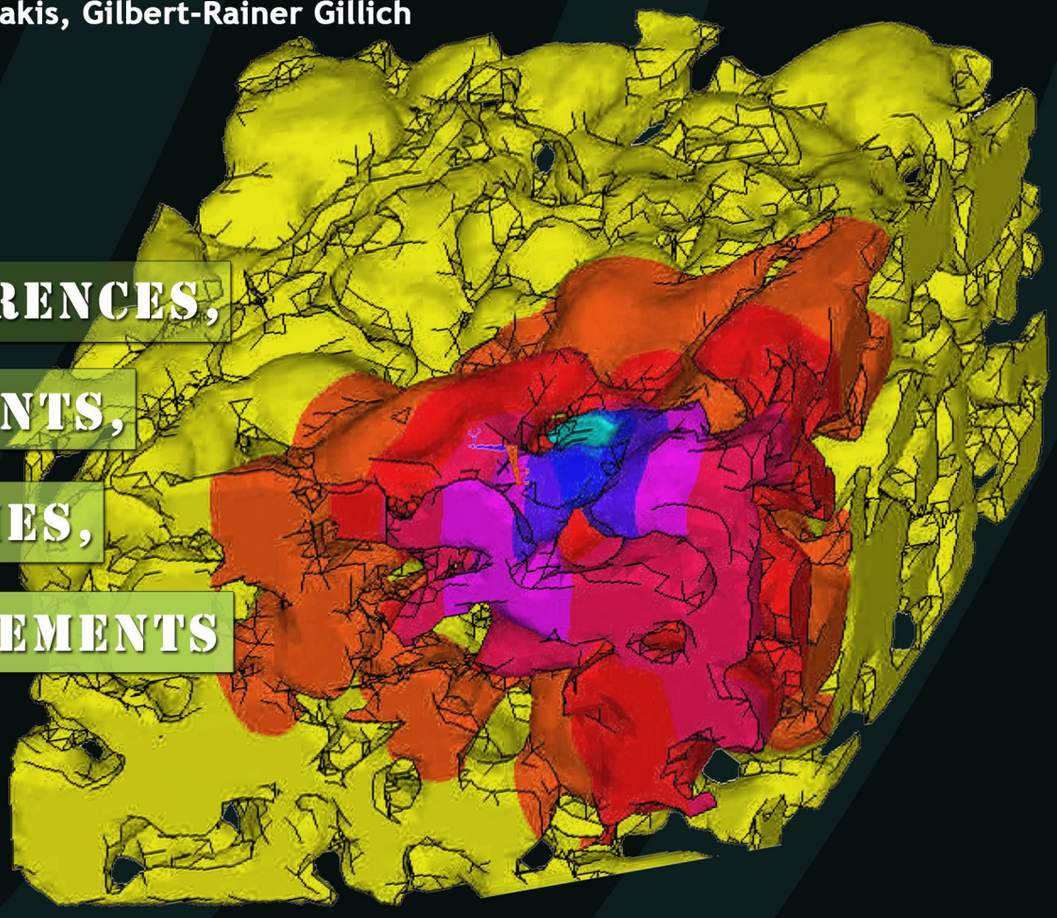
Editors: Remi Leandre, Metin Demiralp, Milan Tuba, Luige Vladareanu,
Olga Martin, Nikos Mastorakis, Gilbert-Rainer Gillich



FINITE DIFFERENCES, FINITE ELEMENTS, FINITE VOLUMES, BOUNDARY ELEMENTS

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Proceedings of the 4th WSEAS International Conference on
Finite Differences - Finite Elements - Finite Volumes -
Boundary Elements (F-and-B '11)

