Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Large-Eddy Simulation of Turbulent Flows with Thermal Radiation and Turbulence/Radiation Interaction[1] DANIEL HAWORTH, VARUN SINGH, ANKUR GUPTA, MICHAEL MODEST, The Pennsylvania State University — Standard subgrid-scale turbulence models and commercial CFD solvers (FLUENT and STAR-CD) have been employed to explore turbulence/radiation interaction (TRI) using large-eddy simulation (LES). The configuration is planar turbulent channel flow between two infinite, parallel, stationary, plates at different constant temperatures. First, the capabilities and limitations of the codes in predicting correct turbulent velocity and passive temperature field statistics were established through comparisons to DNS data from the literature. Next, a radiative transfer equation solution was added using either spherical harmonics (P1) or discrete- ordinates methods. Radiation properties correspond to a fictitious gray gas with a temperature-dependent Planck-mean absorption coefficient that mimics that of typical hydrocarbon- air combustion products. Simulations were performed for different optical thicknesses. In the absence of chemical reaction, temperature fluctuations and TRI are small, consistent with earlier findings. The addition of chemical reaction enhances the temperature fluctuations, and hence the importance of TRI. This study represents a first step towards using LES to explore and model thermal radiation and TRI in chemically reacting turbulent flows.

[1]Supported by the National Science Foundation under Grant No. 0121573.

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Date submitted: 29 Jul 2005 Electronic form version 1.4