronics, University of Craiova, Romania. He has a BSc and MSc in Automatics from the University of Craiova, Romania. He has a Ph.D. in Automatics from the University of Ploiesti, Romania. Also, he has a BSc and MSc in Mathematics from the Natural Sciences Faculty, University of Craiova, Romania.

He was director of the research projects supported by international grants at University of Houston (USA)- 6 months (Fulbright Grant), at the University of Coimbra, Portugal – 9 months (NATO grant), at the Polytechnics of Milano, Italy- 4 months (a CNR-NATO grant). In 2004 he was invited at the Mathematics Department, University of Trento, Italy, for 2 months.

Ion Cârstea published 10 books in the area of programming languages, advanced computers and CAD of the electromagnetic devices. He is the co-author of the book FINITE ELEMENTS in WSEAS Press, 2007. He is the author of more than 130 papers in revues, scientific journals and international conference proceedings. He is a reviewer for several WSEAS International Conferences and was a member in many international scientific committees. In the year 2007, he was Plenary speaker and chair at the WSEAS Conferences from Arcachon (France) and Venice (Italy).

His research interests include parallel algorithms and parallel programs for numerical simulation of the distributed-parameter systems, software products for coupled and inverse problems in engineering, domain decomposition method in the context of the finite element method.

Plenary Lecture IV

Numerical and Analytic Investigation of Some Nonlinear Problems in Engineering Sciences

Professor Gabriella Bognar
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Abstract: In this talk we present theoretical and numerical results in connection with quasilinear partial and ordinary differential equations. The investigated nonlinear problems appear in the mathematical model of many problems in physics and mechanics. The qualitative and quantitative properties of solutions to quasilinear ordinary and partial differential equations are examined.

To prove or disprove some of the conjectures require some massive numerical experiments which helps to visualize some important facts and helps to make appropriate decisions and to find optimal strategies.

Brief Biography of the Speaker: Gabriella Bognar received the M.Sc. in Mechanical Engineering from University of Miskolc, Miskolc, Hungary, the Ph.D. in Mathematics and 'Candidate' of Math. Sciences from the Hungarian Academy of Sciences. She is presently a Professor at the Department of Analysis, University of Miskolc, Hungary. Her teaching and research interests are in the areas of ordinary and partial differential equations, analysis, and complex functions.

Gabriella Bognar has published 5 books, and over 70 papers. She has been reviewer of Mathematical Reviews. She is on the editorial board of Mathematical Notes, Miskolc.

Plenary Lecture V

Nonlinear Optimization Models and Solving Algorithms based on Appropriate Neural Networks

Professor Nicolae Popoviciu
Hyperion University of Bucharest, Romania
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Abstract: This work contains a complete set of algorithms for several quadratic and nonlinear optimization problems. The problem constraints are very differently. For each type of constraint an appropriate algorithm is given. The algorithms for linear bound constraints and nonlinear optimization are based on neural networks and uses a system of differential equations. In order to reduce the sensitivity and round off errors a preconditioning method is used. A great number of numerical applications illustrates the algorithms.

We use the square matrices *M* of the type $n \times n$ or rectangular matrices *M* of type $m \times n$.

All the used vectors are column vectors i.e. x, c, d, p, r, u, v, w and denote, for example,

$x = x_{n\times 1}$ or $x \in R^n$, $x = (x_i)$. The letter *T* means the transposition.

Here we enumerate several nonlinear optimization models and mention the appropriate algorithms to solve them.

There are a lot of quadratic optimization (QO) models (or quadratic programming (QP) models) and nonlinear optimization models (NO) and here we mention several of them. We denote by θ the null vector of an appropriate space, let us say R^n and $x \in R^n$ is the unknown vector of the any optimization problem.

