Abstract Submitted
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Unbiased multi-fidelity estimate of failure probability of a free plane jet[1] ALEXANDRE MARQUES, BORIS KRAMER, KAREN WILLCOX, Massachusetts Inst of Tech-MIT, BENJAMIN PEHERSTORFER, University of Wisconsin-Madison — Estimating failure probability related to fluid flows is a challenge because it requires a large number of evaluations of expensive models. We address this challenge by leveraging multiple low fidelity models of the flow dynamics to create an optimal unbiased estimator. In particular, we investigate the effects of uncertain inlet conditions in the width of a free plane jet. We classify a condition as failure when the corresponding jet width is below a small threshold, such that failure is a rare event (failure probability is smaller than 0.001). We estimate failure probability by combining the frameworks of multi-fidelity importance sampling and optimal fusion of estimators. Multi-fidelity importance sampling uses a low fidelity model to explore the parameter space and create a biasing distribution. An unbiased estimate is then computed with a relatively small number of evaluations of the high fidelity model. In the presence of multiple low fidelity models, this framework offers multiple competing estimators. Optimal fusion combines all competing estimators into a single estimator with minimal variance. We show that this combined framework can significantly reduce the cost of estimating failure probabilities, and thus can have a large impact in fluid flow applications.

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