Advanced simulation methods for uncertainty quantification and risk analysis

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Engineering problems have uncertainties in various forms and of various nature arising from, for example, limited information, human factors, subjectivity and experience, imprecise measurements and unknown physics. Despite this, decision makers still need to make definite choices based on the available information. To deliver products with commissioned reliable performance, complex technological installations, engineering systems and components have to be designed to cope with risk and uncertainty. Probabilistic and non-probabilistic as well as mixed concepts of imprecise probabilities have been developed, applied and achieved a new level of acceptance.

The solutions of such problems are increasingly leveraging on the availability of efficient simulation methods. While new algorithms are still arising in different fields, Monte Carlo methods are now established and ready for applications in the real practical engineering setting, thanks to the advent of modern computer technology and advancements in algorithm efficiency. Examples of new methods include Subset Simulation, Line Sampling, sparse-grid stochastic collocation methods, Bayesian nested sampling and new adaptive Monte Carlo and quasi-Monte Carlo methods. Nevertheless many issues are still encountered in real applications and new expectations or endeavors are forming upon recognition of the availability of these powerful tools.

This Special Session aims at bringing together researchers, academics and practising engineers, providing a forum for discussion on theoretical and practical issues in the development, implementation and scalability of Monte Carlo methods. Contributions to theory development, applications, and implementation in engineering practice, are welcome. The issues of numerical efficiency and applicability to industry-size problems are of particular interest.