Model 1. *The unconstraint model.*

Find x so that $[\min]F(x); F(x) = \frac{1}{2}x^T Q x - c^T x$. The unconstrained solution is obtained from $gradF(x) = \theta$. The matrix Q could be an invertible or non invertible matrix, but *always* it is a **symmetric** matrix, because we can express $\frac{1}{2}x^T Q x = \frac{1}{2}x^T Q_s x$, $Q_s = \frac{1}{2}(Q + Q^T)$, (symmetric) and $Q_a = \frac{1}{2}(Q - Q^T)$ (asymmetric), $x^T Q_a x = 0$.

Model 2. *The classical QP model.*

Find the vector x so that $[\min]F(x); F(x) = \frac{1}{2}x^T Q x - c^T x$, $Cx = d, x \geq \theta$.

If Q^{-1} exists, then the solution x is obtained by Hildreth D'Esopo algorithm. The algorithm is not based on neural networks.

Model 3. *The QP model with bilateral linear bound constraints*].

Find the vector x so that $[\min]F(x); F(x) = \frac{1}{2}x^T Q x - c^T x$, $q_{ii} > 0$, $p \leq x \leq r$.

This model is solved by an algorithm based on neural network procedure. The algorithm has two steps. The first step is a preconditioning technique. The second step is the solving algorithm.

Model 4. *The QP model with one quadratic constraint* [8].

Find the vector x so that $[\min]F(x); F(x) = \frac{1}{2}x^T Q x$, $x^T C x = 1$.

Model 5. *The nonlinear convex optimization.* (The generalization of model 2).
Find the vector *x* so that

$[\min]F(x), F: R^n \to R$, differentiable, convex; $Cx = d, C = C_{m\times n}, d = d_{m\times 1}, x \geq \theta$.

Model 6. *The nonlinear convex optimization, with bilateral linear bound constraints.* (The extension of model 5).

Find the vector *x* so that $[\min]F(x), F: R^n \to R$, *F* differentiable, convex, $Cx = d, C = C_{m\times n}, d = d_{m\times 1}, x \geq \theta$, $p \leq x \leq r$.

Model 7.*Variational inequality problem.*

Denote $\Omega_2 = \{x \in R^n / Cx = d, x \geq \theta\}$. A differentiable vector function $G: R^n \to R^n$ is given. Find the vector $x^* \in \Omega_2$ so that $(x - x^*)^T G(x^*) \geq 0$, $\forall x \in \Omega_2$.

Now, shortly we mention that our aim is to solve the model 2 (by Hildreth-D'Esopo algorithm), model 3 (by preconditioning techniques and Neural Networks) and models 5,6,7 (by Neural Networks).

Brief Biography of the Speaker:

Name	**Mr. Nicolae POPOVICIU**
Affiliation	**Professor Dr. Math.**
	HYPERION University of Bucharest
	Dean : Faculty of Math. – Info
Born	September 4 , 1943
Place of Born	Romania, District of SIBIU
Nationality	Romanian
Education	Faculty of Mathematics, Diploma 1966
	University of Bucharest, Romania
Doctor in Math	**University of Bucharest, Diploma 1976**
Title	**Professor (full)**
Place of Job	Faculty of Math-Info (from 2004- today)
	Hyperion University of Bucharest, Romania
Position	**Dean of Faculty of Math-Info**
Published Books	**16** (all in Romanian Language)
Published Papers	**83** (almost all papers are in English Language)
	(9 papers are in WSEAS Press, 1 paper in CRC Press)
Plenary Speaker/Chairman	Many times Plenary Speaker and Chairman section in WSEAS Conferences
Studies Abroad	1970 (9 months) University Lomonosv of Moscow
	1973 (6 months) University Paris VI, France

Visiting Prof 1977 (1 month) Technical University of Vienna

1978 (2 weeks) Karolin University of Prague

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Tel. 0040726 141 266 ; 004021 242 89 09

