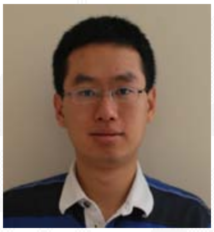
PRISM Seminar Series

Friday, February 1st, 2013
12:30 pm, BRK 1001

"A Framework for Uncertainty Quantification: Calibration, Validation, and Computational Resource Allocation"



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Abstract: A comprehensive view of uncertainty quantification (UQ) includes several activities in order to account for various sources of errors and uncertainty in engineering systems. In this talk, we will first focus on two of these UQ activities: model calibration and model validation, and then discuss an efficient uncertainty propagation algorithm based on model selection.

In our approach, model calibration is performed using a Bayesian network built upon the Kennedy-O'Hagan framework, which includes a discrepancy term to account for inadequacy in the form of the physics model. The model discrepancy may include both bias and variance corrections, each of which may be either constant or varying with respect to the model inputs.

In model validation, we assess the predictive capability of the model under uncertainty. Two model validation metrics will be introduced: Bayes factor and a reliability-based metric, each of which provides a clear probabilistic interpretation.

Propagating uncertainties to a system-level quantity of interest (QoI) can be very expensive when system models require a large amount of computation. To address this issue, we often utilize cheaper models in the form of mathematical surrogates or reduced-order and reduced-physics models. We discuss a procedure for efficiently selecting among the available options with the goal of accurately predicting the distribution of the QoI.

Speaker Bios: You Ling is a doctoral student under Prof. Sankaran Mahadevan in the department of civil and environmental engineering at Vanderbilt University. He obtained his bachelor's degree from Shanghai Jiao Tong University in China and master's degree from Vanderbilt University. He is currently working on time-dependent reliability analysis of microelectro-mechanical system (MEMS) devices with focus on uncertainty quantification (model calibration, model validation, and uncertainty propagation).

Joshua Mullins is currently a doctoral student under Prof. Sankaran Mahadevan in the department of civil engineering at Vanderbilt University. He has previously received a bachelor's degree and master's degree from the same institution. His research interests include calibration, validation, and uncertainty quantification with a particular focus on resource allocation for both physical experiments and computational simulations.