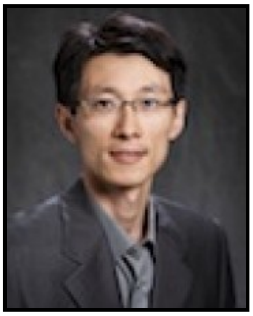

Computational Mathematics Seminar Series

Coupling the reduced-order model and the generative model for an importance sampling estimator

Xiaoliang Wan, Louisiana State University

Associate Professor

Digital Media Center 1034
April 02, 2019 - 03:30 pm

Abstract:

In this work, we develop an importance sampling estimator by coupling the reduced-order model and the generative model in a problem setting of uncertainty quantification. The target is to estimate the probability that the quantity of interest (QoI) in a complex system is beyond a given threshold. To avoid the prohibitive cost of sampling a large scale system, the reduced-order model is usually considered for a trade-off between efficiency and accuracy. However, the Monte Carlo estimator given by the reduced-order model is biased due to the error from dimension reduction. To correct the bias, we still need to sample the fine model. An effective technique to reduce the variance reduction is importance sampling, where we employ the generative model to estimate the distribution of the data from the reduced-order model and use it for the change of measure in the importance sampling estimator. To compensate the approximation errors of the reduced-order model, more data that induce a slightly smaller QoI than the threshold need to be included into the training set. Although the amount of these data can be controlled by a posterior error estimate, redundant data, which may outnumber the effective data, will be kept due to the epistemic uncertainty. To deal with this issue, we introduce a weighted empirical distribution to process the data from the reduced-order model. The generative model is then trained by minimizing the cross entropy between it and the weighted empirical distribution. We also introduce a penalty term into the objective function to deal with the overfitting for more robustness. Numerical results are presented to demonstrate the effectiveness of the proposed methodology.

Speaker's Bio:

Xiaoliang Wan received his PhD in Applied Mathematics from Brown University in 2007. After a two-year postdoc training at MIT and Princeton University, he joined LSU as an assistant professor in 2009. He is now an associate professor in the department of mathematics at LSU. He researches numerical algorithms for stochastic modeling and uncertainty quantification.

This lecture has refreshments @ 03:00 pm

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