Editors
Elena Scutelnicu
Ljubomir Lazic
Pablo Fernandez de Arroyabe

Advances in Remote Sensing, Finite Differences & Information Security

- Proceedings of the 5th WSEAS International Conference on Finite Differences - Finite Elements - Finite Volumes - Boundary Elements (F-and-B '12)
- Proceedings of the 8th WSEAS International Conference on Remote Sensing (REMOTE '12)
- Proceedings of the 11th WSEAS International Conference on Information Security and Privacy (ISP '12)

Prague, Czech Republic, September 24-26, 2012

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Preface

This year the 5th WSEAS International Conference on Finite Differences - Finite Elements - Finite Volumes - Boundary Elements (F-and-B '12), the 8th WSEAS International Conference on Remote Sensing (REMOTE '12) and the 11th WSEAS International Conference on Information Security and Privacy (ISP '12) were held in Prague, Czech Republic, in September 24-26, 2012. The conferences provided a platform to discuss iterative methods, nonlinear problems, stability, godunov finite volume discretizations, sensor design and calibration, data acquisition and processing, image processing, pattern recognition, photogrammetry, passive attacks, access control, hardware security, intrusion detection 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 sent to international indexes. They will be also available in the E-Library of the WSEAS. Extended versions of the best papers will be promoted to 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

Investigation and Numerical Resolution of Some Nonlinear Partial Differential and Integro-Differential Models

Professor Temur Jangveladze
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Abstract: In mathematical modeling of many natural phenomena and processes can be described by the initial-boundary value problems posed for parabolic differential and integro-differential models. Most of these problems are nonlinear and multi-dimensional. These moments significantly complicate investigation of such models. Construction, investigation and computer realization of algorithms for approximate solution of these problems are the actual sphere of contemporary mathematical physics and numerical analysis.

One very important nonstationary model is obtained at mathematical modeling of processes of electro-magnetic field penetration in the substance. In the quasi-stationary approximation, the corresponding system of Maxwell's equations has the form:

$$\frac{\partial H}{\partial t} = -rot\left(\nu_m rot\, H\right), \tag{1}$$

$$c_\nu \frac{\partial \theta}{\partial t} = \nu_m \left(rot\, H\right)^2, \tag{2}$$

where $H = \left(H_1, H_2, H_3\right)$ is a vector of magnetic field, θ – temperature, c_ν and ν_m characterize correspondingly heat capacity and electroconductivity of the medium. System (1) describes propagation of magnetic field in the medium, and equation (2) describes temperature change at the expence of Joule's heating without taking into account of heat conductivity.

Maxwell model (1), (2) is complex for investigation and practical study of certain diffusion problems, therefore its comparatively simplified versions are often used and studied.

If c_ν and ν_m depend on temperature θ, i.e. $c_\nu = c_\nu\left(\theta\right)$, $\nu_m = \nu_m\left(\theta\right)$, then the system (1), (2) as it was done in the work - Gordeziani D.G., Dzhangveladze T.A., Korshia T.K. Existence and Uniqueness of a Solution of Certain Nonlinear Parabolic Problems. Differential'nye Uravnenyia, 1983, V.19, N7, p.1197-1207 - can be rewritten in the following form:

$$\frac{\partial H}{\partial t} = -rot\left[a\left(\int_0^t \left|rot\, H\right|^2 d\tau \right) rot\, H \right], \tag{3}$$

where coefficient $a = a\left(S\right)$ is defined for $S \in \left[0, \infty\right)$.

Investigation of (3) type models began in the abovementioned work. Thereafter many scientific works were dedicated to (3) type integro-differential models.

