

Proceedings of the International Symposium  
on Engineering under Uncertainty: Safety  
Assessment and Management (ISEUSAM - 2012)



Subrata Chakraborty • Gautam Bhattacharya  
Editors

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# Preface

In engineering applications, it is important to model and treat adequately all the available information during the analysis and design phase. Typically, the information is originated from different sources like field measurements, experts' judgments, objective and subjective considerations. Over these features, the influences originated from the human errors, imperfections in the construction techniques and production process and influence of the boundary and environmental conditions are added. All these aspects can be brought under one common denominator: that is, "presence of uncertainty." Thus, reliability and safety are the core issues which need to be addressed during the analysis, design, construction and operation of engineering systems under such uncertainties. In this backdrop, the aim of ISEUSAM 2012 is to facilitate the discussion for a better understanding and management of uncertainty and risk, encompassing various aspects of safety and reliability of engineering systems. To be specific, the overall theme of the symposium is modelling, analysis and design of engineering systems and decision-making under uncertainties relevant to all engineering disciplines.

The symposium, being the first of its kind organized in India, received overwhelming response from national as well as international scholars, experts and delegates from different parts of the world. Papers were received from authors from several parts of the world including Australia, Canada, China, Germany, Italy, Sharjah, the UK and the USA, besides India. More than 200 authors from India and abroad have shown their interest in the symposium, out of which a total of 90 papers were presented in various technical sessions comprising 4 plenary sessions and 12 parallel technical sessions.

The proceedings began on January 4, 2012, on a grand scale amidst rousing welcome to the delegates and great enthusiasm amongst the organizers and the participants with the opening ceremony hosting, amongst other dignitaries, Dr. Rakesh Kumar Bhandari, Director, Variable Energy Cyclotron Centre, Kolkata, who inaugurated the 3-day international event, Professor Ajoy Kumar Ray, Vice Chancellor, Bengal Engineering and Science University,

Shibpur, who presided over the opening session, and Professor Arun Kumar Majumdar, Deputy Director, Indian Institute of Technology Kharagpur, who graced the occasion as the guest of honour.

The inaugural keynote address, delivered by Achintya Haldar, Emeritus Professor, University of Arizona, USA, on *Past, Present and Future of Engineering under Uncertainty: Safety Assessment and Management*, set the tone for the rest of the proceedings. This was followed by a series of technical sessions including plenary sessions on numerous sub-themes spread over all three days. The other keynote addresses include *Techniques of Analysis of Imprecision in Engineering Systems* by Ajoy K. Ray, Vice Chancellor, BESU, Shibpur; *Uncertainty Quantification in System Risk Assessment and Decision-Making* by Sankaran Mahadevan, John R. Murray Sr. Chair in Engineering, Vanderbilt University, USA; *Advancing Geotechnics in the Twenty-First Century – Dealing with Uncertainty and Other Challenges* by Robin Chowdhury, Emeritus Professor, University of Wollongong, Australia; *State of the Art on Stochastic Control of Structures for Seismic Excitation* by T.K. Datta, Emeritus Professor, IIT Delhi; *Discovering Hidden Structural Degradations* by Abhijit Mukherjee, Director, Thapar University; *SHM of Prestressed Concrete Girder Bridge* by Pradipta Banerji, Director, IIT Roorkee; *Nanotoxicology: A Threat to the Environment and to Human Beings* by D. Dutta Majumder, Professor Emeritus, Indian Statistical Institute, Kolkata; *Uncertainty in Interpreting the Scale Effect of Plate Load Tests in Unsaturated Soils* by Sai K. Vanapalli, Professor and Chair, Civil Engineering Department, University of Ottawa, Canada; and *Response Control of Tall Buildings Using Tuned Liquid Damper* by S. K. Bhattacharyya, Director, CBRI, Roorkee. Two other eminent personalities who had accepted the invitation to deliver keynote lectures, but due to unavoidable circumstances could not be present on the occasion, also sent their contributions for inclusion in the symposium proceedings. These are *Uncertainties in Transportation Infrastructure Development and Management* by Kumares C. Sinha, Olson Distinguished Professor of Civil Engineering, Purdue University, USA, and *Physical Perspective Towards Stochastic Optimal Controls of Engineering Structures* by Jie Li, State Key Laboratory of Disaster Reduction in Civil Engineering, Tongji University, Shanghai, China.

