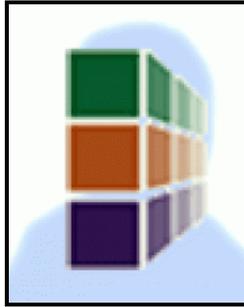


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### Special Guest Lectures

#### A Dimension-Adaptive Sparse Grid Stochastic Collocation Technique for Partial Differential Equations with High-Dimensional Random Input Data

Clayton Webster, Sandia National Laboratories

John von Neumann Fellow, Computer Science Research Institute

Johnston Hall 338  
January 22, 2008 - 03:40 pm

#### Abstract:

This talk will propose and analyze a dimension-adaptive (anisotropic) sparse grid stochastic collocation method for solving partial differential equations with random coefficients forcing terms (input data of the model). These methods have proven to have dramatic impact on several application areas, including statistical mechanics, financial mathematics, bioinformatics, and other fields that must properly predict certain model behaviors. The method consists of a Galerkin approximation in the space variables and a collocation, in probability space, on anisotropic sparse tensor product grids utilizing either Clenshaw-Curtis or Gaussian knots. Even in the presence of nonlinearities, the collocation approach leads to the solution of uncoupled deterministic problems, just as in sampling-based methods, such as Monte Carlo. This talk includes both a priori and a posteriori approaches to adapt the anisotropy of the sparse grids to each given problem. This talk will also provide a rigorous convergence analysis of the fully discrete problem and demonstrate strong error estimates for the solution using  $L_q$  norms. In particular, our analysis reveals at least an algebraic convergence with respect to the total number of collocation points. The derived estimates are then used to compare the efficiency of the method with other ensemble-based methods. Numerical examples illustrate the theoretical results and are used to compare this approach with several others, including the standard Monte Carlo. In particular, for moderately large dimensional problems, the sparse grid approach with a properly chosen anisotropy is very efficient and superior to all examined methods.

#### Speaker's Bio:

Clayton Webster is a computational mathematician at Sandia National Laboratories. He received his Ph.D. in 2007 from Florida State University. His research interests include numerical analysis, applied mathematics and computational science, with particular focus on: theoretical and numerical investigations of solutions to Stochastic PDEs (SPDEs); both Verification and Validation (V&V) and Uncertainty Quantification (UQ) in the realm of both abstract mathematical theory and numerical implementation and analysis; high-dimensional interpolation/integration when applied to both deterministic and stochastic problems; and stochastic reduced-order models, stochastic optimal control and parameter identification for nonlinear SPDEs.