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MULTIFIDELITY UNCERTAINTY QUANTIFICATION FOR NON-DETERMINISTIC MODELS

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Multifidelity Uncertainty Quantification (MF UQ) allows for the reduction of the computational cost of uncertainty propagation for high-fidelity applications by fusing information from models with varying cost and accuracy. Virtually all existing MF UQ strategies can achieve high efficiency whenever high correlations exist among quantities of interests obtained from different models. Non-deterministic models are useful in a variety of scientific and engineering applications like turbulent flow simulations, particle-in-cell methods for plasmas, modeling of material microstructures, and radiation transport. Such models are characterized by an uncontrollable source of variability that, by augmenting the variability due to random inputs, can degrade the correlation among model outputs. In turn, degraded correlations reduce the efficacy of MF UQ strategies. For non-deterministic models, realizations corresponding to the same random inputs lead to different values. Therefore, it is only possible to obtain meaningful quantities of interests by defining statistics over the replicates. Statistics over the replicates (*e.g.* expected values) are beneficial for MF UQ because they can decrease the models' uncontrollable variability and increase the correlation. However, running enough replicates also significantly increases the computational cost. In this contribution, we explore the effect of the number of replicates on the performance of MF UQ strategies. More formally, we will consider the all-at-once sample allocation problem for a fixed cost augmented by the selection of the optimal number of replicates for each model. The goal is reaching the most effective trade-off between exploring the random space and increasing the correlation at any one point in the space. Numerical results for several applications scenarios will be presented and discussed for the MF UQ strategies performance with respect to their single fidelity counterparts.

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