Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

A Reaction Progress Variable Approach for LES of Sooty Flames[1]

AMIT KUMAR, PAUL DESJARDIN[2], University at Buffalo, the State University of New York — A reaction progress variable approach is developed for subgrid scale (SGS) modeling of non-premixed sooty turbulent diffusion flames using a mixture fraction conserved scalar approach. Two- phase state-relations are constructed using three reaction progress variables to account for the soot formulation processes and radiation heat loss. Source/sink terms for soot formulation are based on existing phenomenological models and discrete ordinate method (DOM) is used to solve the radiative transfer equation. An assumed beta PDF distribution is used for characterizing the variation of the SGS two-phase mixture fraction for Large Eddy Simulation (LES). The resulting formulation couples the combustion, soot and radiation models to provide a self-consistent methodology to close SGS turbulence-chemistry-radiation interactions. Simulations are conducted of a turbulent diffusion flame for the experimental conditions of Coppalle and Joyeux. Comparisons are conducted of mean and RMS temperature, soot volume fraction to experimental data. A sensitivity study reveals the importance of turbulence-radiation interactions and the dependence of the results on modeling approximations.

[1]This work is supported by the National Science Foundation (NSF) under grant No. CTS-0348110

[2]corresponding author

Paul DesJardin
University at Buffalo, the State University of New York

Date submitted: 06 Aug 2006 Electronic form version 1.4