11th. World Congress on Computational Mechanics (WCCM2014)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

Uncertainty Modeling and High Performance Stochastic Methods for Computationally Intensive Calibrations, Predictions and Optimizations

Tan Bui-Thanh[1], **Thomas Carraro**[2], **Marko Laine**[3], **Ernesto E. Prudencio**[4,*]

1 - Department of Aerospace Engineering and Engineering Mechanics, Institute for Computational Engineering and Sciences, The University of Texas at Austin, Austin, TX 78712-1221, USA; tanbui@ices.utexas.edu

2 - Institut für Angewandte Mathematik, Ruprecht-Karls-Universität Heidelberg, 69120 Heidelberg, Germany; thomas.carraro@iwr.uni-heidelberg.de

3 - Finnish Meteorological Institute, Earth Observation, Atmospheric Remote Sensing, FI-00560 Helsinki, Finland; Marko.Laine@fmi.fi

4 - WesternGeco-Schlumberger, Houston, TX 77042, USA; eprudencio@slb.com

Keywords: Uncertainty Modeling, Uncertainty Quantification, Stochastic Methods, Hybrid Methods, High Performance Computing

Various engineering designs and the study of several natural phenomena have been successfully conducted with deterministic models and simulations, usually leading to extreme large scale discretized computational problems that demand the use of parallel computing and sophisticated deterministic methods. During the last years, however, uncertainty quantification has been receiving increasing attention from the engineering and scientific communities. Such trend calls for the incorporation of stochastic components in predictive simulations and optimizations, able to properly model uncertainties in complex systems, and the adoption of stochastic methodologies able to cope with computationally intensive models.

This mini-symposium invites presentations addressing uncertainty modeling, as well as the use and analysis of stochastic methods for the quantification of uncertainties in complex problems in natural sciences and engineering. Examples of such methods are Markov chain Monte Carlo, polynomial chaos, Gaussian processes, particle filters, and emulators, as well as hybrid approaches combining deterministic with stochastic methods. We also invite presentations addressing computer science and parallel computing issues in the context of large scale stochastic problems. Examples of such issues are load balancing, scalability, and parallel statistical libraries. We encourage the participation of a broad range of applications, e.g. optimal experiment design, stochastic optimization, risk analysis, data assimilation, civil engineering systems, climate, material science, combustion, drug design, geosciences, biological tissues, to name a few. Examples of problems to address are:

1. How to characterize uncertainties in data, scenarios, and models?
2. How to propagate uncertainties from measured data to models?
3. How to propagate uncertainties from model parameters to predictions?
4. How to design the next “best” possible experiment, and what does “best” stand for?
5. How to quantify the influence of calibration data into quantities of interest to be predicted in scenarios potentially very “far” from the calibration scenarios?
6. How to efficiently compute risks of failure, specially in the case of rare events?