If the magnetic field has the form $H = \left(0, U, V\right)$ and $U = U\left(x,t\right)$, $V = V\left(x,t\right)$, from (3) we obtain the following system of nonlinear integro-differential equations:

$$\frac{\partial U}{\partial t} = \frac{\partial}{\partial x}\left[a\left(S\right)\frac{\partial U}{\partial x} \right], \qquad \frac{\partial V}{\partial t} = \frac{\partial}{\partial x}\left[a\left(S\right)\frac{\partial V}{\partial x} \right], \tag{4}$$

where

$$S(x,t)=\int_0^t\left[\left(\frac{\partial U}{\partial x}\right)^2+\left(\frac{\partial V}{\partial x}\right)^2\right]d\tau\,. \tag{5}$$

For more thorough description of electromagnetic field propagation in the medium, it is desirable to take into consideration different physical effects, first of all - heat conductivity of the medium. In this case, again with taking into account of Joule law, instead of equation (2), the following equation is considered

$$c_\nu\frac{\partial\theta}{\partial t}=\nu_m(rot\,H)^2+\nabla(k\nabla\theta), \tag{6}$$

where k is heat conductivity coefficient, which also depends on temperature. Some aspects of investigation and numerical resolution of one-dimensional version of system (1), (6), in case of one-components magnetic field, are given for example in the work - Abuladze I.O., Gordeziani D.G., Dzhangveladze T.A., Korshia T.K. Discrete Models for a Nonlinear Magnetic-field Scattering Problem with Thermal Conductivity. Differential'nye Uravnenyia, 1986, V.22, N7, p.1119-1129.

Many scientific papers are devoted to the construction and investigation of discrete analogues of abovemensiond differential and integro-differential models. Many authors are studying convergence of semi-discrete analogues and finite-difference schemes for the models described here and for the problems similar to them. There are still many open questions in this direction.

We study existence, uniqueness and asymptotic behavior as $t\to\infty$ of solution of different kind of initial-boundary value problems for system (4), (5) as well as numerical solution of these problems. We compare theoretical results to numerical ones.

Special attention is paid to construction of discrete analogs corresponding to one-dimensional model, as well as to construction, analysis and computer realization of decomposition algorithms with respect to physical processes for (1), (6) model. The above-mentioned decomposition is defined by splitting the equation (6) in two parts: in the first part the Joule heat release is taken into account and it is equivalent to the integro-differential model (3), and in the second – heat conductivity of the medium, which gives the nonlinear system of parabolic type.

Brief Biography of the Speaker:

Prof. Temur Jangveladze (Dzhangveladze) graduated from Ivane Javakhishvili Tbilisi State University, Department of Applied Mathematics and Cybernetics in 1977. He was Junior Scientific Researcher (1977-1983), Scientific Researcher (1983-1988), Senior Scientific Researcher (1988-1998), Leading Scientific Researcher (1998-present) of Ilia Vekua Institute of Applied Mathematics of Ivane Javakhishvili Tbilisi State University. Invited Assistant (1981-1984) and Invited Docent (1984-1988), Docent (1988-1998), Professor (1998-2009), Invited Professor (2009-present) at Ivane Javakhishvili Tbilisi State University. Professor at Ilia State University (2006-2010). Invited Professor (2001-2010), Professor (2010-present) at Caucasus University. Since 1977 till now Prof. T. Jangveladze has been reading the lectures in Numerical Analysis, Numerical Solutions of Differential Equations, Nonlinear Partial Differential and Integro-differential Models, Mathematical Modeling and etc. In 1984 he defended Ph.D. (candidate degree) thesis in specialty "Computational Mathematics". In 1998 he defended a thesis for a Doctor of Science (Habilitation) Degree in specialty "Theoretical Bases of Mathematical Modeling, Numerical Methods, Program Complexes". Field of his scientific interests is Nonlinear Differential and Integro-Differential Equations and Systems, Numerical Analysis, Nonlocal Boundary and Initial Value Problems, Mathematical Modeling and etc. The full list of his publications comprises more than 120 scientific papers and text books. He is editor of journal "Reports of Enlarged Session of the Seminar of I.Vekua Institute of Applied Mathematics" and member of editorial board of several international scientific journals. He was the member of international program committee and the participant of many international scientific conferences. Prof. T. Jangveladze is a head of Department of Informatics of Tbilisi International Centre of Mathematics and Informatics (TICMI). He is chair of the Enlarged Sessions of the Seminar of Ilia Vekua Institute of Applied Mathematics, Section of Partial Differential Equations.

