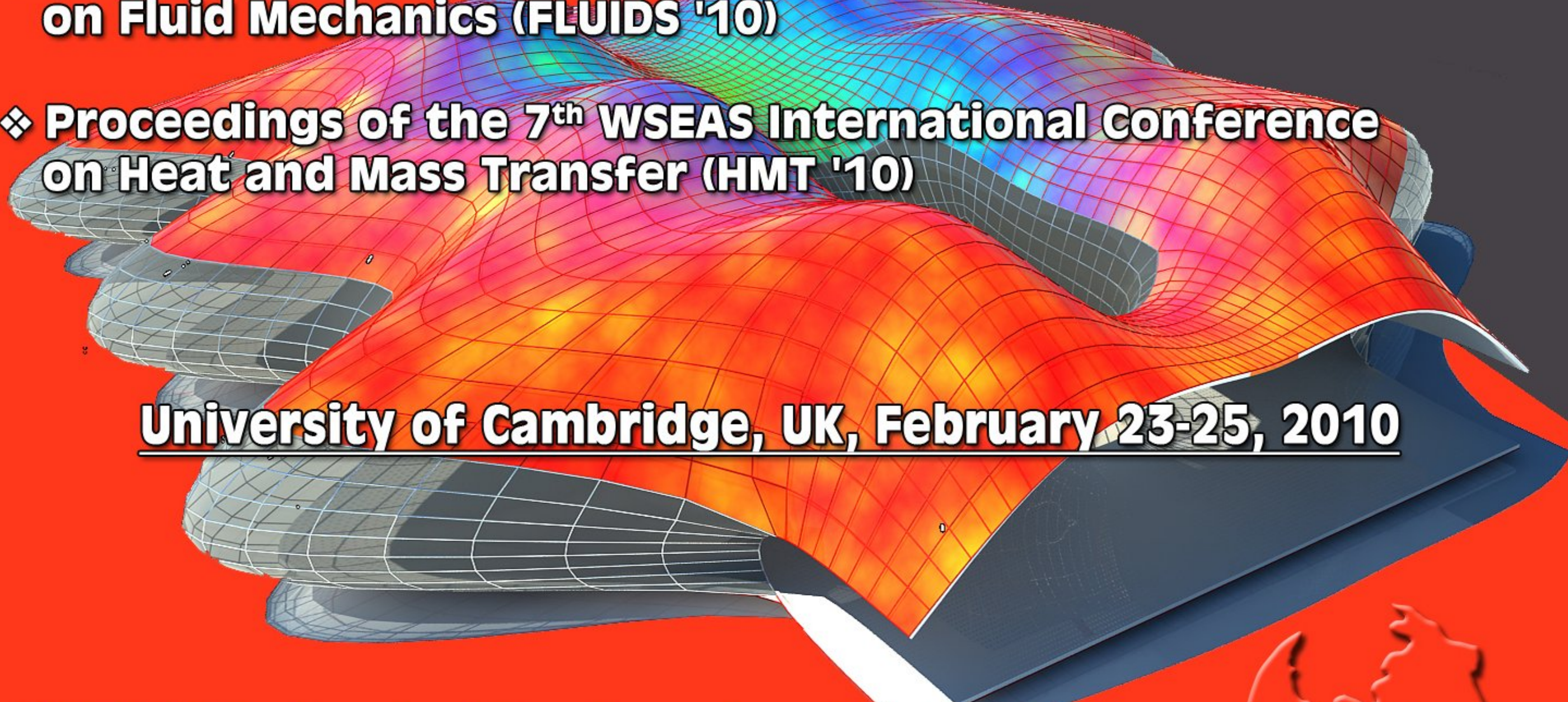
Editors:
Prof. Siavash H. Sohrab, Northwestern University, IL, USA
Prof. Haris J. Catrakis, University of California, CA, USA
Dr. Nikolai Kobasko, "IQ Technologies Inc", USA

Continuum Mechanics, Fluids, Heat

- Proceedings of the 5th IASME / WSEAS International Conference on Continuum Mechanics (CM '10)
- Proceedings of the 7th WSEAS International Conference on Fluid Mechanics (FLUIDS '10)
- Proceedings of the 7th WSEAS International Conference on Heat and Mass Transfer (HMT '10)



