RECENT ADVANCES in CONTINUUM MECHANICS

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Cambridge, UK, February 24-26, 2009

Proceedings of the 4th IASME / WSEAS International Conference on CONTINUUM MECHANICS (CM'09)

Mathematics and Computers in Science and Engineering
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Preface

This year the 4th IASME / WSEAS International Conference on CONTINUUM MECHANICS (CM'09) was held in the University of Cambridge as in 2008. The Conference remains faithful to its original idea of providing a platform to discuss theoretical and applicative aspects of solid mechanics, fluid mechanics, gas mechanics, rheology, industrial applications, environmental problems 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.

During this last year we witnessed the growth of the European Union interest in Continuum Mechanics. This is an additional proof that they are seen not only as an exciting research area but also as technologies that may solve current European citizens' concerns with several practical problems.

For a discipline which is central to research and also to industry, and which generates interests not only among academicians but also among large companies and government departments and agencies, it is important to look at the market and at its movements.

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

To What Extend could be Quantum Mechanics be Submissive. What we have Recently Understood about Quantum Control

Professor Zakhariev Boris Nikolaevich
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Abstract: Correction of the present defect in quantum education throughout the world must be performed by the new breakthrough in quantum mechanics which was recently achieved due to the inverse problem approach. It allows finding infinite (!) number of exactly solvable models instead of only about ten previously known about 100 years. It means an incomparable more convenient basis for the quantum education and countless instructive examples of the precise control of the spectral parameters. That was impossible to imagine in the previous quantum theory. Another great achievement was the discovery of qualitative rules of transformations of the most elementary wave constituents, their separate bumps. This opened the 'black box' of the above mentioned exact models and intensifies many times their usefulness. One acquires the notion about the simplest "bricks" and building blocks of potential and wave transformations. It means a real quantum ABC to acquire the quantum literacy and facilitate the future discoveries. So, one gains the absolutely unexpected ability of immediate prediction how, in principle, to achieve the given properties of the constructed objects. An unprecedented combination of qualitative simplicity and clarity with absolute exactness was achieved. Unlike the numerous textbooks on quantum mechanics, mainly compilations, the one recently published by us (Nova Publishers? New York) has no analogs. Being first hand information it is utmost intelligible due to computer visualizations. It is not a substitution of the traditional books, but a fundamental, strengthening and simplifying addition to them enlarging and deepening the understanding of the subject instead of previously unintuitive and approximate approach. Recently we have achieved a new progress in extending our “solutions in mind” to more complicated objects (multi-channel, multidimensional and few –body systems).

Brief Biography of the Speaker: Zakhariev Boris Nikolaevich was born 29 September 1933. Graduated from Department of Physics, Moscow State University (1956), Russia.
Admitted to the Laboratory of Theoretical Physics of the Joint Institute for Nuclear Research (JINR, Dubna) where B.Z. is working till now. B.Z. has investigated the problems of nuclear fusion in mu-molecular three-body systems with S.S.Gershtein under the guide of Ya.B. Zeldovich and A.D.Sakharov. It was an excellent school of quantum multichannel formalism. The corresponding pioneer results were used for many years by the researches in this direction and constituted the B.Z.'s Candidat thesis defended in 1960.
For his unified theory of quantum reactions, B.Z. has got the second scientific degree (Russian Doctor of Phys.-Math. Sciences) in 1970. In 1974 these methods of close coupling of channels were published in B.Z.'s first book (Atomizdat).
His numerous results on quantum inverse problem theory were published in the second book "Potentials and quantum scattering" (Energoatomizdat, 1985) which was revised, translated into English and published as "Direct and Inverse Problems" in 1990 by Springer.
The main points of qualitative theory of spectral, scattering and decay control (quantum design) were collected in the third and fourth books "Lessons on Quantum Intuition" (JINR, 1996) and "New ABC of Quantum Mechanics" accepted for publication.
B.Z. became professor in 1991, selected and named Soros Professor in 1994 (confirmed in 1996) "in recognition and appreciation of outstanding contributions to science". He is the only Soros Professor in Laboratory of Theoretical Physics of JINR (among more than 150 its scientific collaborators).
During the last 4 years B.Z. has delivered about 200 lectures and reports at 40 scientific and educational centers ("Global" program of information about the new theory in which his school has leading positions in the world) of

Russia (20 of them best in Moscow), Europe, Canada, South Africa, Australia spreading new elements of quantum literacy (B.Z. Paris, Montpellier, Aux-le-Bain (France), Nils Bohr Inst. (Copenhagen, Denmark), Quebec and Edmonton (Canada), Hamburg, Berlin, Siegen, Bochum, Giessen, Freiburg, Dresden (Germany), Wienna, Graz (Austria), Prague, Libice, Cracow, Szecin, Mikolayki, Budapest, Bratislava, Bucharest (East Europe), Pretoria, Iohannesburg (South Africa), at World's Math.-Phys Congress in Brisbane (Australia).). B.Z. has organized 5 School-Seminars "Secrets of Quantum and Mathematical Intuition" at Dubna (1993-1997).

