Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Evaluation and Quantification of Uncertainty of RANS turbulence and turbulent mixing models for a separated flow[1] CATHERINE GORLE, Stanford University, RICCARDO ROSSI, Universita di Bologna, Stanford University, GIANLUCA IACCARINO, Stanford University — The inability of the k-ε and k-ω RANS turbulence models to correctly predict flow separation and reattachment limits the reliability of simulations of complex flows. When also predicting the turbulent diffusion of a scalar, algebraic models for the scalar fluxes, which rely on the turbulent viscosity or Reynolds stresses predicted by the turbulence model, introduce additional errors in the solution. In the present work these errors are evaluated by comparing the Reynolds stresses obtained from the RANS models to DNS results for the flow over a wavy wall. The effect of the coupling to the mean flow is eliminated by freezing the flow to the time-averaged DNS flow field and only solving the transport equations for the turbulence quantities. The goal of this analysis is to establish a statistical model for the errors in the modeled Reynolds stresses. The errors are investigated in terms of the turbulence kinetic energy and eigenvalues and eigenvectors of the anistropy tensor. The statistical models for these quantities are used to perturb the Reynolds stresses and quantify the uncertainty in the location of the reattachment point. By also introducing the perturbations in an algebraic model formulation for the scalar fluxes the capability of quantifying the uncertainty in scalar mixing is investigated.

[1]This material is based upon work supported by the DoE [NNSA] under Award Number NA28614.

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Date submitted: 12 Aug 2012 Electronic form version 1.4