



UNIVERSITY OF NIŠ

The scientific journal FACTA UNIVERSITATIS

Series: **Mechanics, Automatic Control and Robotics** Vol.2, No 8, 1998 pp. 801 - 805

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## CONTEMPORARY PROBLEMS OF MECHANICS VIEWED THROUGH THE 5<sup>TH</sup> GREEK NATIONAL CONGRESS ON MECHANICS

UDC: 531

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**Abstract.** *A view of contemporary problems on Mechanics through the paper presented on the 5<sup>th</sup> Greek National Congress on Mechanics is given. The analysis is primarily based on the invited papers because they should present "the state of art" in a given area. A short report on the Congress organization is also given.*

### 1. INTRODUCTION

The 5<sup>th</sup> Greek National Congress on Mechanics was held at the University of Ioannina in Greece from the 27 to 30 of August 1998. Congress was organized by the Hellenic Society for Theoretical and Applied Mechanics (HSTAM), a member of IUTAM, founded 1978. Congress general chairman was Christos V. Massalas, rector of the University of Ioannina, and the organizing committee was formed by the representatives from the best known Greek universities (university of Patras, Athens, Ioannina, Thessaloniki, ...) and Academy of Athens, whose main subject of interest was Mechanics. The scientific sponsor of the Congress was HSTAM and besides the universities of Ioannina, Patras, Athens and Chaina, Congress was sponsored by the General Secretariat of Research and Technology, Ministry of Culture, Technical Chambre of Greece and several companies, like System Informatics, Epsilon Software and so on.

Although organized as a national congress and attended mainly by Greek scientists, a large number of contributions from all of the world were presented: USA, Yugoslavia, France, England, Canada, Ukraine, Bulgaria, Sweden, Russia, Germany, Kuwait, Poland, Ireland, Netherlands and Israel. The most of foreign presentation came from USA, having a common characteristics of joint research programs between USA and Greek universities. The similar situation was with the paper from Germany and England while the contributions from Yugoslavia were mainly done by Yugoslav authors only. The

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Received September 10, 1998

social part of Congress was conducted in an excelant way.

## 2. CONTEMPORARY PROBLEMS ON MECHANICS

As it is usually for this type of congresses a broad range of topics was covered. The program contained following sections: Special Topics on Mechanics, Non-Smooth Mechanics, Scattering Theory and Elasticity, Non-Linear Problems, Beams, Plates and Shells, Numerical Method in Solids, Composite Materials and Structures, Mixtures, Fluid Mechanics, Numerical Methods in Fluids, Micromechanics, Structural Analysis and Design, Biomechanics, Stability of Systems, Fracture Mechanics, Numerical Methods for Evaluation PDEs, Thermal Effects, Vibrations and Waves and Boundary Element Method.

To give a good analysis of presented papers and point out the best contributions, it would be necessary to have an expert for each topic. One other approach could be to give a presentation of invited papers because they should be the "State of Art" in a given area. Almost all sections had an invited paper, so all topics were practically covered.

The Congress started with Plenary section, Special Topics on Mechanics, with three presentations and then at the beginning of almost all of the sections an invited lecture was presented as follows:

**M. Hayes**, University College Dublin, Ireland, gave a presentation on wave propagation in homogeneous anisotropic elastic materials. For homogeneous plane waves it is shown that the group velocity is normal to the slowness surface. The argument presented is valid whether or not there are internal constraints such as incompressibility. The Fedorov & Fedorov decomposition of the acoustical tensor valid for RTHC (orthorhombic, tetragonal, hexagonal, cubic) crystals is introduced and used to show how bounds may be obtained on the squared wave speeds. Inhomogeneous plane waves are also considered.

**F. P. J. Rinwott**, University of Toronto, Toronto, Canada, proposed a physical principle to describe the behavior of dissipative gyroscopic systems, based upon the tendency of the angular momenta with respect to the common mass centre of the individual gyros forming the system to strive for collinearity.

