FACTA UNIVERSITATIS
Series: **Mechanics, Automatic Control and Robotics** Vol. 5, N° 1, 2006, pp. 161 - 162

A SUMMARY OF THE FIRST CONFERENCE ON NONLINEAR SCIENCE AND COMPLEXITY

Albert C.J. Luo, **Conference Chair, NSC 2006**

Department of Mechanical and Industrial Engineering, Southern Illinois University Edwardsville, Edwardsville, IL62026-1805, USA, Tel: (618)650-5389, Fax: (618)650-2555, Email: aluo@siue.edu

The 2006 *International Conference on Nonlinear Science and Complexity* held in Beijing, China, August 7-12, 2006. This conference provided a place to exchange recent developments, discoveries and progresses on *Nonlinear Science and Complexity*. The fundamental and frontier theories and techniques for modern science and technology were presented. In addition, this conference provides a platform to exchange the methodology in applied nonlinear science, nonlinear modeling and intelligent computations. The conference focused on the following topics:

- Lie Group Analysis and Applications in Nonlinear Science (Nail H. Ibragimov) (9 papers)
- Nonlinear Wave Dynamics and Patterns in Geophysical Flows (Lev A. Ostrovsky and Victor I. Shrira) (14 papers)
- Chaotic Dynamics and Transport in Classic and Quantum Systems (Sergey Prants) (12 papers)
- Nonlinear Dynamics, Oscillations and Stability (Albert C.J. Luo, Pei Yu, Subhash Sinha) (21 papers)
- Nonlinear Fluid Mechanics (Gazanfer Unal and Shijun Liao) (7 papers)
- Dynamics in Continuous Media and Wave Propagations (Liming Dai) (11 papers)
- Modeling and Nonlinearity in Sensors, Bio-devices, MEMS and Nano-systems (Frank Z. Feng, G. Nakhaie Jazar) (4 papers)
- Nonlinear Modeling and Control of Smart Material Systems (M.H. Elahinia, Xubin Song) (15 papers)
- Nonlinear Modeling and Control and Intelligent Computing (Zhongliang Jing, Trong Wu) (8 papers)

Many papers presented in this conference show excellent achievements in nonlinear science and complexity. In this conference, some useful tools were presented in the Lie group analysis to solve nonlinear partial differential equation. Some important issues in nonlinear wave dynamics in geophysics and nonlinear fluid mechanics were presented. The nonlinear bio-physics is a main direction for nonlinear science and complexity. The Homotopy techniques were extensively used to obtain the analytical solutions. Some fundamental problems and theories in classic and quantum dynamical systems were discussed. Some theory and methodology in nonlinear dynamics were presented. For instance, N.A.Magnitskii's recent results as the newest achievements in chaotic dynamics were reported by the news letter of Nonlinear Science. Some

interesting results about dynamics and vibration in sensor and smart systems were presented. Interval computation and nonlinear modeling in dynamics and control were briefly included. The organizers believe this permanent record will make the work last longer and more influent. The conference organizers wish to express their deep appreciation to all the authors and reviewers. This conference had 80 participants to present 101 papers out of 120 papers from 23 countries.

This conference supports the journal "Communications in Nonlinear Science and Numerical Simulation (Elsevier)" to chase the best scientists in Nonlinear Science and Complexity and obtain the best papers from them. This journal published many milestone achievements on nonlinear science and complexity. Especially, the fractional dynamics is leading the research in field. In addition, this conference tries to encourage the best scientists either to write the books on the monograph book series on "Nonlinear Science and Complexity (Elsevier)" or to edit chapters on the edited book series on "Advances on Nonlinear Science and Complexity (Elsevier)". The two book series have published several books. The corresponding websites and sample books are:

http://www.elsevier.com/wps/find/bookdescription.cws_home/BS_S592/description#description

- Biology, Sociology, Geology by Computational Physicists, 1
- Fractal Dimensions for Poincare Recurrences, 2
- Singularity and Dynamics on Discontinuous Vector Fields, 3
- Stochastic Dynamics and Control, 4

http://www.elsevier.com/wps/find/bookseriesdescription.cws_home/BS_ENSC/description

- Bifurcation and Chaos in Complex Systems, 1

The editors welcome the best scientists in nonlinear physics and others to contribute their original ideas to the book series. The editors will push the best books to be published fast. To enhance the communication on community of Nonlinear Science and Complexity, the Transaction of Nonlinear Science and Complexity will be published by World Scientific Publishing. Many authors request to establish a "Society of Nonlinear Science and Complexity" to exchange the recent development in the field. The two special topics on the conference are as follows:

On *N*-Dimensional Nonlinear Dynamics on Continuous Vector Fields

Albert C.J.Luo

In this talk, a different view to look into the fundamental theory in dynamics is presented. The ideas presented herein are less formal and rigorous in an informal and lively manner. The ideas may give some inspirations in the field of nonlinear dynamics. The concepts of local and global flows are introduced to interpret the complexity of flows in nonlinear dynamic systems. Further, the global tangency and transversality of flows to the separatrix surface in nonlinear dynamical systems are discussed, and the corresponding necessary and sufficient conditions for such global tangency and transversality are presented. The ε-domains of flows in phase space are introduced from the first integral manifold surface. The first integral quantity increment is introduced as an important quantity. The stability of equilibriums and periodic flows in nonlinear dynamical systems are discussed through the first integral quantity increment. The invariant set fragmentation caused by the grazing bifurcation is discussed. The global grazing bifurcation is a key to determine the global transversality to the separatrix. The complexity of the global chaos is measured by invariant sets on the separatrix surface. The invariant set fragmentation of strange attractors on the separatrix surface is central to investigate the complexity of the global chaotic flows in nonlinear dynamical systems.

Computing an Organism: Computational Modeling of Biological Development

James A. Glazier

The complex pattern formation which occurs during biological development offers many challenges and opportunities to applied mathematicians and physicists. While living organisms obey rules quite different from those of equilibrium statistical physics, a combination of network approaches at the subcellular level, cell-based models at the tissue level and continuum PDE modeling at the organ level, can explain many developmental phenomena. Such theoretical understanding can guide both the design and interpretation of experiments and will be critical to the development of many biomedical applications, especially in regenerative medicine and tissue engineering. While we are still far from being able to compute an organism, we have made substantial progress in a number of areas. I will illustrate applications of modeling to *Dictyostelium discoideum*, limb development, tumor growth, somitogenesis, gastrulation, angiogenesis and vasculogenesis *in vitro*.