University of Cambridge, UK, February 23-25, 2010

Continuum Mechanics, Fluids, Heat

WSEAS Mechanical Engineering Series
A Series of Reference Books and Textbooks

ISBN: 978-960-474-158-8
ISSN: 1790-5095

Published by WSEAS Press
www.wseas.org

CONTINUUM MECHANICS, FLUIDS, HEAT

Proceedings of the 5th IASME / WSEAS International Conference on CONTINUUM MECHANICS (CM '10)
Proceedings of the 7th WSEAS International Conference on FLUID MECHANICS (FLUIDS '10)
Proceedings of the 7th WSEAS International Conference on HEAT and MASS TRANSFER (HMT '10)

University of Cambridge, UK
February 23-25, 2010

WSEAS Mechanical Engineering Series
A Series of Reference Books and Textbooks

Published by WSEAS Press
www.wseas.org

ISSN: 1790-5095
ISBN: 978-960-474-158-8

CONTINUUM MECHANICS, FLUIDS, HEAT

Proceedings of the 5th IASME / WSEAS International Conference on CONTINUUM MECHANICS (CM '10)
Proceedings of the 7th WSEAS International Conference on FLUID MECHANICS (FLUIDS '10)
Proceedings of the 7th WSEAS International Conference on HEAT and MASS TRANSFER (HMT '10)

University of Cambridge, UK
February 23-25, 2010

WSEAS Mechanical Engineering Series
A Series of Reference Books and Textbooks

Published by WSEAS Press
www.wseas.org

All papers of the present volume were peer reviewed by two independent reviewers. Acceptance was granted when both reviewers' recommendations were positive.
See also: http://www.worldses.org/review/index.html

ISSN: 1790-5095
ISBN: 978-960-474-158-8

World Scientific and Engineering Academy and Society

CONTINUUM MECHANICS, FLUIDS, HEAT

Proceedings of the 5th IASME / WSEAS International Conference on CONTINUUM MECHANICS (CM '10)
Proceedings of the 7th WSEAS International Conference on FLUID MECHANICS (FLUIDS '10)
Proceedings of the 7th WSEAS International Conference on HEAT and MASS TRANSFER (HMT '10)

University of Cambridge, UK
February 23-25, 2010

Michael Aronov, UNITED STATES
Mohammadmasoud Azhdari moghaddam, IRAN
Regita Bendikiene, LITHUANIA
Helmut Benigni, AUSTRIA
A. C. Benim, GERMANY
Friedrich-Karl Benra, GERMANY
Stasys Bockus, LITHUANIA
Hermenegildo Borges de Oliveira, PORTUGAL
Mircea Boscoianu, ROMANIA
Malek Bouhadef, ALGERIA
Andris Buikis, LATVIA
Adriana Catanase, ROMANIA
Costin Cepisca, ROMANIA
Claudia Cherubini, ITALY
Ashfaque Ahmed Chowdhury, AUSTRALIA
J. P. Curtis, UK
Farhang Daneshmand, IRAN
George Darie, ROMANIA
Konrad Domke POLAND
Michel El Hayek, LEBANON
Tayfour Elbashir, OMAN
Arpad Fay, HUNGARY
Petr Filip, CZECH REPUBLIC
Nicolas Galanis, CANADA
Sergey Gaponov, RUSSIA
Aitor J. Garrido, SPAIN
majid Ghassemi, IRAN
Yury Gogotsi, UNITED STATES
Jonas Gyly,USA
Vasileios Hamosfakidis, UNITED STATES
Assia Helali, FRANCE
Jun Huang, FINLAND
Dagmar Janacova, CZECH REPUBLIC
Mak Kai Long, HONG KONG S. A. R.
X.Kakatsios, GREECE
Bouhadef Khedidja, ALGERIA
Jaewon Kim, KOREA
Karel Kolomaznik, CZECH REPUBLIC
Pavel Kuibin, RUSSIA
Albert Kurbatskiy, RUSSIA
T.-W. Lee, UNITED STATES
V. C. Loukopoulos, GREECE
Fathi Mahfouz, EGYPT
D. S. Mathioulakis, GREECE
Mohamed Maidi, UNITED KINGDOM
Elena Martin, SPAIN
Sushanta K Mitra, INDIA
Dawid Myszka, POLAND
Santirat Nansaarng, THAILAND
Jiri Neustupa, CZECH REPUBLIC
Cong Tam Nguyen, CANADA
Guillermo Paniagua, BELGIUM
Thales Papazoglou, GREECE
Sophia Psychoudaki, GREECE
Yulia Peet, FRANCE
Guillaume Polidori, FRANCE
Jiri Pospisil, CZECH REPUBLIC
Thomas Prevenslik, GERMANY
Robert Pucher, AUSTRIA
Mohammad Rasul, AUSTRALIA
Mourad Rebay, FRANCE
Constantin Rotaru, ROMANIA
Gilles Roy, CANADA
Saeed-Reza Sabbagh-Yazdi, IRAN
M. Sakellariou-Makrantonaki, GREECE
Lamberto Tronchin, ITALY
Martin van den Toorn, THE NETHERLANDS
Heimo Walter, AUSTRIA
Ying Wang, CHINA
Dirk Weltersbach, GERMANY
Henning Zindler, GERMANY