Plenary Lecture 2

The Relationship between Changes of Deflection and Natural Frequencies of Damaged Beams

Professor Rainer Gillich
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Abstract: The paper describes the relationship between changes of deflection of beams due damages and the natural frequency changes. Previous papers relate the influence of damage location and severity upon the natural frequency changes of weak-axis bending vibration modes, for which the authors have found a correlation. It base on the reduction of stiffness in a slice of the beam and consequently on the reduction of the potential stored energy in that slice. While the stiffness reduction affect also the deflection under the own mass of the beam, we concluded that it can be found a relationship between deflection and frequency changes. Researches performed this direction revealed that it is a clear dependency between deflection and frequency changes, what makes deflection an important feature of beam behavior, usable in damage assessment.

Brief Biography of the Speaker:
Gilbert-Rainer Gillich is Professor of Vibrations and Machine dynamics at the Faculty of Mechanics and materials Science of the “Eftimie Murgu” University of Resita - Romania. He earned undergraduate degree in Mechanical Engineering (1986) and PhD degree in Strength of materials, elasticity and plasticity (1999) at the “Politehnica” University of Timisoara. He gained extensive industrial experience in various fields of mechanical engineering, by working in the Steel Factory of Resita, which is completed by teaching and research activities at the “Eftimie Murgu” University of Resita and the Research Institute for Construction Equipment and Technology from Bucharest. These activities are concretized in several books and more than 100 articles in reference journals and international conferences, 17 finalized national and international founded research projects and 2 patents. Since 2002 he currently held courses at: Johannes Gutenberg Universitat Mainz (Germany) and Universita degli Studi di Sassari (Italy). He is official reviewer of some journals indexed in international databases and was involved in organizing international conferences as co-organizer, stream proposer or acting as program committee member or reviewer. He is member of the International Institute of Acoustics and Vibration (IIAV), European Acoustics Association (EAA), European Association for Signal Processing (EURASIP), the Balkan Environmental Association (B.EN.A.), The General Association of Engineers in Romania (AGIR), Romanian Acoustic Society (SRA), Romanian Association of Tensometry (ARTENS) and Robotics Society of Romania (SRR). His research interests are: Applied mechanics and vibration; Damage detection; Structural health monitoring; Signal analysis and signal processing; Acoustics; Environmental issues.

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Plenary Lecture 3

Numerical Surface Model Precision: Case of DEM's

Professor Jose Francisco Zelasco
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Abstract: A Digital Surface Model (DSM) is a numerical surface model which is formed by a set of points –point cloud-, arranged as a regular or irregular grid, to study some physical surface, Digital Elevation Models (DEM), or other possible applications, such as a face, or some anatomical organ, etc. The study of the precision of these models, which is of particular interest for DEMs, has been the object of several studies in the last decades. The measurement of the precision of a DSM model, in relation to another model of the same physical surface, consists in estimating the expectancy of the squares of differences between pairs of points, called homologous points, one in each model which corresponds to the same feature of the physical surface. But these pairs are not easily discernable, the grids may not be coincident, and the differences between the homologous points, corresponding to benchmarks in the physical surface, might be subject to special conditions such as more careful measurements than on ordinary points, which imply a different precision. The generally used procedure to avoid these inconveniences has been to use the squares of vertical distances between the models, which only address the vertical component of the error, thus giving a biased estimate when the surface is not horizontal. The Perpendicular Distance Evaluation Method (PDEM) which avoids this bias, provides estimates for vertical and horizontal components of errors, and is thus a useful tool for detection of discrepancies in Digital Surface Models (DSM) like DEMs. The solution includes a special reference to the simplification which arises when the error does not vary in all horizontal directions. Taking some precautions, the PDEM may be employed in the cases of DEM's obtained by means of the Interferometry SAR Technique and the LISAR technique.

Brief Biography of the Speaker:
Jose F. Zelasco is graduated as surveyor from the Buenos Aires University. Then he was working several years in Africa (Nigeria and Algeria). Afterwards he graduated in informatics from the Pierre et Marie Curie University (France) and obtained his Diplome D'Etudes Approfondies (French master) in geodetic sciences, from the Ecole Nationale de Sciences Geographiques. Finally he got his PhD in applied mathematics from the Montpellier II University (Academie de Sciences et Techniques du Languedoc). He has been member, co director and director of several research projects. He is professor at the Buenos Aires University (Computer Sciences Department and Mechanical Department. He is director of the LEMI laboratory (University of Buenos Aires). His research interests, now in the mentioned laboratory and in the Technological National University focus on stereoscopy, stereology and stereotactic neurosurgery (mechanical and informatics support). He is author of about 60 papers published in several journals and conference proceedings, and invited book chapters.

