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Short Bio

Michael Beer is Professor and Head of the Institute for Risk and Reliability, Leibniz Universität Hannover, Germany. He is also part time Professor at the University of Liverpool and guest Professor at Tongji University and Tsinghua University, China. He obtained a doctoral degree from Technical University Dresden, Germany, and worked for Rice University, National University of Singapore, and the University of Liverpool, UK. Dr. Beer's research is focused on uncertainty quantification in engineering with emphasis on imprecise probabilities. Dr. Beer is Editor in Chief of the ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A Civil Engineering and Part B Mechanical Engineering. He is also Editor in Chief (joint) of the Encyclopedia of Earthquake Engineering, and Associate Editor of Information Sciences. He has won several awards including the Alfredo Ang Award on Risk Analysis and Management of Civil Infrastructure of ASCE. Dr. Beer is the Chairman of the European Safety and Reliability Association (ESRA) and a Co-Chair of Risk and Resilience Measurements Committee (RRMC), Infrastructure Resilience Division (IRD), ASCE. He is serving on the Executive Board of the International Safety and Reliability Association (IASSAR). He is a Fellow of the Alexander von Humboldt-Foundation and a Member of ASCE (EMI), ASME, IASSAR, CERRA, IACM, ESRA, EASD, and GACM.

Abstract

Structural dynamics analysis with uncertainties

In structural dynamics we are challenged by large structures, nonlinearities and uncertainties, which call for highly efficient models and analysis technologies to provide realistic results at reasonable computational cost. Three concepts are discussed in this context. First, an efficient analysis of aleatory uncertainties is considered. A modified exponential covariance model is presented, which offers not only an improved representation of the key physics behind fluctuating engineering quantities, but also improves the efficiency of spectral stochastic analyses significantly. Second, the quantification of epistemic uncertainties is addressed. Compressive sensing technologies are proposed to solve the problem of missing data in records for estimating power spectral densities. The epistemic uncertainties from

limited and imprecise data are translated into both probabilistic and interval-based representations of the functional values of the power spectral densities. Third, the concept of operator norm is presented as a technology to efficiently solve first passage problems even with hybrid uncertainties consisting of both aleatory and epistemic components. This approach integrates the first two developments, as well.