Preface

This year the 5th IASME / WSEAS International Conference on CONTINUUM MECHANICS (CM '10), the 7th WSEAS International Conference on FLUID MECHANICS (FLUIDS '10) and the 7th WSEAS International Conference on HEAT and MASS TRANSFER (HMT '10) were held at the University of Cambridge, UK, February 23-25, 2010. The conferences remain faithful to their original idea of providing a platform to discuss solid mechanics, fluid mechanics, gas mechanics, hydraulics, heat and mass transfer, air pollution problems, mathematical models in continuum mechanics, experimental techniques in continuum mechanics, hydrotechnology, turbomachinery, propulsion systems, meteorology, water resources management, thermal engineering, turbomachinery, geoscience, solar energy, clean technologies, applications of thermal science in astronomy and space science, urban areas and heat pollution 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 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.

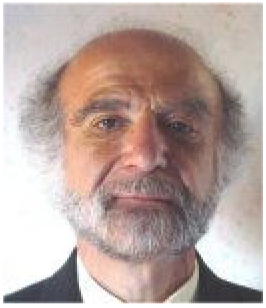
Conferences such as these can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors

Table of Contents

Plenary Lecture 1

Hamiltonian Formalisms Applied to Continuum Mechanics Potential Use for Fracture Mechanics



Professor Naman Recho
ERMESS/ EPF-Ecoles d'Ingenieurs, Sceaux and
LaMI, University Blaise Pascal, Clermont II
France
E-mail: naman.recho@epf.fr

Abstract: The first part of this paper deals with several Hamiltonian formalisms in elasticity. We first present briefly the formalisms of Zhong and Bui, (Bui, [1]; Zhong, [2]), which resolve respectively the two-end problem and the Cauchy problem in elasticity. Then we propose a new Hamiltonian formalism, which resolves simultaneously the two problems mentioned above and it shows the link between the two formalisms. The potential use for fracture mechanics purposes is then mentioned. In fact, when traditional theories in fracture mechanics are used, asymptotic analyses are often carried out by using high-order differential equations governing the stress field near the crack tip. The solution of the high-order differential equations becomes difficult when one deals with anisotropic or multiplayer media etc. The key of our idea is to introduce the Hamiltonian system, usually studied in rational mechanics, into continuum mechanics also, one can obtain a system of first-order differential equations, instead of the high-order differential equation. This method is very efficient and quite simple to obtain solution of the governing equations of this class of problems. It allows dealing with large range of problems, which may be difficult to resolve by using traditional methods.
By using this approach, we have resolved various problems. Some of them have been solved previously and some not yet. We see that the present method is particularly efficient for resolving multi-material problems. So the multi-material problem can be resolved as a single material problem through the construction of a transfer matrix.
We believe that a large domain can be found in applying this new approach into fracture mechanics.

