Computational Mathematics Seminar Series

Uncertainty Quantification Algorithms and Applications for High Dimensional Stochastic PDE Systems

Guang Lin, Pacific Northwest National Laboratory

Staff Scientist, Fundamental & Computational Sciences Directorate

Johnston Hall 338
March 13, 2012 - 03:30 pm

Abstract:
Experience suggests that uncertainties often play an important role in quantifying the performance of complex systems. Therefore, uncertainty needs to be treated as a core element in modeling, simulation and optimization of complex systems. In this talk, a new formulation for quantifying uncertainty in the context of subsurface flow and transport problem will be discussed. An integrated simulation framework will be presented that quantifies both numerical and modeling errors in an effort to establish "error bars" in CFD. In particular, stochastic formulations based on Galerkin and collocation versions of the generalized Polynomial Chaos (gPC), multi-output Gaussian process model, Multilevel Monte Carlo, scalable multigrid-based pre-conditioner for stochastic PDE, adaptive ANOVA decomposition, and some stochastic sensitivity analysis and Bayesian parameter estimation techniques will be discussed in some detail. Several specific examples on flow and transport in randomly heterogeneous porous media, Bayesian climate model parameter estimation will be presented to illustrate the main idea of our approach.

Speaker's Bio:
Guang Lin is an applied mathematician whose research interests include diverse topics in computational science both on algorithms and applications. A main current thrust is stochastic simulations and multiscale modeling of complex systems. Particular aspects include: Numerical solution of stochastic differential equations, modeling uncertainty with polynomial chaos, exascale computing, model validation and calibration, robust control and optimal design, and rare events detection and prediction.

Refreshments will be served.
This lecture has a reception.

Center for Computation & Technology
2003 Digital Media Center • Telephone: +1 225/578-5890 • Fax: +1 225/578-8957