**B. Tabarrok**, University of Victoria, Canada, reviewed on the conservation properties in certain functionals in classical dynamics as well as the functional of higher order and several independent variables. These inherent properties are then generalized and used in finite element analysis to check the quality of computed solutions and to improve the mesh for more accurate solutions.

**Z. Naniewicz**, Warsaw University, Poland, discussed on the regularity of the nonlinear term in hemivariational inequalities considered on vector-valued Sobolev spaces. This term expresses the virtual work of the nonmonotone multivalued stress-strain or reaction-displacement law, which gives rise to the hemivariational inequality under consideration.

**G. Simites**, University of Cincinnati, U.S.A., gave a presentation about the problem of instability of imperfect, laminated, moderately thick, circular cylindrical shells under the action of individual and combined application of uniform axial compression and external lateral pressure. The analysis is based on nonlinear kinematics relations, where the effect of transverse shear deformation is taken into account. The buckling is assumed

to be elastic and the geometry to have initial geometric imperfections. A solution methodology has been developed and employed in generating results. The imperfection sensitivity is investigated. The results obtained indicate that geometric imperfections have small effect on the limit point load for moderately thick cylindrical shells. In addition, limited parametric studies have been made in order to assess the effect of length to radius ration, radius to thickness ration and stacking sequence on the critical loads.

**D. Weichert**, Institute of General Mechanics RWTH Aachen, Germany, presented numerical and experimental results on the geometrically and physically non linear dynamic response of metal plates to impulsive pressure loading. He also discussed the efficiency of alternative material models to represent correctly the measured vibrations of the investigated plates.

**S. Radev**, Bulgarian Academy of Sciences, Bulgaria, in a joint research with the scientist from the University of Provence – France, gave a presentation on the disintegration of an infinite axisymmetric viscous liquid column surrounded by a gaseous or viscous liquid medium, simulated numerically by using a streamfunction-vorticity formulation of the Navier-Stokes equations. Along one wavelength the evolution of the disturbances is followed from a given initial perturbation to the jet break-up. It is shown that initial cosinusoidal disturbance retains a similar form at the first stages of its evolution in time. Due to the appearance of multiple harmonics the surface profile is transformed to a cosinusoidal form, which contains a satellite drop attached to the main one. It is shown that the size of the satellite is strongly connected to the wavelength and that the amplification rate of the temporally growing disturbances is time dependent except for the initial time interval.

**M. Fremond**, Laboratoire des Materiaux et des Structures du Genie civil, France, showed on three examples that in three-dimensional solid mechanics the macroscopic power of the interior forces seems to have a very fixed even intangible expression what can be modified or adapt to the problem under consideration. The first example is devoted to microscopic movements which modify the macroscopic properties of materials. The second example deals with new materials of civil engineering made of a large number of long fibres buried in a solid. The last example is devoted to the old and complex problem on collisions of rigid bodies. The basic idea which is developed is that the system made of a point moving with respect to a rigid body is deformable since the distance of the point to the body changes.

**Ch. C. Chamis**, NASA Lewis Research Center, Cleveland, USA, described a computational simulation methodology for probabilistic design/analysis of engine blades. The methodology is demonstrated by applying it to rotating engine structural components subjected to cyclic mechanical and thermal loads. A unified multi-factor interaction model developed at NASA Lewis Research Center is used to account for the degradation of material properties caused by cyclic loads. Computational simulation of acoustic fatigue in composite blades is also described. Results show that fatigue of metal blades is ten times the number of cycles to initiate damage. Additionally, degradation of vibration frequencies and modes proved guidelines for configuring in-service health monitoring systems.

**K. Hedrih**, University of Niš, Yugoslavia, introduced the "support" vectors of the body mass linear moment as well as of the body mass inertia moment for the pole 0 and axis oriented by unit vector  $\vec{n}$ . Some knowledge about change (rate) in time and time derivatives of the body mass linear moment vectors and body mass inertia moment

vectors for the pole and axis for the different properties of the body dynamics are pointed out. By using mass moment vectors and their derivatives, the linear momentum and angular momentum of the rotor which rotates around one or two rotation axes are expressed simpler than the other ways.

