

Preface

Mechanical process involving deformable solids are abundant in industry and everyday life and play an important role in engineering structures and systems. They include a large variety of phenomena and, therefore, the need of using mathematical models (based on fundamental physical principles) that can predict reliably the evolution of deformable bodies under the action of external loads was recognised long time ago. Mathematical models used in Solid Mechanics are usually expressed in terms of partial differential equations, associated to various boundary and initial conditions. Their validity depends on how well the theoretical results they predict agree with the results of repeatable experiments. Indeed, the crucial modelling criterion is that a mathematical model should be able to describe those mechanical properties of the real system that are under the consideration with the desired accuracy. In some special cases, the solution of the established mathematical model may be found analytically, where the obtained solution is ‘exact’ under the assumptions made during mechanical and mathematical modelling. Nevertheless, in most of the cases computational procedures have to be utilised to find the numerical solutions.

Mathematical modelling in Solid Mechanics requires, generally, three steps. The first one is construction of mathematical models based on constitutive assumptions and thermodynamic principles. It needs a lot of engineering experience since proper analogies between the reality and the model, dependent on the goals of the analysis, have to be established. The second step is given by the mathematical and numerical analysis of the models. It is devoted to existence, uniqueness and convergence results for the continuous or discrete solutions and error estimates for approximation schemes, among others. Finally, the third step consists in construction of reliable and efficient algorithms for the numerical approximations of the models, to provide numerical simulations and comparison of the numerical results with the experimental ones.

The aim of this edited volume is to present new and original results of mathematical modelling in Solid Mechanics. It contains a large variety of results which cover the path starting from the construction of the models and ending with the numerical solution and engineering applications. It is structured into 18 contributions

that have not been published before, have been obtained by recognised scholars in the area and have gone through a rigorous refereeing process. Most of the contributions made the subject of oral presentations to the international conference *Emerging Trends in Applied Mathematics and Mechanics* (ETAMM 2016), organised by the *Laboratory of Mathematics and Physics* (LAMPS) of the University of Perpignan Via Domitia, France. This successful meeting held in Perpignan during May 30–June 3 2016 and gathered more than two hundred mathematicians, interdisciplinary scientists and engineers from all over the world. It was organised, together with this volume, with the collaboration of the Scientific Committee of the *International Research Centre for Mathematics and Mechanics of Complex Systems* (MEMOCS) of the Università dell’Aquila, Italy. The quest of a deeper interdisciplinary collaboration among mathematicians and applied scientists has been shared between the organisers of ETAMM 2016 and the MEMOCS researchers and was the main leit-motif of all talks presented.

This volume addresses engineers, applied mathematicians and scientists. Advanced graduate students can also benefit from the material presented in this book. Generally, the reader is expected to have background knowledge on mechanics of continua, partial differential equations, nonlinear analysis, numerical analysis and computer sciences.

As editors, we wish to express our gratitude to all authors for their valuable contributions to this special issue. We really appreciate their professional job in the achievement of this volume. We extend our thanks to the reviewers for their very helpful comments that have improved the final versions of some papers. We would like to express our sincere thanks to Springer staff for inviting us as editors of this volume and for their help in bringing it in your hand.

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