Special Issue on “Design, Modelling and Experiments of Advanced Structures and Systems”

Preface

This special issue contains ten full-length papers of presentations, which were given during the *5th International Symposium on Design, Modelling and Experiments of Advanced Structures and Systems (DeMEASS V)*, which was held in October 2012 in Ulrichsberg, Austria. The spirit of the symposium, which was co-organized by the Research Area Mechanics and Model Based Control of the Austrian Center of Competence in Mechatronics and by the Institute for Technical Mechanics at the Johannes Kepler University Linz, was to collect the international expertise of the participants and to promote intensive and fruitful discussions among them, with a special emphasis on the active involvement of young researchers in the field. Presentations were given by Ph.D. students as well as junior post-doctoral researchers, which are also the first authors of the contributions to this special issue.

Over its five editions, DeMEASS has attracted high quality contributions from an increasing number of participants with constantly higher profiles. During the first four editions (held in Bardoneccia - Italy, Bad Herrenalb - Germany, Vernon - France and Urspelt - Luxembourg), the topical span was gradually broadened; in particular, extending the initial focus on adaptive structures and smart systems towards general advanced structures and systems. The fifth edition added an additional focus on the application of advanced materials in mechatronics. This broadening of the considered topics is also reflected by the papers collected in the special issue.

Five papers are concerned with modelling, experiments and applications of adaptive structures with integrated piezoelectric sensors and actuators. Yao *et al*. present a linear computational homogenization framework to evaluate the effective electromechanical coupling coefficient of composite structures with embodied piezoelectric structural fibers. Refined 1D electromechanically coupled modelling of piezoelectric beams based on the Carrera Unified Formulation is proposed in Miglioretti *et al*. in order to accurately model the variation of the mechanical and electrical fields within the cross section. Tondreau *et al*. introduce the concept of a triangular point load actuator on plate structures using piezoelectric macro fiber composites, which is then verified with 3D Finite Element computations. An experimental assessment of the performance of a smart composite device with integrated piezoelectric transverse d_{15} shear sensors and the corresponding numerical simulation of the experimental benchmark by 3D electromechanically coupled Finite Elements are presented in Berik *et al*. Finally, a semi-analytical approach for simulating the use of PZT patches attached to a substrate structure for actuating and sensing ultrasonic guided waves with possible applications to damage detection is developed in Vivar Perez *et al*. Four papers are devoted to research on advanced structures and materials, other than piezoelectric ones. Materials range from aluminium foam to functionally graded materials, to biological tissue and to carbon nanotubes. Modelling and experimental testing of aluminium foam sandwich panels is studied in D’Alessandro *et al.*, in which the foam core is modelled as a nonhomogenous material with randomly distributed mass and stiffness. The Carrera Unified Formulation is used for the analysis of functionally graded beams made of aluminium and zirconia by Giunta *et al*. and for the analysis of nonhomogenous atherosclerotic plaque using enhanced 1D structural models by Varello and Carrera. In both contributions the accuracy of the prediction of the mechanical fields within the nonhomogenous cross section is close to 3D Finite Elements; yet, with a significantly reduced computational effort. The mechanical properties and the deformation behavior of carbon nonotubes are studied in Eberhardt and Wallmersperger, in which a molecular mechanics approach is used; results for the Young’s modulus for several single wall carbon nanotubes are presented and discussed. The special issue is completed by a paper concerned with advanced robotic actuators with variable stiffness by Beckerle *et al*., in which the system dynamic influences are analyzed. Specific results regarding system dynamics, power analysis and stiffness variation are worked out.

The guest editor would like to thank the authors for publishing their contributions in this special issue and the numerous reviewers who contributed to the preparation of this issue. Finally, the guest editor would like to express his sincere gratitude to Prof. Fabio Casciati, one of the Editors-in-Chief of Smart Structures and Systems for the opportunity to have this special issue published and for his ongoing support to complete it.

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