PREFACE: FIRST QUEST CONFERENCE

Uncertainty is ubiquitous in nature, engineering systems, and our society. It may arise from incomplete representations of the underlying processes, unknown parameters and inputs to the mathematical models, approximations of numerical schemes, and many other factors. Recent advancements in mathematical modeling and data and computational sciences enable one to address those issues through the study of Uncertainty Quantification (UQ), a developing field "bringing to fruition the dream of being able to accurately model and predict real complex processes through computational simulators" [1]. Inherently interdisciplinary, an effective UQ requires not only the domain knowledge of specific processes and data to construct mathematical models, its implementation also seeks a host of mathematical and statistical tools with high-performance computation.

To meet the growing interests of UQ from various industrial and research communities, the Society for Industrial and Applied Mathematics started the first biannual meeting in 2014, the SIAM Conference on Uncertainty Quantification. In 2015, a new conference called Quantification of Uncertainty in Engineering, Sciences and Technology (QUEST) was initiated in China. The goal of the meeting is to bring together the leading researchers from a large variety of disciplines to address recent development and challenges in many practical fields. Over the three-day conference from October 19 to 23, 2015, keynote speeches were given by the top UQ experts such as Dr. Roger Ghanem, Dr. George Karniadakis, Dr. Nicholas Zabaras, Dr. Wei Chen, Dr. Dongbin Xiu, and Dr. George Christakos. It also attracted 40 presentations ranging from environmental sciences, epidemiology, energy systems, and biomedical engineering to social sciences.

We would like to thank the *International Journal for Uncertainty Quantification*, the first professional journal dedicated to UQ (its impact factor a year after the journal started being evaluated doubled to 1.0), for giving us the opportunity to prepare this special issue in conjunction with the QUEST Conference in 2015. The key focus of the present special issue is to highlight the demand of UQ in many areas and includes seven peer-reviewed articles from a multidisciplinary perspective.

The first paper by Huo and coauthors examines the explosive critical phenomena of combinational phases on multiplex networks. By applying the Kuramoto model on multiplex networks, they found an abrupt transition in the synchronization of combinational phases and presents the phases of oscillators.

The second paper by Wang, Wu, and Xiao investigates model-form uncertainty reduction in Reynolds-averaged Navier-Stokes (RANS) models in turbulent flows. To be specific, they propose a Bayesian framework by incorporating various types of prior knowledge and show that informative physics-based prior plays an important role in model prediction when the observation data are limited.

Zhang, Duan, and Peng propose an optimization scheme to match scenes in navigation systems. By first identifying the matching interval and points, they design a cost function in accordance with required accuracy and determine the filtering parameters using local sensitivity analysis. Their work provides a theoretical basis for engineering applications.

The paper by Xu and coauthors studies the software reliability growth model in a network environment. Treating the collective environmental uncertainty as temporally correlated noise, they provide a semianalytical solution of fault removal number in the software fault detection process, which is often modeled as the nonhomogeneous Poisson process (NHPP). Experimental comparisons with existing methods demonstrate that the new framework shows a closer fit to actual data and exhibits a more accurately predictive power.

Zhao, Yang, and Xiao introduce a repeated-kernel-density-estimation-based approach for constructing evidence bodies from uncertain observations and interval measurements. Using kernel density estimation with a loop, they obtain a family of probability distribution based on given observations and discretize the probability box, characterized by the bounds of the probability distribution family, using an outer discretization method.

The paper by Shi and coauthors focuses on the peer review process of scientific proposal evaluations in China, which may be subject to uncertainty including individual reviewers bias and potential discussion under the table. By

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building a mathematical framework to model the peer review process, they numerically demonstrate that the number of proposals has greater impact on overall fairness.

Finally, Li and coauthors present an effective calibration method for experimental design of complex systems. Through analyzing the influences of various experimental costs, sampling sequences, and spatial positions of experiment points, they define a sequential sparsity iterative optimal design model for experimental designs integrated with cost and spatio-temporal weights. Using theoretical inferences and numerical simulations, it is shown that their regression model yields smaller parameter estimation error than conventional ones.

We hope that these articles will provide stimulating thoughts to readers interested in the field of Uncertainty Quantification and its applications. In an age of data explosion, high-performance computing, increasing multidisciplinary research, and growing complexity of engineering systems and social structure, there is no doubt that the new tools of UQ will help bridge various disciplines and connect fundamental research with applications.

We would like to thank everyone who has contributed to this special issue. We wish to express our sincere thanks to Dr. Nicholas Zabaras, Editor-in-Chief of the *International Journal for Uncertainty Quantification*, for giving us the opportunity to be Guest Editors for this issue. Many thanks to all the authors for their interesting contributions, to the reviewers for improving the quality of the manuscripts, and to the editorial staff for their help in the production of this special issue.

REFERENCES

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