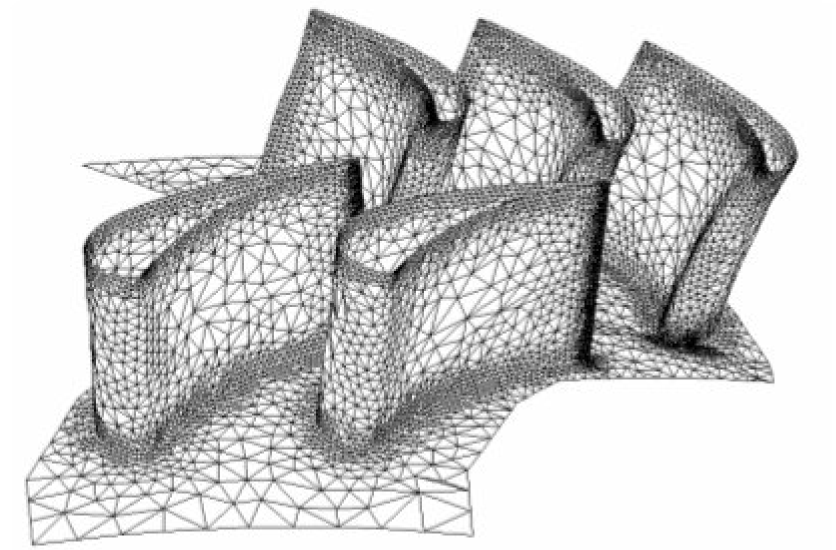
Brief Biography of the Speaker:
Naman Recho is a Professor at the University Blaise Pascal in Clermont Ferrand, France, he is also head of ERMESS- Research laboratory (Equipe de Recherche en Mecanique et Securite des Structures) at EPF Engineering school in Sceaux, France.
He has worked extensively with conceptual and applied aspects of fracture mechanics, with welded offshore structures and reliability analysis of cracked structures. He also teaches at Centre des Hautes Etudes de la Construction, Paris, and is guest Professor at Hefei University of Technology in China.
Professor Naman Recho was educated at the French University of Pierre and Marie Curie in Paris. He graduated in this university as Doctor Engineer in 1980 and "Docteur d'Etat Es-Sciences Physiques" in 1987. He is full Professor since 1988. He is delegate (Delegation CNRS) at National Centre of Scientific Research in Paris 2005-2007 and has written three textbooks within Fracture Mechanics and Fatigue Analysis.
In the recent 10 years, he directed more than 15 theses dealing with fracture mechanics and fatigue design of welded joints and participated into several research programs with industries.

Plenary Lecture 2

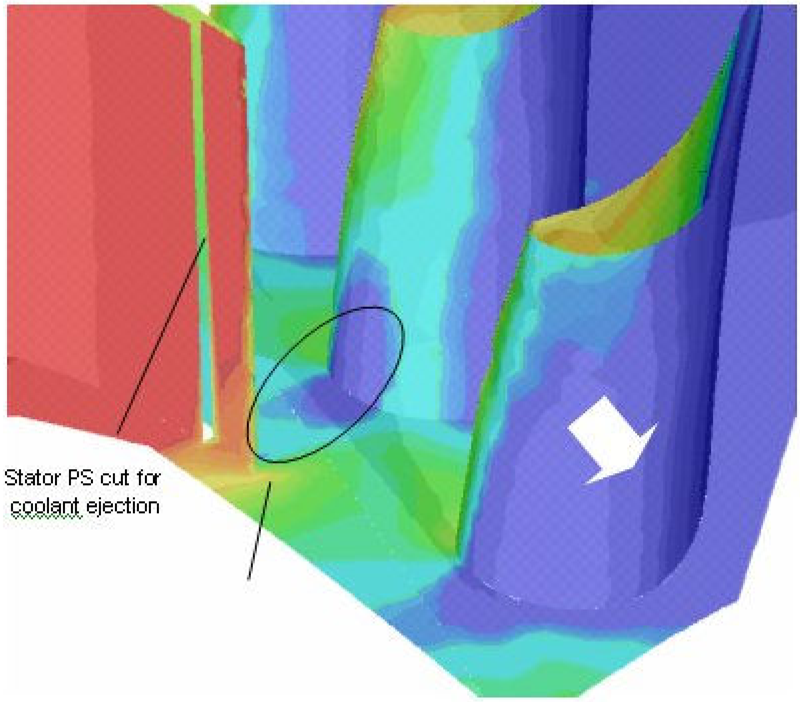
Unsteady Flow Simulation In Turbomachinery
A Numerical Challenge

Professor Francesco Martelli
Energetics Dept. "S. Stecco" - University of Florence
Firenze - Italy
E-mail: francesco.martelli@unifi.it

