03-3 IUTAM Symposium on Chaotic Dynamics and Control of Systems and Processes in Mechanics Rome, 8-13 June 2003

a) Scientific Committee

G. Rega (Italy, Chair), F. Vestroni (Italy, Co-Chair), F. L. Chernousko (Russia), E. Kreuzer (Germany), F. C. Moon (USA), G. Stepan (Hungary), J. M. T. Thompson (UK), H. Troger (Austria) and D. H. van Campen (The Netherlands)

b) Short summary of scientific progress achieved

The Symposium continued the tradition of earlier IUTAM Symposia in the field of nonlinear and chaotic dynamics in mechanics (Stuttgart, 1989; London, 1993; Ithaca, NY, 1997), a research area which keeps on engaging a large and active community of scientists. Accounting for the increased interest towards control of chaos and - more generally - of nonlinear dynamics, this fourth Symposium in the series was aimed at diving deep both into theory and applications to mechanics of nonlinear and chaotic dynamics, and into their control.

The Scientific Program included five working days, with presentation of 4 Key Lectures, 35 Lectures and 10 Posters, organized in fifteen sessions.

Scientific progress was achieved within the following main topics addressed in the Symposium:

(i) Complex mechanical systems and processes
(ii) Features of nonlinear interactions in mechanical systems
(iii) Patterns of novel bifurcations, with special emphasis to non-smooth systems
(iv) Dimensionality and reduced-order models of continuous systems
(v) Exploitation of dynamical system properties for application purposes
(vi) Control of spatio-temporal dynamics.

The need to overcome the limitations inherent to the archetypal single- or few-degree-of-freedom systems mostly

considered in the past, and to develop more reliable models for the analysis of high-dimensional systems and processes encountered in technical applications, clearly emerged from the presentations and from the very active and fruitful discussion. In particular, the scientific sessions highlighted the role of experimental investigations, the need to generalize dynamical systems techniques to the analysis of new complex behaviours, the implications of chaos in the design and operating conditions of advanced systems, and the needs and features for its overall and local control.

In the meeting held at the end of the Symposium, the Scientific Committee fully agreed on the need to pursue the near future organization of further IUTAM Symposia devoted to topics of nonlinear/chaotic dynamics, and of their control, in order to mark hopeful advancements in the area and monitor new research achievements.

c) Countries represented and number of participants

63 registered participants from the engineering, physics and applied mathematics communities attended regularly the Technical Sessions of the Symposium, coming from 20 different countries, according to the following geographical distribution: Austria (1), Brazil (1), Canada (1), Czech Republic (1), China (1), Denmark (1), Germany (6), Greece (3), Hungary (2), Israel (1), Italy (13), Japan (1), Morocco (1), Poland (1), Russia (5), Serbia-Montenegro (1), the Netherlands (2), Turkey (1), U.K. (8), U.S.A. (12).
A number of Italian Ph. D. students and University scientists also attended some scientific sessions.

d) Publication of Proceedings of the Symposium

Full papers of both lectures and poster presentations are going to be published as Symposium Proceedings by the Kluwer Academic Publishers. For each submitted paper, the review process is being driven by getting two reviews either from members of the Scientific Committee (primarily) or from other participants to the Symposium, with the aim of achieving a standard of the Proceedings comparable to that of refereed

journals in the field. At December 2003, nearly two/thirds of the review process has been completed.

e) Financial supports

Some funds were made available by:
- International Union of Theoretical and Applied Mechanics (IUTAM)
- University of Rome "La Sapienza"
- Department of Structural and Geotechnical Engineering
- Banca di Roma
- Iricav
- Italferr
- Italsocotec
- Kluwer Academic Publishers
- Pegaso
- Società Italiana per Condotte d'Acqua
- Società Stretto di Messina

We thank our sponsors for their contribution to the success of the Symposium.

f) Scientific program

Monday 9

Key Lecture I
Pfeiffer F., Sedlmayr M., Spatial motion of CVT-chains

Session 1: Mechanical Systems
Stepan G., Szalai R., Hogan S.J., *The chaotic oscillations of high-speed milling*
Schweizer B., **Wauer J**., *Nonlinear interaction in magnetohydrodynamic bearings under oscillating electric fields*
True H., Trzepacs L., *On the dynamics of a railway freight wagon wheelset with dry friction damping*
Virgin L.N., **Plaut R.H**., *Nonlinear oscillations of a buckled strut used as a vibration isolator*

Session 2: Structural Systems
Benedettini F., Alaggio R., *Post-critical finite, planar*

dynamics of a circular arch: experimental and theoretical characterization of transitions to non regular motions
Gonçalves P.B., *The non-linear dynamics of thin walled shell structures*
Gottlieb O., Champneys A.R., *Global bifurcation and chaotic dynamics of nonlinear thermoelastic microbeams subject to electrodynamic actuation*

Session 3: Dynamics and Condition Monitoring
Cusumano J.P., Chelidze D., *Phase space warping: a dynamical systems approach to diagnostics and prognostics*
Giagopulos D., Salpistis C., **Natsiavas S**., *Dynamics and parametric identification of geared rotordynamic systems*