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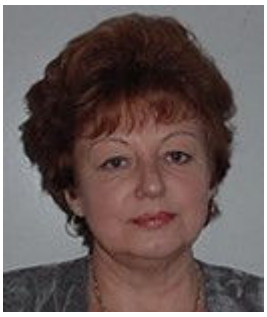
Plenary Lecture 4

Integration of RS and GIS to Encourage Automation, Temporal Analysis and to Support the Decision Making



Associate Professor Dana Klimešová
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&
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Abstract: The plenary speech discusses the contribution of remote sensing and image processing techniques to improve cognitive processes, acquire vector data and support decision making. Also the problem of knowledge management is addressed and the different ways of knowledge integration are discussed. The speech is focused on the possibility to support our decisions using GIS and knowledge database in combination with raster oriented advanced methods to acquire, analyze and evaluate data. The satellite data and regular automated processing can bring new aspects into landscape evaluation including temporal point of view and understanding the changes and trends in various contexts.
During the past few decades, significant progress has been made in the development of decision support systems, image processing techniques and geographical information processing. The goal of this kind of research is to integrate information and knowledge and accelerate the use of knowledge-based databases. This approach is closely connected with temporal analysis of objects and it is the reason why the talk focuses on temporal analysis techniques and discusses the various areas where these results can be applied. Accessible satellite data can bring new aspects into landscape evaluation including temporal point of view and understanding various contexts on the background of the process understanding. The plenary speech discusses the contribution of image processing techniques to improve cognitive processes and deals with the relations between knowledge management, uncertainty and the context evaluation on the background of computer science, artificial intelligence and the new possibilities of information technologies that can help us to carry out the knowledge management strategies.

Brief Biography of the Speaker:
Dana Klimešová is with the Czech University of Life Sciences Prague (CULS), Faculty of Economics and Management, Kamýcká 129, 165 21 Prague, Czech Republic, (e-mail: klimesova@pef.czu.cz) and with the Institute of Information Theory and Automation Czech Academy of Sciences, Pod vodárenskou věží 4, 182 00 Prague 8. She works on CULS as Associate Professor and Deputy Head of Department of Information Engineering. Education: She received Master Degree in Numerical Mathematics, Faculty of Mathematics and Physics, Charles University in Prague, 1973. Ph.D. Degree in Computer Science, Thesis: Texture Processing in Remote Sensing, Czech Academy of Sciences, Prague, 1987. Research interests: Spatial modelling, geographical information management, context mapping, GIS, image processing. Education activities: Geographical information systems and image processing, remote sensing, projecting and system engineering.

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Plenary Lecture 5

Duality and Projective Computation in Engineering and Geometry

Professor Václav Skala
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&
Department of Computer Science
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VSB-Technical University of Ostrava
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Abstract: Development of new algorithms is a crucial part not only in research, but it is needed in Engineering applications, namely in all computational fields, Computer Graphics, Visualization and Computer Vision fields.
Understanding of projective geometry and the principle of duality enable to understand the substance of the solved problem as the problem can be transformed to a dual space, where the solution is simple and/or helps to develop new algorithms.
Projective geometry notation and use can be used in computational problems and in many cases helps to speed up computation. Especially if the matrix-vector architecture like GPU is used, the reformulation of the problem using projective notation increases the speed of computation.
The principles will be demonstrated on simple examples. Examples of computational problems, disasters caused by numerical computations will be presented as well.
• Typical engineering and geometrical problems
• Euclidean and projective spaces, transformations, properties
• Duality (linear), property of dual transformation, dual problems
• Algorithm complexity – simple geometrical examples – and dual problems
• How dual formulation can influence development of a new method, algorithm
• Robustness and influence to algorithm design
• Typical examples how projective/dual formulation can speed up computation
• How projective formulation supports algorithms for GPU architecture
• Typical examples of geometrical problems, their projective reformulation leading to significant speed up and in some cases to reconsideration leading to lower algorithm complexity