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

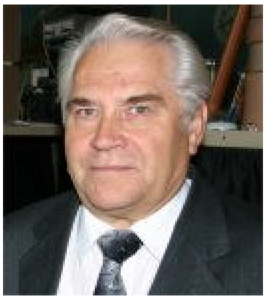


3D wall pressure pattern

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 3

Adequate Modeling of Fluid Flows



Professor Yuli D. Chashechkin
Laboratory of Fluid Mechanics
Institute for Problems in Mechanics of the
Russian Academy of Science
101/1 prospect Vernadskogo, Moscow, 119526 RUSSIAN FEDERATION
E-mail: chakin@ipmnet.ru

Abstract: For definition of adequate analytical and laboratory modeling of fluid flows conditions the conventional fundamental governing equations set is analyzed thoroughly. The basic equation in this approach is a state equation defining a number of thermodynamic variables which are necessary to characterize properties of particular medium and flow conditions. The total fundamental set of governing equations consisting of state, continuity and transport of momentum, temperature and constituent component equations is treated as singular disturbed system. Dissipative properties of the fluid are characterized by kinematic viscosity, temperature and diffusivity coefficients of constituent. General solutions of the linearized governing equations sets consist of regular and singular disturbed on dissipative factors functions. All flow components are characterized by their scales. Regular disturbed solutions (redics) of the set describe waves and vortices. Rate of their dissipation is proportional to viscosity and other kinetic coefficients. In limiting case redics are matched continuously with solutions of appropriate Euler equations set. Rich family of singular disturbed functions (sidics) describes fine flow components. Sidics transverse length scales are defined by dissipative factors and intrinsic frequencies of the problem that are by frequency of buoyancy (or rotation) in stratified (or vortex) flows. Besides boundaries the fine flow components manifest themselves inside the fluids as interfaces. The sidics are responsible for energy dissipation, production and transport of vorticity and anisotropic transport of contaminants. In general non-linear description all flow components interact between themselves directly in spite of the scales differences. Illustrative experimental investigations of 2D and 3D periodic internal wave beams, lee waves and wakes past uniformly moving obstacles in a continuously stratified fluid were performed in laboratory tanks using markers, schlieren instruments and conductivity sensors. Restructuring of interfaces and their transformation into vortices and vortex systems were registered far from the solid boundaries directly inside the continuously stratified fluid. New structural elements that are "tubular structures" were visualized in the periodic internal wave beams. Extended singular components accumulate contaminants and provide their fast transport. Strong anisotropy of a dye transport in a stationary compound vortex motion produced by uniformly rotating disc in cylindrical container was observed. Spiral arm was spinning from a dye drop put into center of surface trough produced by compound vortex. Set of all flow scales ratios form conditions of adequate laboratory modeling. Extrapolation of model data on environmental and technical conditions is discussed.

Brief Biography of the Speaker:
Yuli D. Chashechkin is head of the Laboratory of Fluid Mechanics of the A.Yu.Ishlinski Institute for Problems in Mechanics of the Russian Academy of Sciences and professor of Physical Faculty of M.V.Lomonosov Moscow State University. His main research interests concern foundations of fluid mechanics, theory of stratified and rotating flows, optical visualization of fluid flows. In these fields, he authored or co-authored over 200 scientific papers published in reviewed journals or presented at international conferences. Well known his schlieren images of internal waves, convective flows, vortices and wakes. As invited research professor he visited and worked in a number of Western and Eastern Universities including Arizona State University (USA), Ecole Normale Superior (Paris, France), The Tokyo University (Japan), University Toulon-Sud (France), University Polytechnic Catalonia (Barcelona, Spain) and others. He took part in a number of national and international marine cruises for studying marine turbulence, fine structure and internal waves. He is European regional editor of Journal of Visualization, organizers of biannual conferences on Fluxes and Structures in Fluids and co-editor of their Selected Papers Volumes.