Under B.Z.'s guide 30 diploma works were done by students of Universities of Moscow, Twer, Tashkent, Sofia, Katmandu, Vilnius etc.

Under the guide of B.Z. 7 Doctor (Russian "candidate") thesis works were defended. Three of B.Z.'s young collaborators have got the next scientific degree (Russian doctor). Two Doctor thesis works based on the results by B.Z. were done in USA (Meister) and Austria (Schnizer), two his coauthors are preparing doctor thesis works: Stroh (Germany) and Braun (Pretoria).

In 1996 B.Z. has got the sole prize of organizing commeetee of international Conference on Nuclear Spectroscopie and Reactions.

B.Z. is the member of Executive Board of Moscow Physical Society and of the Editorial Board of the Journal of Moscow Phys. Society.

Plenary Lecture 2

On Reliable Continuum Mechanics Formulations in Multiscale Simulations of Solids

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Abstract: In order to identify the best technique to solve a class of fully three-dimensional geometrically multiscale model problems in thermoelasticity, the combination of several finite element approaches and solution techniques, is investigated. The criteria for optimality were robustness, accuracy and execution time. It will be shown that the primal-mixed finite element approach, where displacement and stress variables are simultaneously solved from large scale indefinite poorly scaled system of equations using sparse solver with aid of the matrix scaling routine during the factorization process, enables the reliable solution even if hexahedral finite elements in a mesh differ in size up to six orders of magnitude. A number of pathological benchmark model problems, with material interfaces or coating, with geometrical scale resolutions up to 8 orders of magnitude and aspect ratio of finite elements up to 7 orders of magnitude, are examined to test the robustness and execution times, on a standard PC computing platform. The comparison with simplified theories, as beam and plate, is evaluated in detail also. The new definition of multiscale reliability is given.

Brief Biography of the Speaker: Dubravka Mijuca is a professor in the Department of Structural Engineering at the Faculty of Civil construction Management, University UNION, Belgrade. She received her MSc and PhD in Computational Mechanics at Department of Mechanics at Faculty of Mathematics University of Belgrade, Serbia, where she spent here academic career, before coming in present academic institution in 2007 to serve as a dean. Her research interests include the novel and reliable fully three-dimensional multiscale multifield mixed finite element procedures in thermomechanics for the isotropic, anisotropic and composite bodies with material interfaces, which can be bridged with simulations on micro and nano geometrical levels, without spurious oscillations of the results. The main goal in her research is reliable mechanical and thermal stress calculation on material interfaces, such as, interface between plies in composite, and over the interface of the coating, as well nonphysical interfaces, such as interface between boundary of the macro and nano simulation levels. In addition, her research interest, beside structural efficiency is also in simulation of the energy efficiency of buildings, influence of thermal characteristic of building envelope throughout the geometrical scales on integral energy efficiency of buildings, and interoperability of these two simulations. She is a vice president of Serbian Society of Computational Mechanics, member of general council of Serbian Society of Mechanics, member of NAFEMS and IUTAM. Professor Mijuca's publications have appeared in the journals Computational Mechanics, Computer Assisted Mechanics and Engineering Sciences, Facta Mechanics and Thermal Science. She has published a monograph entitled On Primal-Mixed formulation in Elasticity and Thermoelasticity.