Languages **English, French, Russian**

Domains of Interest

1. Probabilities and Statistics.
2. Optimal Strategy for Markov Decision Processes. Poisson Processes.
3. Distributions and Integral Transforms for Signal Processing
4. Artificial Neural Networks. Fuzzy Sets and Neural Networks.
5. Optimization Problems (Linear, Quadratic, Convex, Nonlinear)

Plenary Lecture VI

Making Asynchronous Systems Theory by Making Use of Dynamical Systems Theory

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Abstract: An n-signal is a function $x:R\rightarrow\{0,1\}^n$ that fulfills certain inertia requirements and an autonomous asynchronous system is a non-empty subset of the set of the n-signals. The autonomous asynchronous systems are the (real time, binary spaces, no input and non- deterministic) models of the autonomous asynchronous circuits from the digital electrical engineering.

The naturalness of the import in the autonomous asynchronous systems theory of some elementary notions from the dynamical systems theory: flows, orbits, nullclins, fixed points, ω-limit points, recurrent points, periodicity, invariant sets, dependence on the initial states, transitivity, attraction, attractors, chaos, equivalence, static and dynamic bifurcation, symmetry- is given by the existence of a generator function $\Phi:\{0,1\}^n\rightarrow\{0,1\}^n$ (called network function by Moisil) and of a vector field $f: R^n \rightarrow R^n$ that play the same role in the two theories. The fundamental ideas of these theories coincide to some extent and the tools of analysis are different, in the sense that the asynchronous systems do not have linearizations, Jacobians, multipliers, Poincare maps etc.

The purpose of the lecture is that of browsing in the context of the autonomous asynchronous systems some usual concepts of the dynamical systems theory.

Brief Biography of the Speaker: Serban E. Vlad was born in 1959 and he works at present as analyst-programmer at the Oradea City Hall. His professional interests include asynchronous systems theory and binary valued mathematical analysis. He is a member of ROMAI and of GAMM, the Romanian and the German societies of applied and industrial mathematics. He is the author of the book 'Asynchronous Systems Theory' that was published by WSEAS in 2007.

Plenary Lecture VII

Vision Based Measurement Systems

Professor Radu I. Munteanu
Member of the Technical Sciences Academy from Romania (ASTR)
Rector of the Technical University of Cluj-Napoca, ROMANIA
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Abstract: The field of food industry is nowadays governed by some of the toughest regulations ever seen in industry in order to maintain the quality of practices such as product traceability and hygiene. Beside these it is required to maintain flexible processes in order to allow alternative products specifications, while maximizing robotic utilization. It is therefore no surprise that this field is very active in introducing automated systems to perform many tasks. The recent advances in semiconductor technology allow to design and implement advanced mathematical methods on low cost hardware platforms. It is a desiderate for smart sensor systems to implement mechanisms similar to the humans mental activity of combining information for the goal of recognizing a measurand that is hardly distinguishable with a single sensor. This presentation will introduce the concept of virtual sensor. A vision based contactless weighting sensor will be presented together with the mathematical foundations required for building and calibrating it. Its real-time performance is demonstrated through the implementation of an automatic sorting system. Further improvements and optimization techniques are introduced in order to make the system able to maximize yield of edible product, reduce labor requirements of the complete system, to provide a process compatible with most current plants and to improve overall plant productivity.

