Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

A Novel Uncertainty Propagation Model for the Burgers Equation[1] TONKID CHANTRASMI, QIQI WANG, GIANLUCA IACCARINO, PARVIZ MOIN, Stanford University — Uncertainty quantification is indispensable to numerical simulations of complex multi-physics problems with sophisticated models. The Monte Carlo approach is statistically sound but extremely expensive; and for this reason it usually requires the development of reduced models of the original system to obtain sufficient realizations. In such a situation, since the prediction quality will be affected by the decreased fidelity of the models, there is no need to quantify the uncertainty too accurately. This suggests the possibility of modeling the uncertainty propagation with the objective of reducing the number of realizations required to achieve the same level of prediction quality for a given computational cost. This work focuses on developing such an approach for the Burgers equation. We decompose the unknown variables into mean and fluctuating parts (in probability space), then derive the corresponding equations starting from the original PDE. General observations and comparisons to several other uncertainty quantification approaches, such as polynomial chaos, are made. Like in turbulence modeling, the non-linearity in the PDE introduces unclosed higher-moment terms and these require modeling. A number of possible closures are proposed and investigated in details.

[1]This work is supported by the US Dept. of Energy in the framework of the ASC program.

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Date submitted: 22 Aug 2006 Electronic form version 1.4