Proceedings of the First International Symposium on Impact and Friction of Solids, Structures, and Intelligent Structures

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Preface

This volume on the Stability, Vibration and Control of Systems contains the proceedings of the first symposium on Impact and Friction of Solids, Structures, and Intelligent Machines, held in the Ottawa Congress Center, Ottawa, Canada, June 27-30, 1998. The purpose of the symposium was to bring together engineers and scientists concerned with modelling, analysis, measurement and control of mechanical systems in presence of impact and friction. It was also the aim of this workshop to stimulate cross-fertilization of different disciplines involved in the impact and frictional aspects of solids, structures and machines and to promote the fundamentals as well as industrial applications. A total of 79 participants from 23 countries played an active role during the lectures and sessions of contributed papers.

The book is about dynamics of mechanical systems in presence of impact and friction. Impact and friction are usually introduced and studied at an elementary level in undergraduate courses in physics. Thus, one may gather the impression that these topics are simple and well understood. In truth, however, nothing could be more complicated and less mature than the study of impact and friction in mechanical systems is both complicated and incomplete and difficult to model accurately. In addition, the governing equations are not easy to tackle even numerically, and analytically intractable in all but the simplest cases.

Contact mechanics has been studied by many of the brightest scientists, e.g., Newton, Coulomb, Reynolds, Hertz, and Sommerfeld. In addition to its practical importance from a practical view, it is also of great theoretical interest and involves fundamental physics, e.g. questions related to the origin of irreversibility and adiabaticity, the role of self-organized criticality and, dynamical phase transitions in molecularly thin lubricant layers. Modern
contact laws lead to mathematical models that are highly nonlinear and nonsmooth or discontinuous. Discontinuous and/or nonsmooth processes introduce problems with data processing techniques such as phase-space reconstructions, and analytical techniques such as perturbation methods and linearization in the vicinity of equilibria or steady motions.

Today due to great advances in computer technology and computational analysis (advances in calculating branching behavior of BVP's, nonsmooth convex analysis, differential inclusions, and the design of proper numerical solution methods for inequality constrained optimization problems), it is possible to solve complex contact problems. Furthermore, new experimental devices, such as atomic force microscopes and quartz-crystal-microbalance probes allow other aspects of contact mechanics to have potentially important applications in nano-tribology. In short, the study of impact and friction, which is one of the oldest problems in physics, is in a phase of rapid and exciting development. These growing research breakthroughs have promoted the development of new technologies in the description and design of systems with impact and friction models, to understand nature, structures, machines, transportation systems, and other processes.

In this volume on Stability, Vibration and Control of Systems, research papers on certain selected topics have been compiled to form an integrated set. While it is not possible to do justice to each paper in this preface, we mention that they represent the following broad topics:

- Inelasticity, Hysteresis, Wear
- Stability and Structures
- Nonlinear Dynamics and Vibrations
- Nonlinear Dynamics and Experiments
- Analysis, Rigid Bodies, Multi-Body Systems, Mechanics and Contact Models
- Applications, Rotating Systems
- Modeling, Computations

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- The Canadian Society for Mechanical Engineering
- Institute for Structronics, Ottawa, Canada
- Worcester Polytechnic Institute, USA
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- Stochastic Mechanics/Analysis Research Group, Worcester, USA

All members of the International Program Committee (IPC) of ISIFSM98 played a key role both in the organization of the ISIFSM98 and in the editing of this book. The IPC was composed of:

- Brian Feeny (Michigan State University, USA)
- Ardeshir Guran (Institute for Structronics, Canada)
It was with shock and deep sadness that we learned of the sudden passing of Professor Panagiotis Panagiotopoulos shortly after the ISIFSM98 meeting on 12 August, 1998. Dr. Panagiotopoulos was a prolific scholar in theoretical and applied mechanics. He conducted excellent fundamental research while simultaneously promoting the practical applications of mechanics to industrial problems. The mechanics community has lost a great scholar, the profession has lost an energetic champion and many of us have lost a warm and charming friend. He will be always remembered as a true scholar, a thoughtful person, and a gentleman. He will be greatly missed. This modest volume is dedicated to his memory.

Ardeshir Guran
Ottawa, October 1998