

Department of Applied and Computational Mathematics and Statistics Colloquium



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Uncertainty Quantification via a Multi-Fidelity Model Reduction Approach

Realistic analysis and design of multi-disciplinary engineering systems require not only a fine understanding and modeling of the underlying physics and their interactions but also recognition of intrinsic uncertainties and their influences on the quantities of interest. Uncertainty Quantification (UQ) is an emerging discipline that attempts to address the latter issue: It aims at a meaningful characterization of uncertainties from the available measurements, as well as efficient propagation of these uncertainties through the governing equations for a quantitative validation of model predictions.

The use of model reduction has become widespread as a means to reduce computational cost of UQ of complex engineering systems. This talk introduces a model reduction technique that exploits the low-rank structure of the uncertain solution of interest – when exists – for fast propagation of high-dimensional uncertainties. To construct this low-rank approximation, the proposed method utilizes models with lower fidelities (hence cheaper to simulate) than the intended high-fidelity model. Using realizations of the lower fidelity solution, a set of reduced basis and an interpolation rule are identified and applied to a small set of high-fidelity realizations to obtain the low-rank, bi-fidelity approximation, which in turn will be employed to generate statistics of the high-fidelity solution. The talk will then focus on the convergence analysis of the method and discuss a verifiable condition for the low-fidelity model to lead to accurate, bi-fidelity approximation. Numerical examples will be presented to illustrate the performance of this approach.

Friday, March 8, 2019
4:15 PM – 5:15 PM
127 Hayes-Healy Center

Colloquium Tea 3:45 PM to 4:15 PM 101A Crowley Commons Room