Plenary Lecture 4

Continuum Versus Quantum Fields Viewed Through a Scale Invariant Model of Statistical Mechanics

Professor Siavash H. Sohrab
Robert McCormick School of Engineering and Applied Science
Department of Mechanical Engineering
Northwestern University, Evanston, Illinois 60208
USA
E-mail: s-sohrab@northwestern.edu

Abstract: The scale invariant forms of the conservation equations will be applied to show that in the absence of convection the velocity field will be governed by non-homogenous diffusion equation similar to the density, the temperature, the pressure, and the vorticity fields. The similarities and the underlying connections between physical phenomena at various scales associated with geometric optics (Hamilton-Jacobi equation), electrodynamics (Schrodinger equation), statistical mechanics (Boltzmann equation), and hydrodynamics (Bernoulli equation) will be explored. In particular, the physical basis of quantum mechanics and the associated double-slit and the EPR problems will be addressed on the basis of a scale invariant description of Heisenberg matrix mechanics and Schrodinger equation. Furthermore, the nature of the connections between quantum versus continuum fields will be explored and its impact on the success of Fourier representation of generalized functions will be discussed. Finally, some of the implications of a scale-invariant model of statistical mechanics to the physical foundation of analysis, non-Euclidean geometry, and prime number theory will be addressed.

Brief Biography of the Speaker:
Siavash H. Sohrab received his PhD in Engineering Physics in 1981 from University of California, San Diego, his MS degree in Mechanical Engineering from San Jose State University in 1975, and his BS degree in Mechanical Engineering from the University of California, Davis in 1973. He then joined Northwestern University in 1982 as postdoctoral research assistant and became Visiting Assistant Professor in 1983, Assistant Professor of Mechanical Engineering in 1984, and since 1990 he is Associate Professor of Mechanical Engineering at the Northwestern University. From 1975-1978 he worked as a scientist doing research on fire protection and turbulent combustion at NASA Ames research center in California. His research interests have been on combustion, fluid dynamics, thermodynamics, and statistical and quantum mechanics.

ISSN: 1790-5095

ISBN: 978-960-474-158-8

Plenary Lecture 5

Advances on Characteristics Changing and Working State Degrading of Passive Vibroisolation Elements

Dr. Silviu Nastac
Research Center for Mechanics of Machines and Technological Equipments
University "Dunarea de Jos" of Galati
Calea Calarasilor 29, 810017, Braila
Romania
E-mail: snastac@ugal.ro

Abstract: This paper presents some special aspects regarding changing and degrading phenomenon of theoretical characteristics for vibroisolation elements during the exploitation. The approaches are based on the internal thermodynamic phenomenon developed into the rubber elements subjected with the various and intensive dynamic charges. The influences are involved about both the static and dynamic characteristics, and consist of rigidity and damping parameters variation.
The main area of this study is framed by the passive isolation against shocks and vibration, due to the different technological equipments, of the sensitive embedded systems. Most of these isolation devices and systems are based on rubber elements and in some exploitation cases it was remarked an unusual behavior or an untimely evolution to a final damaged state.
The analysis is based on the large sets of virtual and instrumental tests, performed for different types of vibroisolation elements, with various structural and functional configurations. All of these was developed supposing the basic compressing and torsion rubber elastic elements, their working principle, and their functional restraints.
Through the comparative analysis of the acquired results, with the computational dynamics simulation, it was developed a few theoretical and operational models. Besides of the thermodynamics phenomenon, that are happen into the isolator, it was supposed the non-linear effects of damping and of rigidity that are usual characteristics of a real elements behavior. The reduction of transient states and decreasing the magnitude of permanent oscillations for specific parameters (like rigidity, damping, natural frequency, etc) around their reference value was the major and permanent purposes of this study.
The main concluding remark denotes the differences between simple theoretical models results and the real elements evolution under the charges. Because of the shifting and modification of the static and dynamic characteristics, the final evolution of the isolator may acquire unbalanced values for specific parameters. As a function of concrete and practical application of these rubber isolators it has to take into consideration the qualitative and quantitative deviation to the theoretical characteristics for a proper evolution such as it was imposed by the initial working conditions.

Brief Biography of the Speaker:
Silviu Nastac (born in 1971) received the PhD degree in Mechanical Engineering from University "Dunarea de Jos" of Galati, Romania, in 2006. He obtained a Master degree's in Computational Mechanics in 1997 and in Mechanics of Deformable Solids in 2004, at the same University. Since 1997 he is a senior research scientist at the Research Center for Mechanics of Machines and Technological Equipments, at Engineering Faculty in Braila, University "Dunarea de Jos" of Galati, Romania. He is a winner of the prize AROTEM of Romanian Association for Construction Technologies, Equipments and Mechanization in 2006. His main research topics include the theory of mechanics, dynamics, vibrations, acoustics, modelling and simulation of dynamic phenomenon, and virtual instrumentation. His work has been published in numerous referee journals, international conferences and several books. He has led and was involved in various research projects and has a plenary lecture at WSEAS Intl. Conf. Recent Advances in Automation & Information 2009. He was proposed and chair a structured session at Intl. Vilnius Conference on Sustainable Development in 2009. He is a member of International Institute of Acoustics and Vibration, International Association of Engineers, Romanian Society of Acoustics, Romanian Society for Theoretical and Applied Mechanics, and he is managing editor, associate editor and reviewer for national and international journals and conferences.

