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## A REVIEW OF THE THIRD INTERNATIONAL CONFERENCE ON NONLINEAR MECHANICS - ICNM-III

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**Abstract.** *The article provides the basic scientific-professional information about the organizer and the program of The Third International Conference on Nonlinear Mechanics - ICNM-III, August 17-20, 1998 at the Shanghai University, China, as well as about its participants. It also presents a review of the given General Lectures and the given short lectures during the Conference, as well as a survey of the directions of further research in the field of nonlinear mechanics.*

### 1. INTRODUCTION

*The Third International Conference on Nonlinear Mechanics* was held in the period August 17-20, 1998. in the Shanghai University, China. It was organized by the Shanghai University (and sponsored by Chinese Society of Theoretical and Applied Mechanics, Municipal Commission of Science and Technology of Shanghai, as well as by National Natural Science Foundation of China, K. C. Wong Education Fondation-Hong Kong, Shanghai Institute of Applied Mathematics and Mechanics, Shanghai Center for Nonlinear Sciences, Lanzhou University, Fundan University, Shanghai Jiaotong University, Tongji University, as well as by Journal "Applied Mathematics and Mechanics"). It is the most competent scientific conference in the field of nonlinear mechanics offering the highest and cognitive potentials in nonlinear mechanics.

Chairman of the Steering Committee was Prof. dr *Wei-Zang Chien*, President of Shanghai University. Vice-Chairmans of the Steering Committee were professors: *A. Jeffrey* (UK), *W. A. Nash* (USA), *V. V. Romyantsev* (Russia), *Hao-sheng Tan* (China) and *Feng-gan Zhuang* (China). Members of the Steering Committee were from U.S.A, Hong Kong, Canada, Australia, Ukraine, France, Japan, Germany, Poland, Holland, China, UK. Chairman of the Scientific Committee was Prof. dr *Tian-min Dai*, and Vice-Chairmans of

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the Scientific Committee were professors: *Chang-jun Cheng*, *Shi-qiang Dai* and *Quanshui Zheng*. Chairman of the Local Organizing Committee was professor *Zhe-wei Zhou*.

This specialized international conference gathered a big number of active and most competent researchers and scientists in the field from all over the world (Australia, Belgium, Canada, China, France, Germany, Poland, Hong Kong-China, Israel, Italy, Japan, Macau, Pakistan, Russia, UK, USA and Yugoslavia).

Twenty-four General Lectures were given with duration of 40 minutes each and 152 short lectures followed by discussions and active response of the participants resulting in the exchange of relevant scientific information, agreements and initiatives for joint research projects.

The Opening Ceremony was led by chairman of Local Organizing Committee, Professor *Zhou Zhe-wei* at Lecture Hall-Shanghai University. Opening Ceremony includes Opening Address by Chairman of Steering Committee professor *Chien Weizang*, Congratulatory Speech by Representative of Shanghai Municipal Government and Congratulatory Speech by Professor *Zhuang Feng-gan*, Chairman of Chinese Society of Theoretical and Applied Mechanics.

The Program of the Conference continued by three General Lectures:

**A. J. M. Spencer (UK):** *The Thermoelastic Springback Effect for Nonlinear Materials*. Springback is an effect that occurs in processing of fibre-reinforced plastic materials, and involves distortion of parts formed at high temperature when they are cooled to an ambient temperature. It is due to differential thermal contraction in highly anisotropic materials. For channel sections, which have single curvature, a simple analysis has been given previously for linearly thermoelastic and thermoviscoelastic materials. This analysis is extended to nonlinear thermoelastic and thermoviscoelastic deformations.

**T. Y. Wu (USA):** *Fully Nonlinear Water Waves*. An expository review is given on a theory of modeling fully nonlinear, fully dispersive, time-evolving, three-dimensional gravity-capillary waves on water of uniform depth. Its relationship with some existing models will be discussed for their differing purposes pertaining to different parametric regimes. Interesting phenomena in various cases will be illustrated by applications of the models with review and discussion of literature.