Brief Biography of the Speaker: Radu Ioan MUNTEANU graduated the Faculty of Electrotechnics, Technical University of Cluj Napoca (UTCN), 1968 and has a PH.D. in Technical Physics (UTCN, 1982). Since then his research and teaching activities covered an large area of electrical and electronical measurements, reliability, data aquisition systems, sensors, virtual instrumentation, medical engineering. He is the author of more then 236 published papers, 25 patents, contributed to more then 27 books and 52 research grants in these fields. Doctor Honoris Causa al "Pro-Deo" University New York, USA (1995); University of Craiova, Romania (2002); North University of Baia Mare, Romania (2003) University of Pitesti, Romania (2004), University of Oradea, Romania (2005), "Aurel Vlaicu" University of Arad, Romania (2006), „Petru Maior" University of Targu-Mures (2007). Editor-in-chief: ELECTROMOTION – An International Journal Devoted to Research, Development, Design and Application of Electromechanical Energy, Converters, Actuators and Transducers; Mediamira Science Publisher; ISNN 1223-057X (1994-); ACTA ELECTROTEHNICA (Academy of Technical Sciences of Romania; Technical University of Cluj-Napoca); Mediamira Science Publisher; ISSN 1224-2497; (1998-), RIV- Journal of Virtual Instrumentation, Technical University of Cluj and National Instruments Inc. Austin (Texas, USA); Mediamira Science Publisher; ISSN 1453-8059; (1998-), SCIENCE POLICY AND SCIENTOMETRIC MAGAZINE; CNCSIS - National University Research Council; Mediamira Science Publisher; ISSN 1582-1218; (2003-). He is a member of the Technical Sciences Academy from Romania and the rector of Technical University of Cluj Napoca (2004 -)

Plenary Lecture VIII

Mathematical Models of Grippers

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Abstract: In robotics technology, the groups belong to the functional units have the greatest variety of design. This is due to the fact, although the robot is a flexible machine, the gripper performs a much more tasks. Nevertheless, these tasks are not limited to prehension only which is why the more generic term end – effector is often used. Many grippers are used in the loading of the manufacturing lines, in packaging and storage as well as the handling of objects in laboratory test and inspection systems. Grippers constitute the end of the kinematic chain in the joint systems of the industrial robots, and facilitate interaction with the work environment. Although universal grippers with large holding can be used for diverse work piece shapes, in many cases they must be adapted to the specific work piece shapes. On the whole, there are many types of grippers. Each of these is specialized in holding of a certain shape of the work piece. Unfortunately, there are few types of universal grippers, which can not grasp any object. In this way it is necessary that a single gripper to grasp work pieces with different dimensions. The most work pieces are cylindrical ones. If the robot handle the cylindrical work piece with various diameters, it is necessary that all pieces to be fixed with their axes in the same position. The self centering grippers can have two or three fingers. They are commonly used for the handling of cylindrical work piece in loading and mounting operations. The fingers may have the rotational or translational movements. If the gripper has two fingers with rotational movements, the active surfaces of the jaws are noncircular shapes. The jaws of the grippers with three fingers have the plane or circular cylindrical shapes, but the driving system has a cam with translational movement. In the work, some considerations with regard to design of the self centering grippers used to handle the work piece with cylindrical shape are presented.

Brief Biography of the Speaker: Prof. Ion Simionescu is graduated from 1959 of POLITEHNICA Institute of Iassy, Machine Building Technology Department. Since 1962 has been working as teacher in POLITEHNICA University of Iassy, ROMANIA, Mechanism and Machine Theory Department Doctoral Thesis, in 1975, on The Synthesis of Linkages with Matrix Operators. Since 1976 working as associate professor and professor in Politehnica University of Bucharest, ROMANIA, Mechanism and Robot Theory Department. Prof. Ion Simionescu has a great experience in mechanism synthesis and design, numerical methods for modeling and nonlinear optimization, simulation and precision of mechanisms, design and optimization of industrial robot mechanisms. Scientific Activities. Scientific researchers in about 32 Research Projects and Grants; author of 8 books edited in Romania and of 1 book edited in Austria, 205 papers and studies published in Proceedings of National and International Conferences and International Reviews, and 30 patents registered in Romania.