Plenary Lecture 3

Unsteady Flow Simulation In Turbomachinery: A Numerical Challenge

Professor Martelli Francesco
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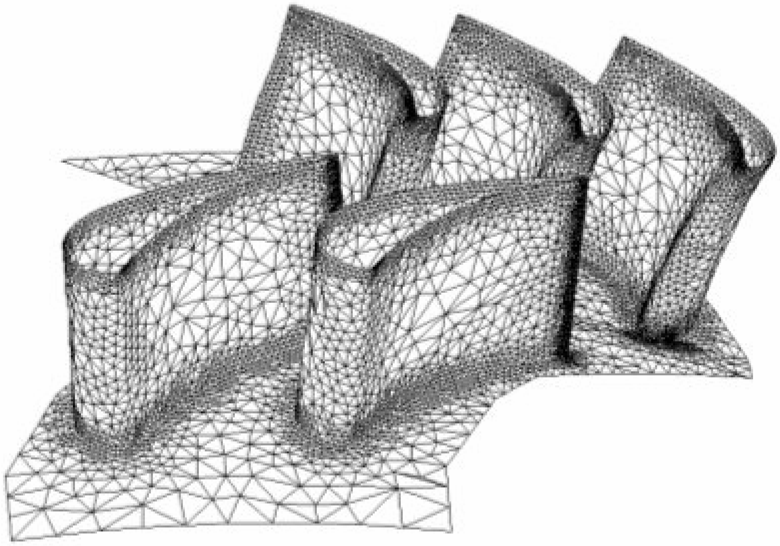
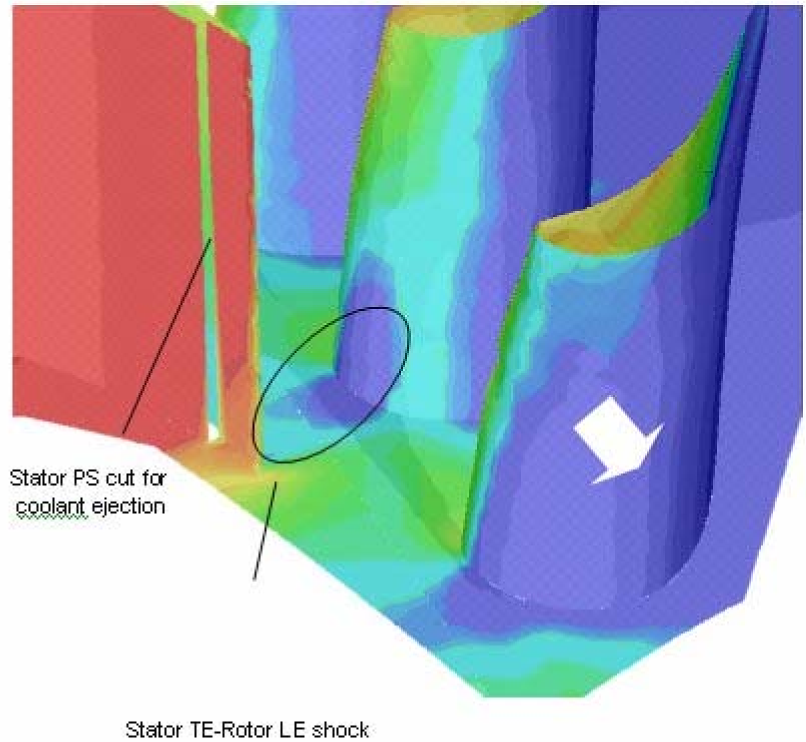
Abstract: The prediction of unsteady flow field in turbine blades as well as in the turbomachinery stages is now an affordable item, and is required by the reduced margin for increasing efficiency, stability and life of propulsion components. The numerical tools are now capable to run within reasonable time 3D unsteady calculation for full stage, and the new techniques on the computation and parallel computer allow the improvements of results in terms of cost and accuracy. Despite this advantages many questions remain open and the physical modelling joint with the numerical improvements is still a challenge if it has to produce usable results ,compared with the experiments. On the other side the huge amount of data extracted from experiments require care and skillness to become usefull tools for design. The two activity interact and support each other in the attempt to improve design quality.
Aim of this paper is the report on some experience and the attempt to give some answer on that challenge, presenting results of an resent activity on modelling side compared with experiments as well.
A full-3D unstructured solver based on an upwind TVD finite volume scheme is developed and applied to the simulation of an unsteady turbine stage. Two different approaches are considered for the time accurate inviscid simulation of the unsteady stator/rotor interaction. The first consists of a classical explicit time accurate multi-step Runge-Kutta scheme. The second is based on a dual-time stepping strategy, which exploits the implicit time-marching Newton-Krylov method. In this case the linear solver of the implicit scheme consists of a preconditioned GMRES and ILU(0) incomplete factorisation. Both the explicit and implicit approaches are designed to run on parallel cluster of workstations. The development of the numerical strategy is discussed with particular concern on the validation of the unsteady model through a comparison against experiments, NISRE approach and a 3D steady stage computation.
The present work considers the application of the fully unstructured hybrid solver for internal viscous flows, as well. The multiblock version of the solver developed for turbine is considered, because of the highly improved performance as compared to the single domain version of the code. Moreover, the high numerical costs involved in 3D unsteady computations required the development of a new parallel single program multiple-data version of the numerical solver.
The results compare favourably with a set of time averaged and unsteady experimental data available for the turbine stage under investigation, which is representative of a wide class of aero-engines. This improved version of HybFlow is applied to the simulation of the BRITE HP turbine stage experimentally tested in the compression tube facility CT3 of the Von Karman Institute (Denos et al. 1999, 2000). Preliminary tests on viscous calculations show a good capability of the solver to manage complex flow conditions and geometry. Some example of calculation grids and results are reported in following figures.