**Zhuang Feng-Gan (China):** *On High Order Accuracy Schemes and the Numerical Simulation of Some Complex Flows*. The paper-lecture gives two guiding principles in the set up of high order accuracy numerical schemes. Several numerical schemes of high order accuracy are then suggested. After a strict test for some typical shock problems, the schemes with or without modifications are applied to study the supersonic reacting mixing layer and illustrate supersonic swirl and shock waves in enhancing the mixing of two different gases.

Conference Program of the first working day continued by eight Parallel General Lectures:

**S. S. Antman (USA):** *The Crucial Role of Viscous Damping in Solid Mechanics*. This paper describes several problems of solid mechanics whose analysis depends crucially on the specific nature of viscous dissipative stresses. Purely longitudinal motions of a viscoelastic rod. Spatial motion of a viscoelastic rod. Shearing oscillations of a viscoelastic layer. Other nonconservative problems.

**Chen Zhi-Da (China):** *Nonlinear Contact Mechanics and Fracture of Plate under Impulsive Load.* Contact Problem is the most challenge and attractive part of mechanics since Hertz. As the contact interface, the pressure and contact area are unknown apriori, at the same time, there always occur large deformation and large local rotation at the contact points, the classical theory of linear elasticity can not solve the contact points. The paper-lecture, it is shown that in the case of large plastic deformation of a circular plate under impulsive load of a rigid ball, the non-Kirchhoff-Love plate theory of Prof. Chien, coupled with nonlinear contact mechanics should be used in solving the problem.

**A. D. Drozdov (Israel):** *Constitutive Models for the Nonlinear Viscoelastic Response of Solid Polymers with Mechanically Induced Material Clocks.* The paper-lecture presents a review of constitutive equations for the nonlinear viscoelastic response of solid polymers under isothermal loading with finite strains. It focuses on materials which do not possess the separability property.

**C. S. Man (USA):** *Material Tensors of Weakly-Textured Polycrystals.* Material tensors to polycrystalline aggregates should also manifest the influence of crystallographic texture on the material properties in question. In this paper we consider weakly-textured polycrystals and outline a procedure by which the quantitative effects of texture on material tensors can be delineated explicitly. This procedure is based physically on an assumption motivated by the general principles of material frame-influence and isotropy of space. It employs mathematical tools from the theory of group representations and theory of invariants.

**Henri Cabannes (France):** *Proof of the Conjecture on "Eternal" Positive Solutions for a Model of the Boltzmann Equation.* According to a classical conjecture, the only positive "eternal" solutions of the Boltzmann equation are the Maxwellian solutions. Author proves this conjecture in the case of a related equation, which is a semi-continuous model of the two-dimensional homogeneous Boltzmann equation.

**W. H. Hui (Hong-Kong):** *A Unified Coordinate System for Computing Discontinuous Flows.*

**Li Jia-chun and Xie Zheng-Tong (China):** *Subgrid Scale Model in Large Eddy Simulation.* The current paper-lecture presents an overview on the present state of the arts in LES of turbulence, especially with stress on subgrid scale models, which appear fundamental to LES. A new SGS model suggested by authors is proved superb to the previous ones when applied in the simulation of turbulence in and over canopy as illustration. LES will become a most promising approach for industry design and environmental prediction at the beginning of the next century while RANS and DNS remain complementary tools in the study of turbulence.

**K. (Stevanović) Hedrih (Yugoslavia):** *Vectorial Method of the Kinetic Parameter Analysis of the Rotor with Many Axes and Nonlinear Dynamics.* By using examples of the rotor system which rotates about two axes with section or without section, we build the vectorial method of the kinetic parameters analysis of the rotors with many axes. The vectors connected for the pole and the axis are used for the analysis of kinetic parameters, by the use of which the rotation properties of the mass configurations are interpreted introducing the mass moment vectors for the pole and the axis, as well as the kinematic vectors rotators. Expressions for the corresponding linear momentum and angular momentum, as well as their derivatives in time are derived. By these expressions vectorial equations of the rotor system dynamics are derived, as well as the expression for the kinetic pressures on the rotor system bearings.

