Abstract Submitted
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A new paradigm for variable-fidelity stochastic simulation and information fusion in fluid mechanics[1] DANIELE VENTURI, Univ of California-Santa Cruz, LUCIA PARUSSINI, University of Trieste, PARIS PERDIKARIS, Massachusetts Institute of Technology, GEORGE KARNIADAKIS, Brown University — Predicting the statistical properties of fluid systems based on stochastic simulations and experimental data is a problem of major interest across many disciplines. Even with recent theoretical and computational advancements, no broadly applicable techniques exist that could deal effectively with uncertainty propagation and model inadequacy in high-dimensions. To address these problems, we propose a new paradigm for variable-fidelity stochastic modeling, simulation and information fusion in fluid mechanics. The key idea relies in employing recursive Bayesian networks and multi-fidelity information sources (e.g., stochastic simulations at different resolution) to construct optimal predictors for quantities of interest, e.g., the random temperature field in stochastic Rayleigh-Bénard convection. The object of inference is the quantity of interest at the highest possible level of fidelity, for which we can usually afford only few simulations. To compute the optimal predictors, we developed a multivariate recursive co-kriging approach that simultaneously takes into account variable fidelity in the space of models (e.g., DNS vs. potential flow solvers), as well as variable-fidelity in probability space. Numerical applications are presented and discussed.

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