Plenary Lecture IX

Unexpected High Temperature Chemical Freezing during Slow Isochoric Cooling

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Abstract: An observation is presented regarding the chemical freezing during a slow calorimeter cooling, after the combustion of solid propellants with excess fuel elements into a vacuum. The residual combustion gas within the calorimeter, mainly consisting of CO2, CO, H2O, H2 and N2, although cooled down to the room temperature, presents a chemical composition that meets almost exactly the value encountered at a very high temperature, namely around 1674±36ºK. It appears abnormal that, during the very slow cooling which follows the isochoric combustion, when any chemical freezing seems mostly improbable, such a freezing occurs however. With utmost regularity, the gases refuse completely to follow the equilibrium below this high 1700K limit. The fact is known at much lower temperatures for the isobaric combustion with oxygen in excess, still there are doubts that it had been previously observed for calorimeter products involving the entire water-gas reaction. Numerical simulation of combustion and nozzle expansion processes got a high accuracy level when this process was included in the computational codes. Recent temperature measurements confirm with good accuracy that this freezing temperature is well below the maximal combustion temperature within the calorimeter, but still very high. Detailed investigations are envisaged through the national grant proposal INTECH by a consortium of professional research teams.

Plenary Lecture X

Topics in Multidimensional Continuous - Discrete Systems Theory

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Abstract: In the last two decades the study of two-dimensional (2D) systems (and more generally, of n-dimensional systems) developed as a distinct branch of system theory, due to its applications in various domains as image processing, seismology and geophysics, control of multipass processes etc.

The two-dimensional (2D) systems were obtained from classical linear dynamical systems by generalizing from a single time variable to two (space) variables. Different state space models for 2D systems have been proposed by Roesser, Fornasini and Marchesini, Attasi, Eising and others.

A subclass of 2D systems is represented by systems which are continuous with respect to one variable and discrete with respect to another one. The continuous-discrete models have applications in many problems like the iterative learning control synthesis or repetitive processes.

The aim of this paper is to develop a complete theory for a class of time-variable 2D systems, which are the continuous-discrete counterpart of Attasi's 2D discrete time-invariant models.

In Section 2 variation of parameters formula is established for 2D continuous-discrete (2Dcd) systems and the formulæ of the state and of the output of the systems are derived.

The concept of controllability which is fundamental in control theory was introduced by Kalman under the stimulation of the engineering problems of time optimal control. The notion of reachability was derived from controllability by reversing the time.

Reachability of time-variable 2Dcd systems is analyzed in Section 3 by introducing a 2D reachability Gramian. Time-invariant 2Dcd systems are studied and several necessary and sufficient conditions of complete reachability and complete controllability are derived. It results that the considered class is the closest one to that of classical 1-dimensional systems, since all the known criteria of reachability for 1D systems can be extended to 2Dcd systems. Other advantages of this framework are that the analysed reachability is global and that time-variable systems can be successfully studied.

The notion of observability is defined and analysed in Section 4 for 2D time-varying continuous-discrete separable systems. An observability Gramian is introduced and completely observable systems are characterized by means of the rank of this Gramian. For completely observable systems a formula is derived which provides the initial state by knowing the control and the corresponding output. For 2D time-invariant continuous-discrete systems a list of necessary and sufficient conditions of observability is established. A geometric characterization of the subspace of unobservable states is given in terms of invariant subspaces included in the kernel of the output matrix. The duality between the concepts of reachability and observability is emphasized as well as their connection with the minimality of these systems.

Section 5 is devoted to the study of stability of the time-invariant 2D continuous-discrete systems. Necessary and sufficient conditions of asymptotic stability are obtained, which extend the conditions for 1D continuous-time and 1D discrete-time systems, including a suitable Liapunov function. A necessary condition is expressed by using a generalized Liapunov equation.

In section 6 a multiple hybrid Laplace transformation is defined and the main properties of this transformation are stated and proved, including linearity, homothety, two time-delay theorems, translation, differentiation and difference of the original, differentiation of the image, integration and sum of the original, integration of the image, convolution, product of originals, initial and final values. Some formulas for determining the original are given. This hybrid transformation is employed to obtain transfer matrices for different classes of 2D continuous-discrete linear control systems of Roesser-type, Fornasini-Marchesini-type and Attasi type models, including descriptor and delayed systems.

