

PREFACE

This thematic book contains selected papers from the 4th International Conference on Physics and Control (PhysCon2009), held at the University of Catania, Engineering Faculty, 1-4 September 2009 and organized by the University of Catania and the International Physics and Control Society (IPACS). In particular, the idea was to focus on including the contributions presented during the special sessions and minisymposia of the Conference. The plenary talks and some invited contributions are also taken into account.

We thank all the authors of the papers presented at PhysCon2009, their contributions made the conference more scientifically appealing. All the papers of PhysCon2009 have been included in a special issue of the IPACS electronic library.

The limited number of papers included in this book gives a complete overview of the activities that covered the area of Physics and Control of PhysCon2009. The interdisciplinarity of both the areas has made this book the first volume covering a wide range of topics on Physics and Control.

This approach leads to a better understanding of the environment in which we live, also allowing us to face new problems that have appeared in control engineering disciplines. We tried to find links among the infinitely many interesting issues that characterize the existing areas of Physics and Control.

In the practice of Physics and Control Engineering, considerable interest has been devoted to the question of whether it is possible to control physical systems, and vice versa, whether it is possible by using intrinsic physical principles to control general systems. The genesis of Physics and Control connection is very old. Furthermore, over the recent decades exploring complexity, the discovery of fundamental new properties of matter, far from equilibrium conditions, the central discovery of prevalence instability in physics, economics and the social world have led to a crucially important perspective to integrate phenomenological evidences in embedded information based devices and circuits devoted to advanced control strategies for large scale systems. Both experimental and analytical methods are combined to emphasize the two paradigms of investigations in both Physics and Control Engineering for the real view of the problems and their prac-

tical understanding, looking into the possibility of generalizations by using mathematical modeling strategies.

In this view, the understanding of innovative control strategies arising from physics methods is considered appealing. Besides, physical theories and applications are nonlinear as more real control applications are nonlinear.

A common principle in this book is to emphasize the intrinsic non-linearity and the growing complexity in control systems. This publication hopes to stimulate new research routes, and create new research networks by encouraging emergent research strategies. Here, we remark that multi-disciplinarity is strategic for research in this century.

From the topics included in the book the following key methods, items and reference terms have been identified.

Key methods:

- advanced matrix linear algebra;
- quantum computation;
- multistability;
- absolute stability;
- harmonic balancing;
- set membership description;
- nonlinear stochastic systems;
- delayed feedback control;
- network theory;
- chaos-based computing;
- synchronization.

Key items:

- biology;
- neuroscience;
- nanotechnology;
- lasers;
- semiconductors;
- microfluidics;
- electromechanical systems;
- manufacturing systems;
- geophysics;
- plasma;
- sensors;
- embedded systems;

- electronic circuits.

Selected terms:

- uncertain destination dynamics;
- chaos computing;
- set membership description;
- virtual sensors;
- institutionalization.

The book is divided into 11 parts. Part A collects the plenary talks of invited speakers and the contributions of the speakers partially supported by the European Grants' Committee of the European Physical Society (EPS). The other chapters are each devoted to one special session. In particular, part B consists of five chapters selected from the contributions on the special session "Modelling and control of coupled stochastic oscillators" organized by Prof. G. Rigatos. Part C collects four contributions from the special session "Multistability in natural and laboratory-scale nonlinear systems" organized by Prof. B. K. Goswami and Prof. U. Feudel. Part D consists of three contributions from the special session "Linear and matritial algebra, open problems related to control theory" organized by Prof. M. Isabel García-Planas. Part E consists of three selected papers from the special sessions on "Localization of oscillations in dynamical systems" (organized by Prof. G. A. Leonov) and "Control of oscillatory delayed-coupled networks" (organized by Prof. C. Masoller and Prof. J. Garcia-Ojalvo). Part F collects four papers from the special session "Microfluidics: Theory, methods and applications" organized by Prof. M. Bucolo. Part G consists of eight chapters selected from the contributions to the special session "Mathematical modelling of dynamic systems for volcano physics" organized by Prof. C. Del Negro. Part H consists of six papers from the special session "Geometric control for quantum and classical models" organized by Prof. A. Sarychev and Prof. U. Boscaïn. Part I consists of eight chapters from the special session "Control problems for dynamical systems under uncertainty and conflict" organized by Prof. T. F. Filippova. Part J collects seven papers from the special session "Physics and control in fusion plasma devices" organized by Prof. G. Vagliasindi, Prof. G. Mazzitelli and Prof. A. Murari. Part K consists of four contributions from the special session on "Modeling and optimization of beam and plasma dynamics" organized by A. Ovsyannikov. The editors of the book would like to thank all the organizers of the special session and Prof. J. Pereira for having organized the mini-symposium on "EU-funded projects in the area of control and large-scale systems".

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