ADVANCES IN MATHEMATICAL AND COMPUTATIONAL METHODS

Editor: Liliana Rogozea

ADVANCES IN MATHEMATICAL AND COMPUTATIONAL METHODS

12th WSEAS International Conference on MATHEMATICAL and COMPUTATIONAL METHODS in SCIENCE and ENGINEERING (MACMESE '10)

University of Algarve, Faro, Portugal, November 3-5, 2010

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Preface

This year the 12th WSEAS International Conference on MATHEMATICAL and COMPUTATIONAL METHODS in SCIENCE and ENGINEERING (MACMESE '10) was held at the University of Algarve, Faro, Portugal, November 3-5, 2010. The conference remains faithful to its original idea of providing a platform to discuss new mathematical methods and computational techniques or applications of known mathematical methods and computational techniques (i.e. differential equations, FEM, BEM, variational calculus, stochastic systems, cellular automata, wavelets, integral equations, universal approximants, optimization and search, clustering and density estimation, filtering and state estimation, linear and non-linear time series, simulation techniques, neural networks, fuzzy logic, evolutionary computing, orthogonal transforms, wavelets, forecasting etc). with participants from all over the world, both from academia and from industry.

Its 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 this conference 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.

A Conference such as this 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

Normal Forms Theory with Applications to the Non-linear Oscillations in Mechanics

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Abstract: It is well known that the theory for many dimensions non-linear mechanical systems is very difficult and it can be applied only to very particular cases. Generally speaking, the approximation of the solution is performed only for one or two dimension systems and, in addition, the equations of motions are assumed to be in a proper form. There is neither an approach for the systems with more than two degrees of freedom, nor indication about how we can obtain the desired form for the equations of neither motion, nor proofs if the theory applied in one or two degrees of freedom can be used in the general case. It is our goal to develop a general theory for these situations. In this paper we started with some backgrounds about the normal forms for vector fields. This theory leads us to a generalization for the multi dimensional systems that characterized the non-linear oscillations of the mechanical systems. Based on this, we obtain the simplest form for the differential equations of motion. We called this form the canonical form, which is met in the literature. The transformation to the canonical form is performed in the most general case and it also offers us the necessary and sufficient conditions for the stability of the motion. The theory developed in this paper is finally applied to a few mechanical systems which are completely solved.

Brief Biography of the Speaker: Nicolae-Doru Stanescu (born 1965) graduated the Faculty of Machines Construction's Technology at the "Politehnica" University of Bucharest in 1989, and the Faculty of Mathematics and Computer Science at the University of Pitesti in 1995. Since 2003 he is PhD in Mechanical Engineering at the University of Pitesti, and since 2008 he is PhD in Mathematics at the University of Bucharest. Now, he is Associate Professor at the Department of Applied Mechanics of the University of Pitesti, where he teaches Mechanics, Numerical Methods and Non-linear Vibrations. He wrote more than 100 articles and 6 books. He participated as researcher or was director at 8 grants. He is member of the International Institute of Accoustic and Vibration in USA, and of Societe des Ingineurs de l'Automobile, France, among other associations. He was invited professor at Instituto Superior Tecnico, Lisbon, Portugal. His fields of interests are: non-linear vibrations, dynamical systems, stability, chaos, and numerical analysis.