The realization problem is studied in Section 7. An algorithm is proposed which determines a minimal realization for separable 2D multi-input-multi-output (MIMO) systems. This method generalizes to 2D systems the celebrated Ho-Kalman algorithm. The proposed algorithm can also be used for MIMO separable 2D discrete-time linear systems or for MIMO 2D systems described by a class of hyperbolic partial differential equations.

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 90 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 some international conferences, chairman of some sections of these conferences. He received the Award for Distinguished Didactic and Scientific Activity of the Ministry of Education and Instruction of Romania.

Plenary Lecture XI

An Intrinsic Study on a Certain Isoenergetic Flow of a Compressible Fluid, with Extension to Some Special Cases in Magneto-Plasma Dynamics

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Abstract:

The Aim of the Work: This intrinsic study was made with the aim of improving and enriching the knoledges about the local physical phenomena encountered in both **fluid mechanics** and **magneto-fluid dynamics**, elaborating a new mathematical model.

Key-Words and Phrases: rotational flows, steady and unsteady flows, virtual isentropic (Bernoulli's) surfaces, inviscid and viscous fluids, compressible fluids, flow of an electroconducting fluid in an external magnetic field

2000 Mathematics Subject Classification: 70 Mechanics of particles and systems; 76 Fluid mechanics; 78 Optics, electromagnetic theory; 80 Classical thermodynamics, heat transfer; 85 Astronomy and astrophysics

Extended Abstract: This work studies and clarifies some local phenomena in fluid mechanics as well as in magnetofluid dynamics, representing a continuation and completion of works [1] - [2] with the viscous effects.

Part One: A model of a certain isoenergetic flow of an inviscid fluid is introduced, in order to establish a simpler form for the general PDE of the velocity potential. It consists mainly in using a new three-orthogonal system of curvilinear coordinates (one of them being tied to the local specific entropy value). The choice of this system (with two coordinate curves lying on the "isentropic" surfaces) enables the treatment of any 3-D flow (rotational, steady and unsteady) as a potential 2-D one, introducing a 2-D velocity "quasi-potential", specific to any isentropic surface. The dependence of the specific entropy on this velocity "quasi-potential" was also established. On the above surfaces the streamlines are orthogonal paths of a family of lines of equal velocity "quasi-potential". The model can be also extended to the rotational flow of a viscous compressible fluid, finding the path for having a first integral, introducing the 0-work (made by the non-conservative terms in the Navier-Stokes equation of motion with a special virtual elementary displacement vector) surfaces and *a new physical quantity* – Selescu's roto-viscous **Ş** vector.

Part Two: The model can be extended to some special (but usual) cases in magneto-plasma dynamics (taking into account the flow vorticity effects and those of the Joule-Lenz heat losses), considering a non-isentropic flow of a barotropic inviscid electroconducting fluid in an external magnetic field. There always are some space curves along which the equation of motion admits a first integral, making evident *a new physical quantity* – Selescu's magneto-hydrodynamic **$** vector. For a fluid having an infinite electric conductivity, these curves are the isentropic lines of the flow, also enabling the treatment of any 3-D flow as a "quasi-potential" 2-D one. Some surfaces of 0-work made by the non-conservative elementary forces with a special virtual elementary displacement vector were also introduced. Even if it does not seem to conform with the title, the case of the unsteady rotational flow (and electric field and charge, and magnetic field as well) of an inviscid and then viscous electroconducting liquid (*incompressible* fluid) was also studied (the case of the MHD generator with liquid), giving an *exact* first integral for the equation of motion. The

model was extended to the unsteady (rotational flow, electric and magnetic field) case of a neutral perfect electroconducting viscous compressible fluid (including the highly ionized plasma).
In all treated cases the new found first integrals are similar to D. Bernoulli and D. Bernoulli-Lagrange ones. The differential equations of the virtual isentropic surfaces and those of Selescu's roto-viscous – **Ş** and magneto-hydrodynamic – **$** vector lines and virtual 0-work surfaces are also given.

