Adaptive hierarchical sparse grid collocation methods for the solution of stochastic differential equations[1]

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Several critical phenomena like contaminant spread, nuclear waste disposal and oil recovery rely on accurate analysis and prediction of multiscale phenomena. Such analysis is complicated by inherent uncertainties as well as the limited information available to characterize the underlying system. In this talk, we will introduce a methodology that accounts for the stochastic and multiscale nature exhibited by such systems. In particular, we will discuss:

(1) A data driven strategy to incorporate limited experimental data into the stochastic analysis, (2) Effective computational strategies to solve the resulting stochastic partial differential equations (SPDEs) using adaptive hierarchical multi-linear sparse grid collocation techniques and (3) A stochastic variational multiscale formulation to incorporate uncertain multiscale features.

A number of examples will be presented to demonstrate the various techniques discussed. These include problems related to long-term integration and stochastic discontinuity, and flow in random heterogeneous media.

[1] Invited seminar at the Stony Brook Mathematics Department and the Institute for Mathematical Sciences, SUNY at Stony Brook (hosts Prof. Xiangmin (Jim) Jiao), Stony Brook, NY, April 2, 2008.