A hybrid HPC framework with analysis for a class of stochastic models

Dr. M. Ganesh
Professor, Colorado School of Mines, USA

We consider a class of wave propagation models with aleatoric and epistemic uncertainties. Using mathematical analysis-based, shape-independent, a priori parameter estimates, we develop offline/online strategies to compute statistical moments of a key quantity of interest in such models. We present an efficient reduced order model (ROM)and high performance computing (HPC) framework with analysis for quantifying aleatoric and epistemic uncertainties in the propagation of waves through a stochastic media comprising a large number of three dimensional particles.

Simulation even for a single deterministic three dimensional configuration is inherently difficult because of the large number of particles. The aleatoric uncertainty in the model leads to a larger dimensional system involving three spatial variables and additional stochastic variables. Accounting for epistemic uncertainty in key parameters of the input probability distributions leads to prohibitive computational complexity. Our hybrid ROM and HPC framework can be used in conjunction with any computational method to simulate a single particle deterministic wave propagation model.