Plenary Lecture 2

Some Mathematical and Computational Methods in Solid Mechanics

Professor Tamaz S. Vashakmadze
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Abstract: A dynamical system of partial differential equations which is 3D with respect to spatial coordinates and contains as a particular case both: Navier-Stokes equations and the nonlinear systems of PDEs of the elasticity theory is proposed.
In the second part using above uniform expansion there are created and justified new 2D with respect to spatial coordinates nonlinear dynamical mathematical models von Karman-Mindlin-Reissner (KMR) type systems of partial differential equations for anisotropic porous, piezo, viscous elastic prismatic shells. Truesdell-Ciarlet unsolved problem (open even in case of isotropic elastic plates) about physical soundness respect to von Karman system is decided. There is found also new dynamical summand (is Airy stress function) to another equation of von Karman type systems . Thus, the corresponding systems in this case contains Rayleigh-Lamb wave processes not only in the vertical, but also in the horizontal direction. For comlpleteness we also introduce 2D Kirchhoff-Mindlin-Reissner type models for elastic plates of variable thickness.
Then if KMR type systems are 1D one respect to spatial coordinates at first part for numerical solution of corresponding initial-boundary value problems we consider the finite-element method using new class of B-type splain-functions. The exactness of such schemes depends from differential properties of unknown solutions: it has an arbitrary order of accuracy respect to a mesh width in case of sufficiently smooth functions and Sard type best coefficients characterizing remainder proximate members on less smooth class of admissible solutions.
Corresponding dynamical systems represent evolutionary equations for which the methods of Harmonic Analyses are nonapplicable. In this connection for Cauchy problem suggests new schemes having arbitrary order of accuracy and based on Gauss-Hermite processes. These processes are new even for ordinary differential equations.
In case if KMR type systems are 2D one respect to spatial coordinates at first part for numerical solution of some corresponding initial-boundary value problems we use Gauss-Hermete processes with discrete-variational and differentiate-parameteric methods.

Brief Biography of the Speaker: Born in Tbilisi(Tb),1937,education: 1954/59 - student Tb. State Univ.(TSU),1959/62 - Post grad. stud. Razmadze Institute of Mathematics,1981-doctorant Moscow Phys.-Tech.Inst. Ph.D(Candidate of Sci.)-1964, Dr.Hab. (Full professor) Solid Mechanics-1984(Lomonosov Moscow SU),1987(Razmadze Inst.),work experience:1962-1973-Senior Reaseachers Razmadze and Vekua Institutes,1973-Head of Dept., Full Prof. Mathematics Vekua Inst. Appl. Math./TSU, First Premium Diploma Works TSU (1959); ; Honor order(2003); Premium Ilia Vekua Georgian NAS (1993), Premium of COBASE (1999, Invited Professor-Explorer Univ. Delaware), Premiums ISF (G.Soros Foundation): 1993-Short-Term, 1995-96-Long-Term-KZB 200 (Leader of Group), Academician Georgian Acad. Engineering Sci., Members Editorial Boards JAFA(Memphis), 4 regional journals in Georgia,1998-2003:Editor-in-Chief Proceed. TSU (Appl.Math.&Comp.Sci), Invited Lecturer: 1983-1989- Math. Summer Schools Pushchino Biophys.Ins.AS FSU, 1979-1996-ISIMM Symposiums, and Participant-more than 100 Inter.Math.Conferences, 175- research paper including review articles, 4- monographs, and 3-manuals. 2-books(ed.)

Plenary Lecture 3

Ethics, Mathematical Methods, Informatics Pattern, Bioterrorism

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Abstract: The development of mathematical methods and patterns of information in the fight against bio-terrorism is a goal of our days.
Today there are many reasons for biological weapons to be chosen as the means to fight the terrorist attacks worldwide. Biological agents can spread easily and produce panic, but especially they can produce a wide range of diseases.
Development of mathematical and computer models for training both specialists and the susceptible population should be a goal for the Military, but especially for those in the medical field.
Bio-terrorism is not a discovery of the XXI Century. Biological agents have been used for centuries because of both relatively low production costs and the fact that disease prevention is difficult.
The development of software and mathematical models has become more intense after the attacks from September 11, and CDC Atlanta divided them into 3 categories. Also there are indicators of terrorist attacks such as number of illnesses and deaths, the dynamics of the epidemic, the rate of affected population and distribution of cases may cause the emergence of models that facilitate the difference between illness induced by people and naturally spread, and facilitate information and training for people to cope with such situations.
However, it is equally important to analyze what are the ethical implications of development and emergence of such mathematical models, the problems of managing such disasters or those related to information management of bioterrorism-related data. It is also necessary to carefully analyze the ethical issues related to the decision to publish or not certain research and analysis models from bioterrorism, the scourge of our century.