Tuesday 10

Key Lecture II
Moon F. C., *Chaotic clock models: a paradigm for noise in machines*

Session 4: Micro-electro-mechanical Systems
Turner K.L., **Shaw S.W**., *Parametrically excited MEMS-based filters*
Balachandran B., Li H., *Nonlinear phenomena in microelectromechanical resonators*

Session 5: Bifurcation, Chaos, Control
Thompson J.M.T., van der Heijden G.H.M., *Patterns of chaotic bifurcation suppressing internal resonance*
Bajaj A.K., Vyas A., Raman A., *Explorations into the nonlinear dynamics of a single DOF system coupled to a wideband autoparametric vibration absorber*
Lenci S., Rega G., *Bifurcation and chaos in mechanical applications: a dynamical systems approach to their control*

Session 6: Control of Systems/Processes I
Schiehlen W., Guse N., *Control of limit cycle oscillations*
Chernousko F.L., Controlled motions of multibody systems along a plane
Steindl A., **Troger H**., *Optimal control of retrieval of tethered subsatellite*

Session 7: Control of Systems/Processes II
Popp K., Rudolph M., *Dynamic vibration absorber for friction induced oscillations*
Vakakis A.F., McFarland D.M., Bergman L., Manevitch L. I., Gendelman O., *Passive vibration control by nonlinear energy pumping : theoretical and experimental results*

Wednesday 11

Session 8: Stochasticity and Imperfections
Ibrahim R.A., Beloiu D. M., Pettit C.L., *Influence of boundary conditions relaxation on flutter of aeroelastic panels*
Hogan S.J., *Dynamics of discontinuous systems with imperfections and noise*

Session 9: Poster Presentation and Discussion
Beletsky V.V., Pivovarov M.L., Savchenko A.A., *Regular and chaotic relative motion of a dumb-bell satellite*
Guennoun Kamar, Belhaq M., **Lakrad F**., *Quasi-periodic oscillations and stability of a two-degree-of-freedom model of a shallow arch under quasi-periodic excitation*
Efimov D.V., **Fradkov A.L**., *Adaptive partial observers for time-varying chaotic systems*
Galvanetto U., Bornemann P.B., *Time integration techniques to investigate the long-term behaviour of dissipative structural systems*
Georgiou I.T., *Identification and construction of reduced models for infinite-dimensional dynamical systems in nonlinear elastodynamics*
Hedrih Stevanović K., *Fascinating nonlinear dynamics of a heavy material particle(s) along circle(s) with coupled rotations and optimal control*
Kovaleva A., *Stochastic resonance and synchronization of stochastic jump processes in a bistable system driven by a weak periodic signal*
Luo A.C.J., *The mapping dynamics of a three-piecewise linear system under a periodic excitation*
Pavlovskaia E.E., Wiercigroch M., *Two dimensional map for impact oscillator with drift*
Yabuno H., Aoshima N., Goto K., *Motion control of an under-actuated manipulator by using high-frequency excitation*

Thursday 12

Key Lecture III
Nayfeh A.H., Masoud Z.N., Nayfeh N.A., *A smart controller for commercial and military cranes*

Session 10: Delay Systems
Sri Namachchivaya N., Van Roessel H.J., *Delay equations with fluctuating delay: application to regenerative chatter*
Hu H., *Global dynamics of a type of nonlinear system with delayed velocity feedback*

Session 11: Nonsmooth Dynamics I
Wiercigroch M., Pavlovskaia E., Karpenko E.V., *Nonlinear dynamics of non-smooth mechanical systems*
Di Bernardo M., Champneys A.R., Kowalczyk P., *Corner-collision and grazing-sliding: on the occurrence of novel bifurcations in nonsmooth systems*
Casini P., Vestroni F., *Non-smooth dynamics of a double-belt friction oscillator*

Session 12: Nonsmooth Dynamics II
Leine R.I., van Campen D.H., *Experiments and modelling of drillstring vibrations*
Kreuzer E., Struck H., *Active damping of spatio-temporal dynamics of drill-strings*
Peterka F., *Dynamics of mechanical systems with soft impacts*

Session 13: Random Systems
Davies H.G., *Two coupled modes with modulated excitation and low-level additive noise*
Wedig W.V., *Vertical dynamics of riding cars under harmonic and stochastic base excitations*

Friday 13

Key Lecture IV
Arecchi F.T., *Control and synchronization of homoclinic chaos and its implication for neurodynamics*

Session 14: Chaos Control and Synchronization
Fradkov A., *Methods and examples of controlling chaos in mechanical systems*
Stefanski A., **Kapitaniak T**., *Synchronization of dynamical systems caused by chaotic excitation*

Session 15: Discrete Dynamics
Manevitch L.I., Gendelman O.V., Savin A.V., Nonlinear normal modes and chaotic motions in oscillatory chains
Domokos G., Sheuring I., Tèl T., On the relationship between discrete and continuous interval maps

Report composed by Giuseppe Rega