

# Uncertainty quantification and multiscale modeling and design of complex engineering systems<sup>1</sup>

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This presentation will review a number of diverse computational techniques that are being developed in our laboratory towards predictive modeling and design under uncertainty of multiscale engineering systems. Particular topics to be discussed include the following:

- Development of an adaptive sparse grid collocation toolbox for (non-intrusive) uncertainty quantification of complex engineering systems.
- Data-driven non-linear (manifold learning) model reduction techniques for the input and output of stochastic PDE systems.
- Multiscale modeling of complex systems including propagation of uncertainty across length scales (e.g. flow in random heterogeneous media).
- Database and statistical learning approaches to multiscale materials modeling.
- Multiscale materials process design for control of microstructure-sensitive properties.

These topics will be highlighted with some preliminary examples demonstrating the methodologies and software under development and the potential industrial advances these techniques offer.

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<sup>1</sup> Invited presentation at ANSYS Inc., Lebanon, NH, June 2, 2008 (host: Lewis Collins).