The Original Contribution of the Work: *A new mathematical model of flow* was elaborated, making evident some *new physical properties and quantities*, being also given *new first integrals for the equation of motion*, integrals obtained by a procedure of eliminating the non-conservative terms in this equation (usually these ones depending upon the path of displacement of the fluid particle, here finding *the most general class of the virtual paths for having 0-work of the terms above*). Intersecting the 0-work surfaces with the isentropic ones (also *virtual*, as a rule they existing), the flow *isentropic lines* (along which the equation of motion also admits a first integral) were found. There is only one case for which the virtual 0-work surfaces coincide with the isentropic ones, namely *the isoenergetic steady and unsteady rotational flows of an inviscid fluid*, such that the virtual isentropic lines rest undetermined (there being an infinity of such kind of lines, among which one can find the *true isentropic* one).

Brief Biography of the Speaker: Senior researcher Richard Selescu graduated as an engineer from the Polytechnic Institute Bucharest, the Faculty of Mechanics, Department of Aircraft Engineering in 1970. He is working in the National Institute for Aerospace Research "Elie Carafoli'' – INCAS, Department of Aerodynamics, at the Trisonic Wind Tunnel Laboratory. He received his PhD degree in Aerodynamics and Fluid Mechanics at the Aerospace Engineering Faculty of the "Politehnica" University Bucharest in 1999. Among the research fields of interest, he approached the analytic modeling in aerodynamics, fluid mechanics and magnetofluid dynamics. Thus, he introduced the following nomenclature: the isentropic surfaces and a 2-D velocity quasi-potential function on these surfaces (in fluid mechanics); the 0-work surfaces for the non-conservative terms in the motion equation (in fluid mechanics and magnetofluid dynamics); a new physical quantity - the MHD vector and its vector lines (in magnetofluid dynamics); a new shock-free axisymmetric supersonic flow - the tronconical flow (in the supersonic aerogasdynamics); the similarity depth for satisfying the gas-hydrodynamic analogy (in the supercritical hydrodynamics).

Plenary Lecture XII

The Risk of Modeling Biomedical Physics

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Abstract: Thinking of the risk analysis of modeling biomedical physics (BP's) from a probabilistic perspective, leads to the conclusion that probability is a measure of expressing uncertainty about the process seen through the point of view of the assessor (i.e. the controller of the process), and based on some background information and knowledge that we have at the time we quantify our uncertainty.

A distinction between objective, real risk, and perceived risk cannot be made. Risk is primarily a judgment, not a fact. As risk expresses uncertainty about the process outcomes, risk perception has a role to play to guide the decision of the controller. A number of different types of models are used in risk analysis. These include both quantity-oriented models and event oriented models. It is difficult to give a detailed specification of what a satisfactory model is. How accurate must a model be in order to be considered satisfactory? One may say that a necessary requirement for a risk model is that any improvement in the model to make it more accurate, as judged by the controller, should not lead to a change in the conclusions considered.

Also, when analyzing BP's performance, human and organizational factors need to be taken into account. For instance, the conventional reliability analysis is based on the premise that increasing the reliability of a system will decrease the losses from failures; but an inappropriate increase of the reliability of the system may determine the risk of a simultaneous increase of the losses from the failure.

In order to avoid these situations, an efficient discrete-event simulation model has been proposed for modeling the immune system of mammalians.

Brief Biography of the Speaker:

- 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.
- Academic Positions: Assoc. Professor, 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 6 books and over 120 scientific papers in conference proceedings and journals.

Plenary Lecture XIII

Probabilistic–Fuzzy Inference Procedures for Knowledge-Based Systems

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Abstract: Knowledge-based systems (KBS) are computer systems using methods and techniques of artificial intelligence. The main components of the systems are the knowledge base and the inference procedure. Such systems are capable of supporting human decisions in many fields of activities, as: control, prediction, diagnosis and many others.

