Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

LES/FMDF of High Speed Spray Combustion ABOLFAZL IRANNEJAD, FARHAD JABERI, Michigan State University — High speed evaporating and combusting sprays are computed with the hybrid two-phase large eddy simulation (LES)/filtered mass density function (FMDF) methodology. In this methodology, the resolved fluid velocity is obtained by solving the filtered form of the compressible Navier-Stokes equations with high-order finite difference schemes. The scalar (temperature and species mass fractions) field is obtained by solving the FMDF transport equation with a Lagrangian stochastic method. The spray is simulated with the Lagrangian droplets together with stochastic breakup and finite rate heat and mass transfer models. The liquid volume fraction is included in the LES/FMDF for denser spray regions. Simulations of high speed evaporating sprays with and without combustion for a range of gas and spray conditions indicate that the two-phase LES/FMDF results are consistent and compare well with the experimental results for global spray variables such as the spray penetration and flame lift-off lengths. The gas velocity and turbulence generated by the spray are found to be very significant in all simulated cases. A broad spectrum of droplet sizes is also found to be generated by the complex and coupled effects of the gas flow turbulence, droplet breakup, evaporation and combustion.

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Date submitted: 25 Jul 2013 Electronic form version 1.4