Preface

To meet the challenges of the fast development of new technologies, many areas of contemporary engineering and applied sciences, which were conventionally divided or loosely coupled in the past, combine their methodologies and merge together to provide new analytical and computational tools. This is especially evident in the area of multibody system dynamics, a branch of computational mechanics dealing with modelling principles and numerical methods for dynamic analysis, simulation and control of mechanical systems.

Originating in analytical and continuum mechanics, as well as in computer science and applied mathematics, modelling methodologies and computational procedures of multibody system dynamics provide a basis for dynamic analysis and virtual prototyping of innovative applications in many fields of contemporary engineering. With the utilization of the computational models and algorithms that classically belonged to different fields of applied science, where, in certain applications, several physical models co-exist and interact within the same simulation procedure, multibody system dynamics delivers reliable simulation platforms for diverse highly-developed industrial products, such as vehicle and railway systems, aeronautical and space vehicles, robotic and autonomous platforms, biomechanical applications and nano-technologies.

However, since application-based modelling and successful implementation of computational methodologies raise many questions in terms of new solutions and optimal use of specific models and numerical procedures, multibody system dynamics is a very active research field. To maintain this development and provide a platform to discuss relevant scientific topics in this rapidly growing discipline, the 2013 edition of the ECCOMAS Thematic Conference on Multibody Dynamics was held in Zagreb, Croatia, and organized at the University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, from 1 to 4 July 2013. More than 250 participants from 38 countries participated in the event.

This book is based on the revised and extended versions of the papers presented at the conference, reporting on the state-of-the-art in the advances of computational multibody dynamics, from the recent theoretical developments to practical engineering applications. Besides ‘traditional’ multibody topics, such as terrestrial vehicles dynamics and robotical systems, as well as applications in aerospace and (today very relevant) wind turbine modelling, certain chapters of the book also reflect new frontiers in the domain of multibody system dynamics, from coupled

problems with the fluid domain and biomolecular applications to geometric integrators and variational formulations. Such a broad spectrum of topics demonstrates the vitality of this branch of computational mechanics, the roots of which can be traced far back in the history of modern engineering (as it is also documented in one of the contributions), but today, it plays a central role in the numerical modelling and optimisation of mechanical systems in a wide range of areas of scientific and engineering relevance.

The book is primarily intended for experienced researchers and doctoral students who are familiar with the fundamentals and wish to study or advance the state of the art on a particular topic in the field of multibody system dynamics. Nevertheless, practicing engineers could also benefit from it, as a variety of the presented applications show strong potential of the multibody modelling concepts, which can serve as an inspiration for further original contributions in engineering and related disciplines, such as bioengineering and applied physics. Furthermore, these pages will inform researchers active in the modern multibody dynamics about some of the principal research directions and recent achievements, as well as of the state-of-the-art applications by some of the most active researchers and prominent experts in the field.

I am grateful to all contributing authors for their active participation and for the time and effort they devoted to the completion of their contributions. I am also very much indebted to the members of the Scientific Committee for their valuable suggestions and support in the organisation of the conference, as this book is its outgrowth. The event was supported by a number of distinguished international institutions, such as ASME, IUTAM, IFToMM, and, of course, ECCOMAS, and the personal involvement of the colleagues who contributed to this support is very much appreciated.

Last but not least, I would like to thank my collaborators at the University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, who have participated in many activities during the recent years and, directly or indirectly, contributed to the publication of this book.

Zagreb, March 2014 Zdravko Terze

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