

“Nonlinear dynamics and control of composites for smart engineering design”

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1 Preface

This Special Issue is aimed at collecting a selection of works initially presented at the Euromech Colloquium 541 “New Advances in the Nonlinear Dynamics and Control of Composites for Smart Engineering Design” held in Senigallia (Ancona), Italy from 3 to 6 June 2013.

The main topics of the Colloquium, which are also the main topics of this Special Issue, were linear and, mainly, nonlinear dynamics, chaos and control of systems and structures made of composite materials for smart applications. Methodologically, both multi-disciplinary and multi-approach researches were encouraged although other approaches were welcome as well.

Nonlinear dynamics and control of composite material are very promising research areas which have recently attracted a lot of interest. The added value of these studies is that they allow us to exploit the main features of nonlinear dynamics to improve the performances of composites, the materials with exceptional mechanical properties.

Consequently, this requires a lot of basic knowledge, both of mechanics and of nonlinear dynamics, to be shaped towards the understanding of the behaviour of non-homogenous materials and structures, among which composites are likely the most important.

On the other hand, this also requires an engineering-based approach to solve problems having in mind an application, which may or may not be easy to realize but is always lurking in the background.

Based on the quality of the proceeding papers and presentations, the best ones were selected, and the authors were invited to contribute by further developing their investigations presented at the Colloquium. Thus, this Special Issue is not a mere collection of weakly improved proceeding papers, but a compendium of deep and relevant scientific works in the subject area, which underwent a regular journal peer review process and which are aimed at representing a future reference for the discipline. This is the way the issue appears long time after the Colloquium.

According to the goal of the Special Issue, the selected contribution is divided into three major parts. The first one deals with nonlinear dynamics and that of mechanics of composites to be studied by means of beams, plates and shells models. This is the most application-oriented part and considers different aspects like for example thermo mechanical behaviour, pre-stress, a finite element method for piezoelectric materials, functional graded structures.

The second part is devoted to control which is often necessary to obtain prescribed behaviours or to

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improve (and even optimize) the performance of the composite. The application of different types of control, classical and non-classical, to composites, is investigated there, emphasising the control of chaos.

The third part is the most theoretically oriented and deals with general and specific features of the theory of dynamical systems applied to mechanical structures. Various topics are investigated there, including non-linear normal modes, energy sinks, stability of limit cycles, synchronization, and identification.

We hope that this Special Issue, which fruitfully brought together scientists with different backgrounds but with common scientific interests, will also be a tool for disseminating the fascinating matter of nonlinear dynamics of composites to trigger new developments, both scientifically and technologically.

Last, but not least, we express our most sincere thanks to all of the authors for accepting our invitation to contribute to the Special Issue as well as to the Journal Editor for hosting it.