Department of Mathematics

University of Houston

Scientific Computing Seminar

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PDF/CDF Method for Uncertainty Quantification

Thursday,October 17, 2013
3:00 PM- 4:00 PM
Room 646 PGH

Abstract:

Ubiquitous heterogeneity and insufficient site characterizations render most physical systems uncertain. To quantify such uncertainty, it is common to treat the uncertain parameters in the governing equation as (correlated) random fields. Standard practices usually focus on the first two statistical moments of system states but in the case of rare events (probability tails), one must obtain the complete information of system states, e.g. their probabilistic density function (PDF) or cumulative density function (CDF).

In this presentation, two recently developed frameworks, the PDF/CDF methods, would be introduced to derive closed-form equations for the PDF/CDF of system states. They enable one to compute not only the probability of rare events, which is critical for risk assessment, but also uncertain parameters with arbitrary correlations.

To be specific, the PDF method, combined with a so-called large-eddy-diffusivity closure, would be employed to study the mesoscopic behavior of dynamical systems described by Langevin equations with colored noise (random fields with finite correlation length); while the CDF method is applied to nonlinear hyperbolic equations, namely, the kinematic wave equation and the Buckley-Leverett equation describing two-phase flow in porous media. We demonstrate the accuracy of the proposed methods through a series of tests against Monte Carlo Simulations.