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Preface

This year the 4th WSEAS International Conference on Finite Differences - Finite Elements - Finite Volumes - Boundary Elements (F-and-B '11) was held in Paris, France, April 28-30, 2011. The conference provided a platform to discuss multidimensional systems, acceleration techniques, error analysis, nonlinear problems, parallel numerical algorithms, discretization techniques, iterative methods, extension to systems of nonlinear conservation laws, numerical flux functions for systems of conservation, integral equations, mesh reduction methods, fundamental solution method, fluid mechanics, composite materials, thermodynamics, statistical physics, heat and mass transfer, electromagnetics, acoustics, quantum mechanics 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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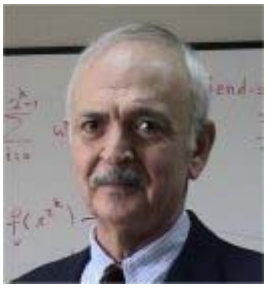
Keynote Lecture

High Dimensional Model Representation (HDMR) and Enhanced Multivariance Product Representation (EMPR) as Small Scale Multivariate Decomposition Methods



Professor Metin Demiralp
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Abstract: The method of finite elements is quite frequently used in the solution of boundary value problems modelled as either ordinary differential equations (ODEs) or partial differential equations (PDEs). It is based on basically weak derivative and Sobolev space concepts. An appropriate bilinear form is constructed from the given equations and accompanying boundary conditions by using these concepts. Then the unknown function is approximately expressed in terms of appropriately defined spline functions over certain convenient subregions of the problem geometry. The linear combination constructed towards this goal contains certain undetermined constants which appear in an algebraic equation, that is linear for the linear ODEs or PDEs, together with linear boundary impositions like Dirichlet or Neumann conditions. The important issue in this approach is the construction of the spline basis set, which is realized in such a way that the resulting algebraic equations possess rather simple structure to be solved for the unknowns. Finite elements can be used for almost anything either derived from ODEs or PDEs, or directly from a function in certain ways although the most desired cases are the differential equations.
Recent developments, especially in last decade, made it possible to decompose a multivariate function or its image under certain appropriate operators to some components which are ordered in ascending multivariance. This approach which was originally proposed by Sobol has been extended to more general representations after the studies by Rabitz group in Princeton and Demiralp group in ?Istanbul, even though the number of the scientists concerning with the issues have been increased recently. The method was named High Dimensional Model Representation (HDMR). There are now many different varieties of HDMR in accordance with the certain particularities of the target function, especially after many works in the Group for Science and Methods of Computing (GfSaMoC, supervised and conducted by Demiralp). Beyond those varieties new quite important approaches like Enhanced Multivariance Product Representation (EMPR) which uses support functions to provide more flexibility to quality control in the truncation approximations have also been developed.
Despite HDMR and EMPR are considered for the continuous structures like multivariate functions of more than one independent variables, recent works of GfSaMoC have shown that these methods can be directly used as orthonormal decomposition methods in Multilinear Algebra even though the preliminary steps to this end were taken by Sobol, Rabitz and some other authors.
Some studies have been realized in GfSaMoC to understand what happens if the HDMR or EMPR geometry is taken to zero limit in the volume. What we have seen was that the constancy measurer of HDMR becomes 1 at the zero volume limit. In other words, the constant component of HDMR was becoming overwhelmingly dominant in that limit, or more precisely, HDMR was becoming composed of just a single constant component. This limiting behaviour was bringing the opportunity of approximating the function under HDMR by just constant component or at most univariate terms when the geometric volume of HDMR diminishes. This urged us to divide the HDMR geometry to certain subgeometries such that the function under consideration can be expressed by at most univariate terms in HDMR for each subregion. The result was a piecewise function whose discontinuities can be smoothened by taking some higher HDMR components or by using an optimisation technique to choose best subregioning through suppressing the function value jumps at the borders of each subregion.
What we have mentioned above can be accordingly modified for the EMPR approach also. Some related theorems about the zero volume properties of HDMR and EMPR together with certain illustrative implementations will be presented during the speech.