Stage Inviscid Coarse Grid



3D wall pressure pattern

In the final version of the papers results and comparision on rotor stator interaction will be reported in more details, and comments and suggestion on the pen question will be discussed.

Plenary Lecture 4

Spatial Behaviour in Continuum Mechanics

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Abstract: In the construction of buildings, bridges, aircraft, nuclear reactors and automobiles, the engineer must determine the depth to which local stresses, such as those produced by fasteners and at joints, or vibrations can penetrate girders, I-beams, braces and other similar structural elements. The determination of the extent of local or edge effects in structural systems allows the engineer to have a clear distinction between the global structure (where strength of materials approximations can be used) and the local excited portions which require a separate and more elaborate analysis based on some exact theories as that of linear elasticity. The standard procedure used in engineering practice to determine the extent of local stresses or edge effects is based on some form of the celebrated Saint Venant principle. A comprehensive surveys of contemporary research concerning Saint Venant principle can be found in Horgan and Knowles (1983) and Horgan (1989; 1996).

As regards elastic vibrations, it was observed in these papers that high frequency effects might be expected to propagate with little spatial attenuation (see also Boley (1955; 1960)). It is outlined in Horgan and Knowles (1983) that one would not expect to find unqualified decay estimates of the kind concerning Saint-Venant's principle in problems involving elastic wave propagation, even if the end loads are self-equilibrated at each instant. In this connection, Flavin and Knops (1987) have carried out an analysis of spatial decay for certain damped acoustic and elastodynamic problems in the low frequency range which substantiates the early work of Boley. These results are extended to linear anisotropic materials in Flavin et al. (1990). It should be noted that all of the investigations mentioned in the foregoing were concerned with elastic materials having a positive definite elasticity tensor.

On the other hand, in the literature concerning thermal effects in continuum mechanics there are developed several parabolic and hyperbolic theories for describing the heat conduction. The hyperbolic theories are also called theories of second sound and there the flow of heat is modelled with finite propagation speed, in contrast to the classical model based on the Fourier's law leading to infinite propagation speed of heat signals. A review of these theories is presented in the articles by Chandrasekharaiah (1998) and Hetnarski and Ignaczak (1999, 2000).

A new thermoelastic theory without energy dissipation has been proposed by Green and Naghdi (1993). This thermomechanical theory of deformable media introduces the so-called thermal displacement relating the common temperature and uses a general entropy balance as postulated in Green and Naghdi (1977). By the procedure of Green and Naghdi (1995), the reduced energy equation is regarded as an identity for all thermodynamical processes and places some restrictions on the functional forms of the dependent constitutive variables. The theory is illustrated in detail in the context of flow of heat in a rigid solid, with particular reference to the propagation of thermal waves at finite speed. The linearized formulation allows the transmission of heat flow as thermal waves at finite speed and the evolution equations are fully hyperbolic.

The linear theory of thermoelasticity without energy dissipation for homogeneous and isotropic materials was employed by Nappa (1998) and Quintanilla (1999) in order to obtain spatial energy bounds and decay estimates for the transient solutions in connection with the problem in which a thermoelastic body is deformed subject to boundary and initial data and body supplies having a compact support, provided positive definiteness assumptions are supposed upon the constitutive coe±cients. Moreover, we have to mention that Chandrasekharaiah (1996) proves uniqueness of solutions, Iesan (1998) establishes continuous dependence results, while Quintanilla (2002) studies the question of existence. Further results of structural stability and decay type are given by Quintanilla (2001, 2003). Quintanilla and Straughan (2000) used logarithmic convexity and Lagrange identity arguments to yield uniqueness and growth without requiring sign definiteness of the constitutive coefficients, while Quintanilla and Straughan (2005) derive energy bounds for a class of non-standard problems in which the initial data are given as a combination of data at initial time and at a later time.

