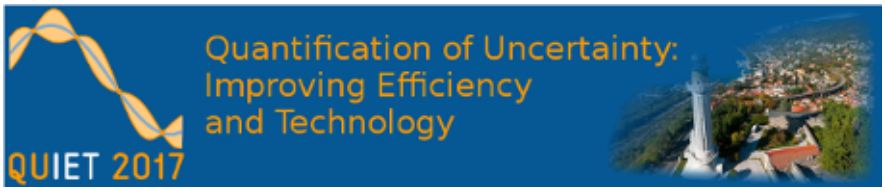

Multifidelity methods for uncertainty propagation and rare event simulation

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In many situations across computational science and engineering, multiple computational models are available that describe a system of interest. These different models have varying evaluation costs and varying fidelities. Typically, a computationally expensive high-fidelity model describes the system with the accuracy required by the current application at hand, while lower-fidelity models are less accurate but computationally cheaper than the high-fidelity model. Uncertainty quantification typically requires multiple model solves at many different inputs, which often leads to computational demands that exceed available resources if only the high-fidelity model is used. We present multifidelity methods for uncertainty propagation and rare event simulation that leverage low-cost low-fidelity models for speedup and occasionally make recourse to the expensive high-fidelity model to establish unbiased estimators. Our methods combine low-fidelity models of any type, including projection-based reduced models, data-fit models and response surfaces, coarse-grid approximations, and simplified-physics models. Our numerical results demonstrate that our multifidelity methods achieve significant speedups while providing unbiased estimators, even in the absence of error control for the low-fidelity models.