Foreword

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Biographical notes: Edoardo Patelli is a member of the Institute for Risk and Uncertainty (University of Liverpool, UK) and Programme Director of the MSc in Nuclear Power Engineering. He pursued research at the Polytechnic of Milan, Italy and at the University of Innsbruck, Austria, under the guidance of the late Professor G.I. Schuëller. His research activities deal with issues at the interface between theoretical basic research, application-oriented developments and numerical implementations. His recent research activities have addressed the problem of robust design and non-deterministic analysis of complex safety critical systems. He is also leading the development of the COSSAN software for uncertainty quantification and management.

Michael Beer is Professor in the School of Engineering and Director of the Institute for Risk & Uncertainty at the University of Liverpool. He graduated with a doctoral degree in Civil Engineering from the Technische Universität Dresden, Germany, worked as a research scholar at Rice University and as Assistant Professor at National University of Singapore. His research is focused on non-traditional uncertainty models in engineering with emphasis on reliability analysis and on robust design. He is a fellow of the Alexander von Humboldt-Foundation, Member of ASCE, ASME, IACM, ESRA, GACM and EASD, and he holds a series of editorial appointments including an Associated Editorship of the *International Journal of Reliability and Safety*.

Ioannis A. Kougioumtzoglou is an Assistant Professor at the Department of Civil Engineering & Engineering Mechanics, Columbia University, USA. He received his Diploma in Civil Engineering from N.T.U.A., Greece (2007), and his MSc (2009) and PhD (2011) in Civil Engineering from Rice University, USA. His primary research interests focus on mathematical modelling and dynamics of complex structural systems, with emphasis on uncertainty quantification aspects. He has published more than 50 technical papers, and he is the 2014 European Association of Structural Dynamics (EASD) Junior Research Prize recipient "for his innovative influence on the field of nonlinear stochastic dynamics".

This Special Issue provides a snapshot of perspectives and approaches concerned with the mitigation of critical threats to engineering performance, such as those presented by natural and technical hazards, extreme events and human errors. It is based on a mini-symposium, which was organised at the 11th International Conference on Structural Safety and Reliability (ICOSSAR 2013), held at Columbia University in New York, NY, in June, 2013.

Sustainable development requires that complex technological installations, engineering systems and components have to be designed to cope with risk and uncertainty. To ensure a faultless life of the products/systems and to provide decision margins, the consequences of unexpected events and threats such as changes of manufacturing process, extreme load conditions (e.g. wind, wave, earthquake), inherently uncertain processes such as fatigue and corrosion and human errors have to be considered explicitly during the design process. In addition, ageing infrastructure requires the availability of efficient maintenance strategies in order to better quantify risk and to devise effective resilience solutions.

In consequence, realistic consideration and treatment of uncertainties of various nature and scale is a key issue in the development of sustainable, durable, cost-effective and feasible engineering solutions.

To achieve robust design, it is necessary to combine uncertainty quantification approaches including generalised probabilistic methods with optimisation techniques. This enables the explicit consideration of effects of uncertainties in the design phase allowing the design and maintenance of systems and components that are less sensitive to, for example, extreme load conditions.

The papers in this Special Issue contribute realistic model capabilities and numerical efficiency for robust engineering solutions. They include mathematical modelling, efficient sensitivity approaches, Bayesian approaches, and numerical algorithms for realistic representation of the uncertainty, structural health monitoring and robust maintenance strategies.

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