In the present lecture we address the question of spatial behaviour of the harmonic vibrations and transient solutions in an anisotropic elastic cylinder under the condition of strong ellipticity for the elasticity tensor. In this respect, for vibrations in the low frequency range, our expected results describe exponential spatial estimates similar with those previously established by Flavin et al. (1987; 1990). Moreover, for harmonic vibrations with appropriate high frequencies, the present results predict some algebraic spatial estimates, con?rming the foregoing observations made by Boley in related context. In fact, we consider a prismatic cylinder occupied by an anisotropic linear elastic material and subjected to zero body force and zero lateral boundary data and zero initial conditions. The motion is induced by a harmonic time{dependent displacement speci?ed pointwise over the base and the other end is subjected to zero displacement (when a cylinder of finite extent is considered, to say). The elasticity tensor is assumed to be strongly elliptic and so a very large class of anisotropic elastic materials is considered, including those new materials with extreme and unusual physical properties like negative Poisson's ratio (that is, so called auxetic materials).
We also address the study of the spatial behaviour of the transient and harmonic in time solutions for the initial and boundary value problems associated with the linear thermoelasticity theory without dissipation energy for anisotropic materials. We derive some differential inequalities for certain cross- sectional integrals and integration leads to estimates describing how these integrals evolve with respect to the axial variable. The methods employed, whose antecedent is the technique developed by Flavin et al. (1990) for the classical elastic problem and later developed Chirita and Quintanilla (1996) and Chirita and Ciarletta (1999) (for dynamic problems) and Chirita (1995) (for steady state solutions), establishes differential inequalities for the selected measures which after integration provides estimates for spatial evolution, provided the strong ellipticity of the constitutive coefficients is assumed. However, here we use an idea developed by Chirita (2007) for linear thermoelasticity of anisotropic materials with a strong elliptic elasticity tensor.
We examine how the amplitude of the harmonic vibration evolves with respect to the axial variable. To this end we associate with the amplitude of the harmonic vibration in concern, an appropriate cross{sectional integral function and further we prove that the strong ellipticity conditions assure that it is an acceptable measure. This is possible thanks to some appropriate auxiliary identities relating the amplitude of the harmonic vibrations. For these measures we are able to establish some differential inequalities whose integration allows us to obtain spatial estimates describing the spatial behavior of the amplitude in concern. In fact, when an identity of conservation energy type is used then certain exponential spatial estimates are obtained for all frequencies lower than a critical value. When a Rellich identity is involved then certain type of algebraic spatial estimates are established for appropriate high frequencies. All results are illustrated for transversely isotropic materials as well as for the rhombic systems.
A description is also given for viscoelastic cylinders, where the existence of the dissipation energy assures the information upon the spatial behaviour of the harmonic vibrations, without any restrictions upon the relaxation tensor.
Our contribution lecture gives a complete discussion about the state of art in the literature of spatial behaviour of the transient and the harmonic in time solutions based upon the recent results obtained by the author and his collaborators and the articles in the field of research on the subject in concern.

Brief Biography of the Speaker: Stan Chirita was born on 21th October 1949 in Vizireni, Buzau District, Romania. He graduated in 1972 from Department of Mathematics at the Al.I. Cuza University of Iasi, Romania. In 1977 he received the Doctor degree in mathematics from Al. I. Cuza University of Iasi with a thesis on the linear problems of the nonlocal theory of elasticity. In 1987 he was awarded with the Gheorghe Lazar Prize by the Romanian Academy for research results on the nonlinear problems of continuum mechanics. He published over 100 articles on the following fields of research: elasticity, thermoelasticity, viscoelasticity, Navier-Stokes fluids, generalized models of continuum media, generalized theories of thermoelasticity, non-simple materials.
He was invited as Visiting Professor by the following universities: University of Naples, University of Bologna, University of Salerno and University of Catania from Italy, University of Plymouth from England, University of Barcelona from Spain, Ecole Centrale de Lyon from France.
In the theory of elasticity he obtained results on the following topics: spatial behaviour, Saint-Venant principle, Saint-Venant problem, Deformation of noncylindrical beams, Holder continuous dependence, Thermal stresses. In the field of the classical thermoelasticity I studied the following topics: uniqueness and continuous data dependence problems, asymptotic partition of energy, spatial behaviour, backward in time thermoelasticity, Holder stability, plate theory. In the field of materials with memory I studied the following topics: uniqueness and continuous data dependence, deformation of vicoelastic cylinders, Saint—Venant principle, spatial behaviour, reciprocal relations, thermoviscoelasticity, Reissner—Mindlin type viscoelastic plate, thermodynamics of materials with heat conduction and viscosity. In the field of fluids I studied the following topics: spatial behaviour in time—dependent Stokes slow flow, uniqueness and continuous dependence problems for incompressible micropolar flows forward and backward in time. In the field of the generalized models of solids I studied the following topics: nonlocal elasticity, micropolar elasticity, materials with microstructure, materials with voids, theory of mixtures. The following generalized theories of classical thermoelasticity are studied: the Green—Lindsay theory of thermoelasticity, the theory of thermoelasticity with one relaxation time, the linear thermoelasticity with memory for heat flux.

