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Adaptive uncertainty quantification using adjoint method and generalized polynomial chaos[1] QIQI WANG, TONKID CHANTRASMI, GIANLUCA IACCARINO, PARVIZ MOIN, Stanford University — Uncertainty quantification of numerical results is a pacing item for numerical simulation of complex engineering systems. This work focuses on uncertainty quantification of complicated physical processes with a very large number of uncertain parameters. Since numerical simulations of complex flows are typically computationally intensive, a balance between the detail of the physical models and the complexity of uncertainty quantification model is critical. Without careful consideration, one can easily become the bottleneck in prediction quality or computational cost. We propose an adaptive procedure to address this challenge. In our uncertainty quantification framework, an adjoint based perturbation method is first used. From the result of the perturbation method, the uncertain parameters that have the largest magnitude and most heavily influence the quantities of interest are selected. Then a polynomial chaos based expansion is used for these critical parameters only. This allows to build accurate response surface without assumptions on the correlations between the uncertain parameters. We will discuss application of our method to the numerical solution of the Navier Stokes equations.

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