Brief Biography of the Speaker:
Metin Demiralp was born in Turkey on 4 May 1948. His education from elementary school to university was entirely 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 was mostly working on methodology for computational sciences and he is continuing to do so. 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. Herschel 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 the same group in 1979–1980. Metin Demiralp has more than 90 papers in well known and prestigious scientific journals, and, more than 170 contributions to the proceedings of various international conferences. He gave many invited talks in various prestigious scientific meetings and academic institutions. He has a good scientific reputation in his country and he is one of the principal members of Turkish Academy of Sciences since 1994. He is also a member of European Mathematical Society and the chief–editor of WSEAS Transactions on Computers currently. He has also two important awards of turkish scientific establishments. The important recent foci in research areas of Metin Demiralp can be roughly listed as follows: Fluctuation Free Matrix Representations, High Dimensional Model Representations, Space Extension Methods, Data Processing via Multivariate Analytical Tools, Multivariate Numerical Integration via New Efficient Approaches, Matrix Decompositions, Multiway Array Decompositions, Enhanced Multivariate Product Representations, Quantum Optimal Control.

Plenary Lecture 1

Stochastic Analysis without Probability: Study of Some Basic Tools

Professor Remi Leandre
Institut de Mathematiques de Bourgogne
Universite de Bourgogne
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Abstract: Stochastic analysis is able classically to represent a small class of partial differential equations. We extend some stochastic objects for some class of partial differential equations when there is until now no stochastic processes. We begin by the case of a generalized Ito formula. We continue by studying the study of some generalized martingale problem when there is no probability. We continue by study a generalized Brownian sheet and study its long time behaviour involved with the Haar distribution on a path group in the Hida-Streit approach of path integral as distribution.

Brief Biography of the Speaker:
Remi Leandre works on the two faces on infinite dimensional analysis:
-The analysis of partial differential equations (Malliavin Calculus).
-The analysis of some infinite dimensional objects. He worked during a lot of time on a stochastic analysis approach to some ideas of the celebrated physicist Witten.
He belongs to the editorial board of several scientific journals. He has organized several conferences. He his editor with X. Dai, X. Ma and W. Zhang of the Festchrift published by the French Mathematical Society, in honour of the celebrated mathematician Bismut. He received in 1988 Bronze Medal of C.N.R.S. as well as Rollo Davidson Prize in 1989 for various works on hypoelliptic difuusions.

Plenary Lecture 2

Stress Analysis of Reinforced Axisymmetrical Shells using Substructures

Professor Olga Martin
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Abstract: A computational efficiency method is presented to study the structure of a rocket fuel tank subjected to an internal pressure. The complete structure is divided into a number of substructures that can be analyzed separately by the displacement method. Finally, using the simultaneous relaxation of the substructures boundary, we find the actual displacements and hence, the values of stresses in the tank structure. Evidently, the solution of the boundary displacements involves a considerably smaller number of unknowns compared with the solution for the complete structure without partitioning. A numerical example proves the advantages of this proposed method based on the techniques of Finite Element Method (FEM). Using a program written in MatLab language, we determine the stresses in the tank structure and study its stability.

Brief Biography of the Speaker:
Olga Martin graduated the Faculty of Mathematics and Mechanics, University of Bucharest, Romania. She received his PhD in mathematics with the specialization in Dynamic Plasticity with paperwork 'Applications of the Finite Element Method in Dynamic Plasticity'. During of twenty years, she had been senior researcher in Aircraft Institute, Strength Materials Department. Technical experience: structural strength computing reports using ANSYS program (wing-fuselage, fuselage frame, fin, elevator, rudder and aileron), dynamic and static test-programs for aircraft structures, fatigue test-programs for aircraft structures, iterative methods for the study of the reactions, which correspond to movable control surfaces, attached at n – points to an elastic structure and program of this, static and fatigue computation of the propeller (mono-bloc hub, blades and blades retention system).
Nowadays, she is Professor, Applied Sciences Faculty, University Politehnica of Bucharest.
Fields of specialization: Mathematical Analysis, Mathematical Physics, Computational and Experimental Solid Mechanics, Numerical Analysis, Statistical Calculus. She has published over 80 research papers and 18 books. She is member of the editorial boards of Politehnica Sci. Bull. Series A, WSEAS Transactions on Applied and Theoretical Mechanics, WSEAS Transactions on Mathematics and she was involved in the program/organizing committees for many international conferences. Membership of Professional Societies Society of Computer Aided Engineering – Member National Union of Romanian Scientists (Founding member) Balkan Society of Geometers, member. Reviewer: WSEAS Press (books and journals), Scientific Bulletin, Politehnica University of Bucharest Scientific Evaluation Societies: RELANSIN, Politehnica University of Bucharest, ARACIS, Bucharest, National Science Fund of Bulgaria.