Plenary Lecture 5

Recent Challenges in Turbulence: Computational Features of Turbulent Mixing

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Abstract: Nowadays, computational fluid dynamics (CFD) becomes more and more mature. In the same time, it becomes more and more difficult to contribute fundamental research to it. The fact that commercial CFD software is a success is proof of the practical importance of the theoretical fluid-dynamics works since Euler. The growing availability of CFD software may seem to be a threat for CFD research. However, how CFD develops remain unpredictable, and it is part of what makes it an exciting and attractive discipline.

This paper aims to exhibit a synthesis of some recent works in CFD. It concerns the turbulence problem in mixing media. The mixing theory appears in an area with far from complete solving problems: the flow kinematics. Its methods and techniques developed the significant relation between turbulence and chaos. The turbulence is an important feature of dynamic systems with few freedom degrees, the so-called "far from equilibrium systems". These are widespread between the models of excitable media, and a recent goal is to find a consistent and coherent theory to stand up that a mixing model in excitable media leads to a far from equilibrium model.

Studying a mixing for a flow implies the analysis of successive stretching and folding phenomena for its particles, the influence of parameters and initial conditions. In the previous works [1,2,3,4,5], the study of the 3D non-periodic models exhibited a quite complicated behavior. In agreement with experiments, they involved some significant events - the so-called "rare events". The variation of parameters had a great influence on the length and surface deformations.

The experiments were realized with a special vortex installation [7], it was used a well-known aquatic algae as biologic material, and the water as basic fluid. It must be noticed that both the experimental an analytical analysis work for any biological material.

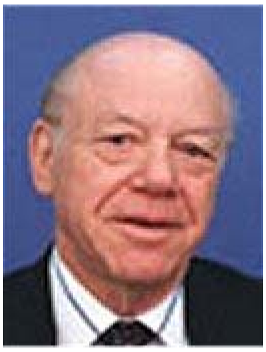
In the paper there are presented a qualitative synthesis analysis, with the corresponding graphical simulations, for the periodic (2D) and non-periodic (3D) flow case. It was used the numeric soft Maple11, with its powerful and fast analysis and numeric tools. The statistical cases are very few (especially in 3D case), and it is pointed out the "rare event" new concept.

Brief Biography of the Speaker: I am associate professor in the Department of Applied Sciences and Environment Protection at the Faculty of Engineering and Management of Technological Systems, University of Craiova, Romania. I received my PhD in Industrial Engineering, at the Department of Engineering of Biotechnical Systems of the Polytechnic University of Bucarest, Romania, where I spent an academic and research stage. My research interests include computational fluid dynamics, especially on the turbulent mixing area, and the interface between the fluid dynamics and computational tools, including adequate software tools. Also optimization methods in the differential equations modeling intelligent flows moving in an actuator, and the interface with magneto-hydro-dynamics are among my recent skills.

I am member of ESF (European Scientific Foundation) database, member of IAENG (International Association of Engineering), member of the Romanian Society of Biotechnology, member of the Romanian Association of Applied and Industrial Mathematics (ROMAI), and Associate Editor of IST Transactions (IST Press, Canada). I have published a monograph entitled "Informational Processing of Measuring Data". Some of my publications (about 30) have appeared in the journal "International Journal of Computing, Communications, Control".

