Dealing with Vague and Imprecise Information in Engineering

Risk and uncertainties are of rapidly growing concern and importance in the light of a quickly growing complexity and changes in our natural and technical environment, economy and society. It has become obvious that approaches to deal with risk and uncertainties in a complex environment can only be effective and efficient when we embark on multi-disciplinary concepts to build our models most realistically. Failure to consider phenomena in such a broad manner can easily lead to unexpected collapse of various natures and result in disasters. Thus, we need an appropriate mathematical modeling and quantification to obtain realistic results when predicting the behavior and reliability of systems and structures of various kinds. But the modeling and quantification are complicated by the characteristics of the available information, which involves, for example, sparse data, poor measurements and subjective information. This raises the question whether the available information is sufficient for a probabilistic modeling or rather suggests a set-theoretical modeling. The framework of imprecise probabilities provides a mathematical basis to deal with these problems which involve both probabilistic and non-probabilistic characteristics of information. This seminar provides an overview on selected concepts of imprecise probabilities. Specific features and relationships between the models are discussed. Particular attention is devoted to the concept of fuzzy probabilities. Examples of applications in engineering underline the usefulness of the concepts discussed.

About the Speaker

Michael Beer is Professor of Uncertainty in Engineering and Director of the Institute for Risk & Uncertainty in the University of Liverpool. He is also the Director of the EPSRC and ESRC Centre for Doctoral Training in Quantification and Management of Risk & Uncertainty in Complex Systems & Environments. Dr. Beer graduated with a doctoral degree in Civil Engineering from the Technische Universität Dresden, Germany. He pursued research in leading roles within a large multi-disciplinary research center in Dresden and during a research period at Rice University (Houston, TX, USA) as a Feodor-Lynen Fellow of the Alexander von Humboldt-Foundation. From 2007 to 2011 he worked as an Assistant Professor in the Department of Civil & Environmental Engineering, National University of Singapore. Dr. Beer’s research is focused on non-traditional uncertainty models in engineering with emphasis on reliability analysis and on robust design. His focus is on both theoretical developments and applications. He is leader and partner for large-scale research programs with a multi-million grant volume. Dr. Beer is a Member of ASME and its Research Committee on Risk Technology, Member of ASCE and Charter Member of its Engineering Mechanics Institute, Member of the European Association for Structural Dynamics, Member of the European Safety and Reliability Association, Member of IACM, Editor in Chief of the Encyclopedia of Earthquake Engineering (Springer), Associate Editor of the International Journal of Reliability and Safety, Associate Editor of the ASCE-ASME Journal of Risk and Uncertainty in Engineering.
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