Plenary Lecture 6

Special and Unusual Aspects Regarding Real Scale Impact Testing Methods for Large Beams

Dr. Carmen Debeleac
Research Center for Mechanics of Machines and Technological Equipments
University "Dunarea de Jos" of Galati
Calea Calarasilor 29, 810017, Braila, Romania
E-mail: cbordea@ugal.ro

Abstract: The study deal with some particular aspects connected to the impact testing methods on real scale intended for instrumental dynamic analysis of large beams. Large beams for viaducts, bridges and other special construction applications necessitate a strictly analysis of transient states when are subjected both to regular and to fortuitous dynamic charges. Experimental tests of these elements are developed both in special setup places – for a singular element, and "in situ" – for the serviceable montage. The most usual way to give it a try of these beams with impulsive loads for real scale experiments is to use a special truck that passed over the transversal obstacles with known characteristics and installed directly upon the rolling way. In this case the instrumental data have to be complete by theoretical study that validate and give it a final confirmation of the qualitative and quantitative results.
The impulsive charge result as a function of the singular obstacle shape, dimensions and material characteristics, and of the number, characteristics and geometrical configuration and distribution of tires. This real scale impact test configuration has the main advantage of a great similarity with the transient charges that will happen in the future exploitation, and the experimental results produce a most realistic characteristic of beams. But, it required a very fine tuning between the obstacles setup montage with the truck movement parameters and the tires characteristics, so that the impact shock has both the necessary energy, and the suiting spectral distribution.
The author develops an analytic method useful in virtual simulation of these complex phenomenon and try to dignify the next major aspects: denote leading parameters of the process, order in a systematic manner the whole parameters that have influences, more or less, in the tire – obstacle – road interactions, put into the evidence the transient behavior of the large beams subjected to an intensive and various impulsive charges with direct relevance in power spectral distribution, and try to establish the right number of traducers and their spatial distribution (based on the optimum ratio between the instrumental requirements and the results accuracy). Also, it was made a computational dynamics study based on the classical wave equation with the final scope of marking out the longitudinal and transversal propagation phenomenon and their interferences.
A few partial concluding remarks are: the special aspects regarding this study results from the great number of parameters and the complexity of their relationships, the unusual aspects was dignified by the comparison between the experimental data and the computational models, the complexity and the difficulties of tuning do not recommend this method for ordinary tests, but the realistic manner of action and the final results accuracy propose it for each case.

Brief Biography of the Speaker:
Carmen Debeleac (born in 1972) received the PhD degree in Mechanical Engineering from University "Dunarea de Jos" of Galati, Romania, in 2006. She obtained a Master degree in Mechanics - Dynamics of Construction Equipments, in 2002, at the same University, and a Senior Manager degree for Scientific Research Projects at "Politehnica" University - AMCSIT Center, Bucharest, Romania, in 2006. Since 1997 she is a senior research scientist at the Research Center for Mechanics of Machines and Technological Equipments, at Engineering Faculty in Braila, University "Dunarea de Jos" of Galati, Romania. She is author of numerous research articles in referee journals and international conferences, covering theory of mechanics, dynamics of construction equipments, vibrations, modelling and simulation of dynamic phenomenon, technologies for construction equipments, and is co-author of the book (with G. Axinti, N. Dragan) Analytic Mechanics with Applications. She has led and was involved in various research projects and has a plenary lecture at WSEAS Intl. Conf. Recent Advances in Automation & Information 2009. She is a member of International Association of Engineers, Romanian Society for Theoretical and Applied Mechanics, Romanian Society of Acoustics, Romanian Association for Construction Technologies, Equipments and Mechanization, and she is managing editor, associate editor and reviewer for national and international journals and conferences.

Authors Index