Plenary Lecture 6

A Rational Integrated Approach to Designer Materials, Aerodynamics, Structural Control and Vehicle Performance: Analytical and Computational Issues



Professor Harry H. Hilton
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Abstract: Traditional protocols as well as past and current conventional wisdom dictate that structural members be analyzed and designed based on readily available “off the shelf” materials. Similarly, aerodynamic shapes are selected from catalogued airfoils and performance is placed on a “best can do” rational. Prescribed limitations, such as constraints on cost, weight, some dimensions, service performances, etc., then leave open only one or two dimensional adjustments for each structural member in order to attempt to satisfy the desired operational effects.
On the other hand, the Computational Structural/Solid Mechanics Group at NCSA/TRECC has developed a novel general analytical approach that is based on the calculus of variations, where material properties, morphed airfoil shapes and servo-controls are tailored/engineered to produce prescribed structural, aerodynamic, aeroelastic and aero-viscoelastic effects as well as flight performance. In essence, this replaces the present prevailing reliance on geometric sizing and supersedes it with optimal material and aerodynamic behavior for each structural element and aerodynamic shape.. Effectively, one does not set out to build a better mouse trap mechanism, but rather analytically determine optimal properties, which if manufactured will produce the “best” mouse trap.
The fundamental paradigm for flight and submarine light-weight structures is the pervasive requirements for analyses and designs that yield high-strength yet lightweight material construction and high lift/low drag devices with integrated with fluid/solid interactions. To that end, proper materials, analytical and computational tools and novel cost effective approaches must be initiated and utilized. Composites have found wide acceptance in fulfilling a significant number of these requirements and are being used to replace many traditional metal (aluminum, magnesium, titanium, etc.) structural components. However, they generally do not behave elastically but rather viscoelastically thus bringing into focus the additional time dimension; relaxation and creep properties and degradation of moduli and failure stresses with time. Ultimately, viscoelasticity introduces new phenomena, such as damping, creep and time dependent failure concepts leading to structural lifetime or survival time criteria as well as deformation induced alterations in aerodynamic responses.
The ultimate benefits stemming from analyses based on designer materials, aerodynamics and controls are that more efficient overall optimal systems can be realized in terms of overall material properties, sizing, performance, response to loads and temperatures, etc.
Of course, the as yet unexamined additionally needed new procedures for manufacturing structural materials to prescribed specifications based on their a priory mechanical properties require to be addressed separately by material scientists. If nothing else, at least new data bases of needed material properties can be established through computer simulations of the analytical results which will serve as guides to materials manufacturers as to what properties are desirable and needed. A parallel statement can be made for new airfoil geometries.

Brief Biography of the Speaker: BS 47 and MS 49 Aeronautical Eng. (compressible aerodynamics) New York U., Ph. D. Theoretical & Applied Mechanics (solid mechanics major with mathematics minor) 51 U of IL. At UIUC since 1949. Aeronautical & Astronautical Eng. department head 74 - 85, assistant dean of engineering sum-mers 1989 & 90. Charles E. Schmidt Distinguished Visiting Professor, Florida Atlantic U., 1997 – 2001, 2007. Fellow of the American Institute of Aeronautics and Astronautics (AIAA). External examiner Nanyang Technological University, Singapore.

Current member of the AIAA Structures Technical Committee, AIAA Advisory Committee on Web Development, AIAA Non-Deterministic Applications Technical Committee, ASME Random Structural Problems Committee, the ASTM Committee D-30 on Composite Materials and two scientific committees organizing international conferences. He is also chairs the AIAA Illinois Section and is a regional director for Sigma Gamma Tau, the national aerospace engineering honor society.
After his retirement in 1990, he has continued to be actively engaged in research, teaching, MS & PhD thesis advising and in public and professional service. He has published or had accepted for publication over 300 papers in archival journals or conference proceedings. His current active analytical & computational research areas are deterministic and stochastic linear and nonlinear viscoelasticity, composites, aeroviscoelasti city, aerodynamic noise, computational solid me¬chanics, structural control and probabilistic failure criteria and analysis, damping & nonlinear dynamics, linear & nonlinear anisotropic viscoelastic finite element analysis, optimum designer materials, piezoelectric, magnetic, and functionally graded viscoelastic materials, electronic packaging, nonlinear creep and delamination column & plate buckling, analytical determination of damping properties, material characterization, stochastic minimum structural weight analysis, probabilistic delamination of composites during service and manufacturing processes (cure), structural control and survivability, engineering education, and structural integrity of dentures.