Brief Biography of the Speaker:
Prof. Vaclav Skala is a Full professor of Computer Science at the University of West Bohemia, Plzen and VSB-Technical University Ostrava, Czech Republic. He received his ING.(equivalent of MSc.) degree in 1975 from the Institute of Technology in Plzen and CSc. (equivalent of Ph.D.) degree from the Czech Technical University in Prague in 1981. In 1996 he became a full professor in Computer Science. In 1997 the Center of Computer Graphics and Visualization (CCGV) was formally established and since then he is the Head of the CCGV in Plzen (http://Graphics.zcu.cz).
Prof.Vaclav Skala is an associate editor of The Visual Computer (Springer), Computers and Graphics (Elsevier), member of the Editorial Board fo Machine Graphics and Vision (Polish Academy of Sciences) and the Editor in Chief of the Journal of WSCG. He is a member of international program committees of prestigious conferences and workshops. He is a member of ACM SIGGRAPH, IEEE and Eurographics Association.
Prof.Vaclav Skala has published over 200 research papers at conferences and research journals. His current research interests are computer graphics and visualization, mathematics, especially geometrical algebra, algorithms and data structures.

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Plenary Lecture 6

New Authentication Methods of Symmetric Cryptographic Check Values

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Abstract: Symmetric cryptographic check values are very sensitive to any change of the message they are appended to. They change about 50% of their bits, if one or more bits of the message change, making the message useless. For the successful verification of symmetric cryptographic check values all of bits of the received check value and that one recalculated of the received message have to be correct. Such a hard verification of messages protected by symmetric cryptographic check values is not suitable for many applications. The introduction of soft verification enables acceptance of messages modified by transmission over a noisy channel, which would be rejected by hard verification. At first an overview over existing algorithms, which introduce tolerant verification of symmetric cryptographic check values, will be given. Afterwards, algorithms are presented, which introduce tolerant verification of messages protected by symmetric cryptographic check values together with a correction of messages corrupted due to the noisy channel. Results show how promising novel algorithms are for correction of messages, which suffer an error rate despite of the use of channel codes.

Brief Biography of the Speaker:
Dr.-Ing. Natasa Zivic received diploma and Magister from the Faculty of Electrical Engineering of the Belgrade University in 1999 and 2002 respectively. She received Dr.-Ing. from the University of Siegen in 2007, where she is currently employed as a lecturer and works on a postdoctoral thesis. Her current research includes channel coding and cryptography, as well as combined applications of both. She is author of 3 monographs, about 85 publications of conference and magazine papers, two German and one USA patents and reviewer of conference and journal papers. Bulletin Board

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Plenary Lecture 7

A Distributed and Autonomous Framework for Resilient Information Networks: Some Results from Self-Repairing Networks

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Abstract: Information networks such as internet and sensor net has been expanded so widely that a normal life cannot be considered without them. On the other hand, many malicious and harmful agents such as warms, viruses and spams have been reported every day. We discuss the problem of spreading the normal state (rather than spreading of the abnormal state) that is formalized as a cleaning a contaminated network by mutual copying. Repairing by copying is the “double edged sword” that could spread contamination when properly used. This talk focuses on not only stationary states but also on transient states of the self-repairing networks. Several implications for the framework of antivirus systems (against computer viruses and worms) will be presented comparing mutual repair and self-repair of nodes in the network. A framework for controlling copying involving a spatial Prisoner’s Dilemma is also introduced. Adaptive character to the network environment will play a critical role when the network environments are dynamic.

Brief Biography of the Speaker:
Yoshiteru Ishida received Dr. Eng. in Applied Mathematics and Physics from Kyoto University in 1986. He served as an assistant professor at Kyoto University from 1983 to 1993. From 1994 to 1998, he has been an associate professor at Nara Institute of Science and Technology. Since 1998, he has been a professor at Toyohashi University of Technology.. He had been a visiting researcher at School of Computer Science, Carnegie-Mellon University (1986-1987), Department of Psychology, Carnegie-Mellon University (1993-1994) and Santa Fe Institute (1997-1998). His research interest includes biological complexity typified by the immune system (“Immunity-Based Systems: A Design Perspective”, as in his book from Springer); self-organization by a game theoretic approach; and qualitative theory on large-scale dynamical networks.

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