In order to accommodate a wide spectrum of highly relevant sub-themes across the major engineering disciplines, presentations of the invited and the contributory papers were held in two parallel technical sessions. Amongst the presenters were senior professors and chairs from reputed universities from India and abroad, most of the IITs and the IISc Bangalore on the one hand, and experts from the R&D organizations such as BARC, AERB, DRDO, CBRI, CRRI, SERC and leading industry houses such as UltraTech Cement, M.N. Dastur & Company (P) Ltd., Petrofac International Ltd., UAE, and L&T on the other. All the technical sessions invariably concluded with a highly animated discussion session which enthralled the participants and brought their applause in appreciation.

The closing ceremony marked a fitting finale to the 3-day event. Professor Achintya Haldar summed up the proceedings over the last 3 days. He also spelt out the future direction of the symposium by mooted a proposal of organizing it on a regular basis. Dr. Milan Kumar Sanyal, Director, Saha Institute of Nuclear Physics, Kolkata, in his role as the chief guest, enlightened the audience about the uncertainties involved in a nuclear project. Dr. T. K. Datta, Professor Emeritus, IIT Delhi, was the Guest of Honour on the occasion. “Death is certain, yet, when, is uncertain. . .” echoed Dr. Datta on a philosophical note and went on to applaud the Department of Civil Engineering, BESU, for putting in such a wonderful effort in organizing this symposium on uncertainty, the first of its kind in India. Representatives from the delegates, including the well-known academician Professor G. Venkatachalam, expressed that they had found the sessions truly engrossing and also that they were highly satisfied with the arrangements. It thus appears that the symposium could at least partly fulfil the objective with which it was organized.

The organizers sincerely regret that this volume could not be made ready well in advance, and, therefore, at the time of the symposium, the delegates and the participants could be handed over only a CD version of their contributions. But, better late than never, that the proceedings could eventually be published, is a matter of some satisfaction.

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Dr. Subrata Chakraborty is currently a Professor at the Bengal Engineering and Science University, Shibpur. He is a fellow of the Indian National Academy Engineering and the Institution of Engineers (India). He has obtained his Ph.D. in structural engineering from IIT Kharagpur in 1995. He was postdoctoral researcher at University of Cambridge, UK and University of Arizona, USA and Technical University of Aachen, Germany. In general, Prof. Chakraborty's research interest lies in the field of computational mechanics under uncertainty, structural health monitoring, vibration control, composite mechanics etc. While his inspiring teaching coupled with innate urge for intensive research has already established him as a distinguished academician at the national level, several awards and laurels have come his way. The Humboldt Fellowship for Experienced Researchers, the INAE Young Engineer Award, the BOYSCAST Fellowship, and the Young Faculty Research Award deserve special mention.

Dr. Gautam Bhattacharya, an experienced academic and researcher, is one of the senior Professors of Civil Engineering at the Bengal Engineering and Science University, Shibpur, and currently the Vice-Chairman, Kolkata chapter of the Indian Geotechnical Society. Having obtained his B.E. and M.E. in Civil Engineering from the erstwhile B.E. College, Shibpur, he went to IIT Kanpur to pursue his Doctoral study during which (1985–1990) he developed great interest in the subject of slope stability, and worked on the application of advanced numerical methods in slope analysis for his PhD thesis. He has since been engaged in teaching soil mechanics and foundation engineering and in pursuing research on both deterministic and probabilistic approaches of analysis of unreinforced and reinforced slopes, retaining structures and foundations under static and seismic conditions. He has published several scientific articles in peer reviewed journals and also co-authored a book with the CRC Press/Balkema. He has teaching, research and consultancy experience in the field of geotechnical engineering for about three decades.



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