Plenary Lecture 3

How to Correlate Vibration Measurements with FEM Results to Locate Damages in Beams

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Abstract: The paper presents a new method to detect damages in beams and assess their location and severity by means of vibration measurements. Typically, changes in natural frequency of beams are relatively small, even for an important reduction of their cross-section; this is one of the major difficulties in locating damages in this way. Our research takes into account the particular manner in which the natural frequencies of the first ten bending modes change due to the occurrence of damage. It is a pattern recognition problem, the measured frequency changes being compared with values contained in a database, determined using the FEM. By comparing the shift in frequency obtained through measurements with those determined using the FEM it was possible to locate damages and estimate their geometry with high accuracy, which leads to the conclusion that the method can be successfully used. The method was validated by experiments.

Brief Biography of the Speaker:
Gilbert-Rainer GILLICH, born on 29.01.1962 in Resita, Romania, graduated the Faculty of Mechanics of the "Politehnica" University Timisoara (1986) where he obtained also his PhD (1999). During of twenty-four years he gained expertise as engineer at the Steel Factory of Resita ad teaching staff at the "Eftimie Murgu" University of Resita where he is now professor of Vibrations and Machine dynamics and in the meantime Vice-Rector for Education. He acted as invited professor at the Johannes Gutenberg Universitat Mainz -Germany, since 2002 and the Universita degli Studi di Sassari - Italy, since 2006. His research is focused on damage detection and structural health monitoring, as well as on base isolation and aseismic protection. He is member of several scientific or professional associations, like: The International Institute of Acoustics and Vibration (IIAV), European Acoustics Association (EAA), European Association for Signal Processing (EURASIP), Balkan Environmental Association (B.EN.A.), The General Association of Engineers in Romania (AGIR), Romanian Acoustic Society (SRA), Romanian Association of Tensometry (ARTENS), Romanian Association of Electronic Industry and Software (ARIES), Robotics Society of Romania (SRR). He was involved, as director or researcher, in 17 finalized national and international founded research projects, publishing 5 books and more than 80 articles in relevant journals and conferences and 2 patents.

Plenary Lecture 4

Evolutionary Algorithms and their Applications

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Abstract: Evolutionary Computation (EC) is the field of research devoted to the study of problem solving via simulated evolution. The first generation ECs consists of Evolution Strategies, Evolutionary Programming and Genetic Algorithms (GAs). “GA-like” techniques and GAs were added to the second generation of ECs. The third generation of ECs merged with the addition of Culture Algorithms, DNA-based computing and Particle Swam Optimization. Combining different attributes from all five paradigms Evolutionary Algorithm (EA) becomes a common term. EAs have been successfully applied to a variety of areas. Motion planning is one of these application areas. I will use the hybrid evolutionary motion planning system for mobile robots operating in an unstructured environment as the example of EAs application.

Brief Biography of the Speaker:
Huiming Yu is a professor and Graduate Coordinator of the Computer Science Department at North Carolina A&T State University, USA. She received her Ph.D. degree from Stevens Institute of Technology in USA in 1992. She has twenty-three years of combined teaching and research experience in software engineering, visualization, information assurance and artificial intelligence. Dr. Yu has received more than five million dollars grants from different funding agencies. She has served as a reviewer for several panels of National Science Foundation and National Aeronautics and Space Administration. Dr. Yu has published more than seventy refereed journal and conference papers and one textbook. She has served as a reviewer/session chair/program committee for more than fifteen conferences.