In this work we present the general methods of creating the probabilistic-fuzzy knowledge base and the inference procedure. A structure of the reason-result fuzzy model is predefined according to expert's experiences, at the beginning of the task. Sets of numerical data, collected in real systems are used to compute empirical probability distributions of linguistic variables of the knowledge representation. The calculated probabilities of fuzzy events have been included into inference procedures.

Models and inference procedures for exemplary tasks are presented.

Brief Biography of the Speaker: Anna Walaszek-Babiszewska, at present, is a professor at the Opole University of Technology, Department of Control and Computer Engineering. She has obtained a MSc degree in Control Engineering from the Wroclaw University of Technology and a PhD as well as a DSc (Habilitation) degrees from the Silesian University of Technology in Gliwice, Poland.

Her research interests include: stochastic and fuzzy modeling, fuzzy systems identification, data analysis, and applications in technological and managerial situations.

She has supervised 3 completed PhDs and reviewed 5 PhDs in technical and economic sciences. She has published 2 monographic books on stochastic and fuzzy modeling and over 80 scientific papers.

She was a member of the Editorial Boards of Management (2000-2005) and Lecture Notes in Control and Computer Science (2003) of the Zielona Gora University Press. She is a member of the Section of Cybernetics in Mining, Mining Committee of the Polish Academy of Sciences (since 1999).

Plenary Lecture XIV

Some Remarks over the MLS Method

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Abstract: The present paper presents a possible implementation of the Element Free Galerkin method to the study of fracture of Mindlin- Reissner plates.

The novelty of this paper resides on the fact that it uses an enriched meshless method (Moving Least Square) around the crack tip in the theory of Mindlin-Reissner plates. This method is especially designed to characterize in a better way the behavior of cracks.

Brief Biography of the Speaker:

a) Studies
BsC 1997 -Faculty of mathematics of the Al. I. Cuza University
MsC 2001- Faculty of Mathematics of the Al. I. Cuza University
PhD 2003 – Faculty of Mathematics of the Bucuresti University

b) Academic Positions
1997-2001 Research assistant / Dept of Mechanics and Astronomy at the Al. I. Cuza Univ
2001-2003 Teaching Assistant / Dept of Applied Math of the Al. I. Cuza University
2003-present Lecturer / Dept of Mathematics of the Al I Cuza University

c) Scientific Activities (research, publications, projects, etc….)

over 25 research papers, 7 books on applied mathematics, computational mechanics and informatics

Special Session I

Theory and Computation in Modeling Complex Systems

Organizer:

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Topics:

- Advanced Algorithms and Computational Techniques for Modeling, Simulation and Optimization
- Approximation Theory and Applications in Modeling Complex Systems
- Applied Mathematics
- Numerical Methods and Applications in Modeling, Simulation and Optimization
- Finite Element Method
- Theoretical Models and Computational Techniques in Modeling Systems from Computer Science, Telecommunications, Computer Networks, Data Transmission. Economics, Biology, Chemistry, Ecology, Industry, etc.
- Software for Modeling, Simulation and Optimization
- Intelligent Systems Modeling
- Advanced in Classification Theory
- Formal Modeling
- Theoretical Models and Computational Aspects in e-learning
- Applications of Grid Computing in Modeling Complex Systems
- Miscellaneous

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Brief Biography of the Organizer:

Prof. Dana Simian received the diploma. in engineering from the University of Sibiu, Romania, the diploma. in Mathematics - Informatics from the University Babes-Bolyai of Cluj-Napoca, Romania and the Ph.D. in Mathematics from Babes-Bolyai University of Cluj- Napoca, She has a great experience in algorithms and numerical methods for modelling and optimization. She was a member of many scientific committees of international conferences. .She published 20 books, 44 articles and she participated to many international conferences. She organized two special sessions, within WSEAS conferences and an international workshop on approximation, modelling and optimization topics. Dr. Simian is a Fellow of WSEAS