By using vectorial equations, we composed two scalar differential equations of the heavy rotor system nonlinear dynamic. For the case when one rotation about axis is controlled by constant angular velocity the nonlinear dynamics of the rotation about other axis is studied. Nonlinear rotor system dynamics are presented by phase portrait in the phase plane, with trigger of the singularities, as well as with homoclinic orbits and homoclinic points of the nonstable type saddle. For the case rotor system dynamics under the action of the perturbed couple the sensitive dependence in the vicinity of the equilibrium nonstable position which corresponds to homoclinic point of the type nonstable saddle, the possibility of the chaotic character behavior is pointed out.

Next working days, the Programm of the Conference contained following sections: *Solid Mechanics, Fluid Mechanics, Nonlinear Dynamics, Mathematical Methods in Mechanics, Solid Mechanics.*

Last working day the Program of the Conference contained the following Parallel General Lectures:

**Yang Gui-Tong (China):** *Nonlinear Strain Waves in Solids.* The lecture presents some phenomena of nonlinear waves in solids. Several kinds of effects of nonlinear are reviewed.

**Zheng Quan-Shui and T. Chen (China):** *Invariance Shifts and Reduced Dependence in Electro-Magnetic Elastic Fibrous Materials with Defects.* In generalized plane electromagnetic elasticity involving a fibrous material with defects, the stress, electric displacement and magnetic induction states may be invariant upon some shifts, the invariance shifts, in the electromagnetic moduli. The present article derives the complete set of the invariance shifts. As an application of the invariance shifts, it is proved that the incremental moduli between the overall and the matrix ones for a multiphase composite with defects depend only on a reduced list of the moduli of the matrix and the inclusions.

**Liu Yan-Zhu and Chen Li-Qun (China):** *Nonlinear Problems in Spacecraft Attitude Dynamics.* This lecture presents a review of some nonlinear problems in spacecraft attitude dynamics. The results on attitude stability of multibody spacecraft, spacecraft with flexible bodies, and spacecraft containing liquid are summarized. The progress in studying bifurcations and chaos of spacecraft attitude motions is surveyed. Some promising directions for further research are proposed.

**Xu Jian-Xue (China):** *On the Nonlinear Parametric Excitation Problems in the Engineering.* In this lecture, the nonlinear parametric excitation problems of a one and a half degree of freedom system describing the dynamics problem of an electromagnetic mechanical coupled system, axial vibration of transformer during ampere-turn unbalance and others are studied, some special problems are presented.

Last working day the Program of the Conference contained the following General Lectures:

**R. Grimshaw (Australia):** *Internal Solitary Waves in the Atmosphere and Ocean.* Author gives a brief account of the basic theory of internal solitary waves with the emphasis on application to observations in the atmosphere and ocean. Starting with the equations of motion for an inviscid incompressible fluid, author indicates how various asymptotic models for weakly nonlinear long waves are derived, including the well-known Korteweg-de Vries equation. Author then describes the solitary wave solutions,

and relate their properties to observations. Various generalizations are considered which inter alia take into account the variable background environment.

**L Ting (USA):** *Notes on the Dynamics of Vortex Filaments and Their Core Structure.* Author give a brief of the asymptotic theory of slender vortex filaments with emphases on i) the choices of scalings and small parameters characterizing the physical problem; ii) the key steps in the formulation of the theory and iii) the assumptions and/or restrictions on the theory of Callegari and Ting (1978). Author present highlists of an extension of the 1978 asymptotic theory: the analyses for core structures with axial variation. Making use of the physical insight gained from the analysis, we present a new derivation of the evolution equations for the core structure. The one is simpler and straight forward and shows the physics clearly.

**A. Jaffrey (UK):** *Techniques for Studying Nonlinear Wave Equation.* This lecture reviews some of the mathematical techniques that can be used both for the determination of general properties of solutions of nonlinear wave equations and also for their explicit solution. Burgers equation without dissipation and a generalization. Shock solutions. Traveling wave solutions and solitons. Self-similar solutions and group theoretic methods. Reductive perturbation method and a generalization. Baclund transformations.