Brief Biography of the Speaker: Professor – chief of Health Promotion, Human Behaviour, Ethics and History of Medicine Department, General Chancellor at the University Transylvania Brasov.
She is member in International Society of Biometrics, member in International Society of Clinical Biostatistics, member in International Society of History of Medicine and editor coordinator of 2 Medical Journal.
She published 21 books like author or co-authors, published in Romania, at the HIMSS, i-technonline
She participates at more than 50 conferences and published 38 papers in extensor at the conference and 72 articles in journals, in the ethics, human behaviour, health promotion and history of medicine.
She was involved in 15 projects like coordinator and member.

Plenary Lecture 4

Softcomputing Methodologies Applied to Audio-Based Information Retrieval

Professor Mario Malcangi
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Abstract: Softcomputing (fuzzy logic and artificial neural networks) have been widely applied in several fields, above all control and pattern matching. With the fast development and the huge availability of extremely pervasive communication technologies such as Internet, new challenges are prompted. Due to large availability of multimedia data (audio, video, images, etc.), searching information is becoming an increasingly complex task because most of information is not available in text format. Audio information is widely spread in multimedia information and it is strictly related to video and image information.
Audio classification is the first step in the developing of complete process that leads to upgrading current text-based search engine with signal-based information such as audio (sounds, music, and speech). Fuzzy logic and artificial neural networks fit optimally the classification problem of the audio information, due to the fuzzy and the neural nature of recognition of specific audio pattern in complex audio contexts (broadcast news, video, TV programs, advertising, etc.).
Non linear nature of audio perception, audio pattern recognition, and audio information extraction from a mix of unknown sources (unmixing) have a perfect matching with fuzzy logic inference and with neural classification.
Both fuzzy logic and neural networks will be discussed in three main audio processing areas, word spotting, speaker recognition, and music pattern recognition Audio features extraction algorithms are firstly explained, then the modelling of a fuzzy inference engine from feature distribution and the training of an artificial neural network for pattern classification are discussed.

Brief Biography of the Speaker: M. Malcangi graduated in Computer Engineering from the Politecnico di Milano in 1981. His research is in the areas of speech processing and digital audio processing. He teaches Digital Signal Processing and Digital Audio Processing at the Universita degli Studi di Milano. He has published several papers on topics in digital audio and speech processing. His current research efforts focus primarily on applying soft-computing methodologies (neural networks and fuzzy logic) to speech synthesis, speech recognition, and speaker identification, where deeply embedded systems are the platform that supports the application processing.

Plenary Lecture 5

Analytical and Boundary Elements based Integral Representation for Numerical Solution of 3-D Potential Problems in Heterogeneous Media Containing Singularities

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Abstract: Mathematical formulation of processes in different areas of physics, e. g. fluid flows and transport phenomena through porous media, electrostatics and electrodynamics, heat conduction etc. lead to boundary value problems for partially differential equation elliptical type. In many engineering applications, the processes mentioned above, have behaviours that mathematically represent singularities (point sources/sinks or line sources/sinks etc. in 2-D or 3-D domain). Generally the numerical solutions with classical numerical methods like FVM or FVM lead to difficulties.

In the paper a solution that eliminates these difficulties and shortcomings are present a method based on integral representation of the solution, combining the Analytical Elements and Boundary Elements which will be called AE-BEM. The presentation will be focused especially on the flow problems in porous media where the singularities are wells or drains shaped as thin objects of finite length etc.

The 3-D flow domain is constituted of several arbitrary distributed sub-domains with different conductivity's (e.g. hydraulic conductivity) called Non-Singularity-Objects (NSO) and several point- source/sink line-source/sink as sub-domains called Singularity-Objects (SO) which can be located arbitrarily regarding the NSO. On the boundary of the NSO transition conditions between the internal and external flow should be satisfied while on the boundary of the SO only boundary conditions for the external process are required. The singular integral representation of the solution of boundary value problems for each object will be used as theoretical base of the AE-BEM. In the paper we present several examples for 3-D flow simulation obtained on the basis of the proposed AE-BEM and its software implementation.

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