**P. D. Spanos**, Rice University, Houston, USA, reviewed on recent developments in ARMA based simulation of random fields in conjunction with Monte Carlo studies of probabilistic mechanics problems. The presentation complemented some of the previous review articles and compared various simulation algorithms, assesses their relative computational efficiency and versatility. Univariate, uni-dimensional, Gaussian, and homogeneous fields for tutorial effectiveness are considered. Nevertheless, appropriate reference are included addressing the simulation of more general fields.

**G. Zloković**, Serbian Academy of Sciences and Arts, Yugoslavia, presented his novel concept of group supermatrices based on utilization of symmetry properties of a configuration in mechanics, with the object to derive mathematical description in the most reduced form and to construct the algorithms which bring the amount of numerical calculation to a minimum. The new method, called *the group supermatrix procedure*, provides maximum utilization of symmetry properties of the configuration, which is realized by a straightforward and uniform process. In comparison with conventional formulation, the group supermatrix procedure provides substantially shorter derivation and much simpler mathematical description, as well as drastically reduced amount of computation and need for memory space of the computer. The procedure is also extended for systems without symmetry properties, which is accomplished by symmetrization of the structure, i.e. by adding fictitious structural parts or removing existing ones, which is formulated by additional conditions at the borders of these parts.

### 3. CONCLUSION

The congress covered a broad range of topics giving a good insight in actual problems in Mechanics, not only in Greece but at the many research centers and universities all over the world. Both, the scientific and social programs were very well organized and it was a real pleasure to take part in such an event.

### APPENDIX

#### *Lectures and authors from Yugoslavia:*

P. V. Vukoslavčević i D. V. Petrović: *The probability density distribution of the vorticity vector field in the near wall region of turbulent boundary layer;*

D. Ivanović: *Magnetic induction influence on velocity field and separation point of MHD unsteady plane incompressible boundary layer on aerofoil;*

R. M. Bulatović and M. Kazić: *Some results on the stability of conservative gyroscopic systems;*

M. Kazić: *Potential energy of the nonconservative systems. Energy integral;*

N. Kazić: *On the steady-state of storage device with phase change material.*

*Sponsors of Yugoslav authors:*

Montenegro Academy of Sciences and Aluminijumski kombinat Podgorica and Yugoslav Federal Ministry for Development, Science and Environmental Protection.

*Sessions:*

Special Topics in Mechanics,  
Non-smooth Problems,  
Non-Linear Problems,  
Scattering theory and Elasticity,  
Beams, Plates and Shells,  
Numerical Methods in Solids,  
Composite Materials and Structures, Mixtures,  
Fluid Mechanics,  
Micromechanics,  
Structural Topics on Mechanics,  
Structural Analysis and Design;  
Biomechanics,  
Vibrations and waves,  
Fractures Mechanics,  
Thermal Effects,  
Stability of Systems  
Boundary Element Method  
Numerical Methods for Evolution PDE.

*Publications:*

- 5th National Congress on Mechanics - Congress Programm, University of Ioannina, 1998, pp. 31;
- 5th National Congress on Mechanics - Abstracts, University of Ioannina, 1998, pp. 132;
- 5th National Congress on Mechanics - Proceedings Vol. 1 and Vol. 2, edited by Academician P. S. Theocaris, Professors D. I. Fotiadis and C. V. Massalas, University of Ioannina, 1998, pp. 1149.

## **SAVREMENI PROBLEMI MEHANIKE KROZ PRIKAZ PETOG GRČKOG NACIONALNOG KONGRESA MEHANIKE**

**Petar V. Vukoslavčević**

*Savremeni problemi mehanike su istaknuti kroz prikaz predavanja i naučnih saopštenja učesnika Petg grčkog nacionalnog kongresa mehanike. Analiza se primarno bazira na radovima po pozivu jer oni predstavljaju "poslednju reč" u datoj oblasti. Kratak prikaz organizacije kongresa je takođe dat.*