**Jan Rychlewski (Poland):** *Elastic Waves under an Unusual Anisotropy.*

**Zhou Heng (China):** *Why K-B Method in Nonlinear Mechanics Usually Does Not Yield Convergent Solution* (As See From its Application in the Theory of Hydrodynamic Stability). Krylov-Bogolubov method is one of the few general methods in nonlinear mechanics and is widely applied. However, it usually does not yield a convergent solution. Author will show why it is so by analyzing a prototype problem in its application in the theory of hydromagnetic stability. Ways of its improvements will also be given. The concept is equally applicable to other problems.

**V. V. Rumyantsev (Russia):** *On General Equations Analytical Dynamics.* The paper-lecture presents an introduction in the theory of the generalized Poincaré's and Chetayev's equations based on a closed system of infinitesimal operators. These equations include both the motion's equations in independent and dependent, holonomic and nonholonomic coordinates for holonomic mechanical systems with finitenumber of degree of freedom. In this sence the generalized Poincaré-Chetayev's equations are the general equations of analytical dynamics. Some examples are considered.

The participation on such a scientific conference offers an outstanding experiance and scientific satisfaction, providing grounds for the comparison of one's own scientific results with the results of other researchers and their evaluation, which is always an inspiration for new scientific projects. The attitudes of the colleagues shared on such occasions are also a unique scientific inspiration; on the other hand, new ideas ease and smooth the way for keeping up with the latest achievements in the field - nonlinear mechanics.

The organizers of the ICNM - III presented following publications: *Final Program and List of Participants*, pp. 27, and *Proceedings of the 3rd International Conference on Nonlinear Mechanics*, edited by Prof. dr Chien Wei-Zang, pp. 884 + 8+4.

The proceedings collects 176 papers accepted for the presentation on the *3rd International Conference on Nonlinear Mechanics*, which was held in Shanghai, a continuation of the two previous ICNMs held in 1985 and 1993. In the Preface of this proceedings Professor Chien Wei-Zang, Chairman of the Steering Committee wrote: "*Nonlinear mechanics is a subject of great importance in the development of science and*

*technology. The aim of the conference is to provide a forum to exhibit the progress in this field during the past five years and a place to further the interaction of modern mathematics and modern mechanics. Compared with the first two proceedings, this one shows more profound insight into the essentials of nonlinear mechanics. It is worthy mentioning that 24 renowned scholars will present a variety of significant topics in the area, which will certainly enlighten the meeting a great deal".*

In the same Preface Professor Chien Wei-Zang pointed out the following: "*This series of Conference have been concerned and supported by the specialists in nonlinear mechanics all over the world, in particular, the member of Steering Committee and Scientific Committee. All the participants knew that among them, Professor Guo Zhongheng played a crucial role in organizing the first two conferences. Unfortunately, on September 22, 1993, that is, less than one month after the ending of the ICNM-II, Professor Guo Zhongheng passed away. On this occasion, I would like to express my profound mourning for him. I believe that all of his friends and students will remember his remarkable contribution to nonlinear mechanics and to our Conferences, and also his perfect personality".*

#### REFERENCES

1. *Final Program and List of Participants*, Shanghai University Press, pp. 27.
2. *Proceedings of the 3rd International Conference on Nonlinear Mechanics*, edited by Prof. dr Chien Wei-Zang, Shanghai University Press, pp. 884 + 8+4.

## **PRIKAZ TREĆE INTERNACIONALNE KONFERENCIJE NELINEARNE MEHANIKE ICNM-III**

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*Člankom se daju naučno-stručne informacije o organizatorima i naučnom programu Treće internacionalne konferencije nelinearne mehanike ICNM-III održane u avgustu, od 17 do 20 1998 na Univerzitetu u Šangaju, Kina, kao i o učesnicima. Dati su apstrakti plenarnih predavanja, kao i izabranih saopštenja. Date su informacije o sekcijama u kojima je konferencija radila.*