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Multifidelity Uncertainty Quantification Strategies for Computational Fluid Dynamics Applications

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ABSTRACT

The accurate evaluation of the performance of complex engineering systems often relies on accurate, but extremely computationally intensive numerical simulations. In recent years, the need for a characterization of a system under unknown operating conditions led to increasing interest in Uncertainty Quantification (UQ) analysis. Even when relying on advanced numerical algorithms, UQ analyses are still limited to fairly simplified models of the original systems. Moreover, the high-dimensionality of the stochastic space and the need for taking into account distinct physical components of a complex device, as for example in aero-elastic or aero-thermal applications, greatly increase the challenges for the UQ analysis. To cope with the limited computational budget associated with the high-fidelity solutions, alternative UQ strategies have recently been introduced (for instance [1,2]) to complement a small set of high-fidelity expensive simulations with a larger number of low-fidelity realizations. The main idea is to use the HF simulations to reduce the bias of the statistical estimators and to rely on less expensive, albeit less accurate, LF models to reduce the variance of the estimators [2] or extract *a priori* information about the optimal collocation of the high-fidelity samples [3]. In this minisymposium, we welcome contributions related to the broad area of multifidelity UQ analysis with a particular emphasis on problems in which fluid dynamics and its physical modelling plays a fundamental role. We also welcome contributions in which the multifidelity UQ analysis is a main component of broader activities, as for instance optimization under uncertainty or sensitivity analysis for complex engineering devices.

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