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Multilevel UQ strategies for large-scale multiphysics applications: PSAAP II solar receiver[1] LLUIS JOFRE, GIANLUCA GERACI, GIANLUCA IACCARINO, Stanford Univ — Uncertainty quantification (UQ) plays a fundamental part in building confidence in predictive science. Of particular interest is the case of modeling and simulating engineering applications where, due to the inherent complexity, many uncertainties naturally arise, e.g. domain geometry, operating conditions, errors induced by modeling assumptions, etc. In this regard, one of the pacing items, especially in high-fidelity computational fluid dynamics (CFD) simulations, is the large amount of computing resources typically required to propagate incertitude through the models. Upcoming exascale supercomputers will significantly increase the available computational power. However, UQ approaches cannot entrust their applicability only on brute force Monte Carlo (MC) sampling; the large number of uncertainty sources and the presence of nonlinearities in the solution will make straightforward MC analysis unaffordable. Therefore, this work explores the multilevel MC strategy, and its extension to multi-fidelity and time convergence, to accelerate the estimation of the effect of uncertainties. The approach is described in detail, and its performance demonstrated on a radiated turbulent particle-laden flow case relevant to solar energy receivers (PSAAP II: Particle-laden turbulence in a radiation environment).

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