Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Adaptive uncertainty quantification using adjoint method and
generalized polynomial chaos\textsuperscript{1} QIQI WANG, TONKID CHANTRASMI, GI-
ANLUCA IACCARINO, PARVIZ MOIN, Stanford University — Uncertainty quan-
tification 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 numer-
cal simulations of complex flows are typically computationally intensive, a balance
between the detail of the physical models and the complexity of uncertainty quant-
tification 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 heav-
ily 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 pa-
rameters. We will discuss application of our method to the numerical solution of
the Navier Stokes equations.

\textsuperscript{1}Supported by DOE/ASC program.

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Date submitted: 15 Aug 2006

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