Plenary Lecture 7

On Gradient Deformation and Flow Theories: From Macro and Meso Scales to Nano and Astro Scales

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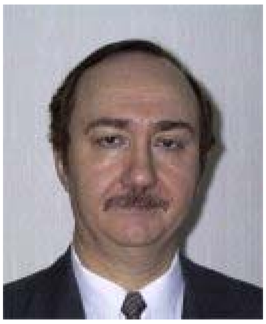
Abstract: Gradient theories for elasticity, plasticity and dislocation dynamics have been advanced by the author and his co-workers to address deformation and flow at various scales at macro, micro and nano regimes. It was shown that instabilities, pattern formation and size effects may be conveniently described, whereas classical continuum theories fail to do so. The theory is now extended to describe coupled physicochemical and electromagnetic processes under applied or internal stress across the scale spectrum within a multiphysics framework. A number of examples of interest to current technology, physical science and biology are discussed.

Brief Biography of the Speaker: E. C. Aifantis is a Professor of Mechanics at the Aristotle University of Thessaloniki, Hellas, and a Distinguished Research Professor of Engineering at Michigan Technological University, USA. For the last 10 years he has been coordinating a European Research/Training Network, sequence on Material Instabilities in Deformation and Fracture involving a number of leading European Laboratories (e.g. Cambridge, Delft and 5 more) with a total of about $5 million. Most recently a European Research Council (ERC) Starting Grant recipient (K. Aifantis) funded with 1.13 million Euros decided to conduct her research in his laboratory (Physics Today - April 2008 issue, pp. 30-31, BBC - http://news.bbc.co.uk/2/hi/science/nature/7264828.stm; Science Careers - http://sciencecareers.sciencemag.org). Moreover, two EU International Incoming Fellowships of 200 kEuros each were awarded (A. Romanov/Ioffe Physicotechnical Institute, Russia, and N. Kioussis/California State University, USA). He is also a co-PI of a NIRT NSF Program on Nanomechanics of Polymeric and Biological Nanofibers with a total budget exceeding $1 million. He has published over 450 papers, edited 12 books, organized numerous international conferences, and has been invited as keynote speaker on various occasions. He is an Editor of the Journal of Mechanical Behavior of Materials, Honorary Editor of Computer and Experimental Simulations in Engineering and Science, on the Advisory/Editorial board of Numerical and Analytical Methods in Geomechanics, Open Mechanics Journal, Journal of Nano Research, Acta Mechanica (formerly), Mechanics of Cohesive-Frictional Materials (formerly). In June 2005 in the joint ASME/ASCE/SES Mechanics and Materials Conference in Baton Rouge, a Symposium was held honoring his contributions in gradient theory, dislocation patterning and material instabilities.

Plenary Lecture 8

Parametric Excitation and Suppression of Oscillations at the Interfaces of Continua



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Abstract: Except theoretical interest, the problem is of paramount importance for practical applications in three different aspects. Parametric excitation of oscillations in continua serves for intensification of various technological and technical processes, e.g. heat and mass transfer, mixing, decreasing of viscosity and conductivity, improving a quality for crystallizating metal, etc. Second, excitation of parameter oscillations is used for disintegration of jet/film flows (spray-coating, metal spraying, granulation of materials, e.g. particles' producing from molten metals). And the third is opposite to the second one, suppression of oscillations for stabilization of unstable regimes/processes, for example, thermal, electromechanical and electrochemical, combustion, and so on. Moreover, sometimes parametric control leads to a process impossible without it.

Brief Biography of the Speaker: Ivan Kazachkov is a Mechanical Engineer. He earned his PhD (Candidate of Physical and Mathematical Sciences, 1981) and MSc (1976) at the National Taras Shevchenko University in the City of Kyiv in USSR. His Full Doctorship (1991) in Engineering Sciences he has got at the Institute of Physics of Riga, Latvian Academy of Sciences. Presently he is teaching at the National Technical University of Ukraine "KPI". He is also an Affiliated professor at the Royal Institute of Technology in Stockholm, where he has been teaching numerical methods and doing research in modeling of multiphase systems as visiting professor during the period of about ten years (since 1999 until 2004 permanently). His research activities include Parametric Control in Continua, Multiphase Flows, Controlled Film Flow Disintegration and Granulation of Metals for Space Industry, Modeling and Simulation. He has more than 200 publications in scientific journals and scientific conferences. He participates in European research programs and committees. Many PhD students are doing research under his supervision.

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