Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Large Eddy Simulations of Two-phase Turbulent Reactive Flows in IC Engines ARAZ BANAEIZADEH, HAROLD SCHOCK, FARHAD JABERI, Michigan State University — The two-phase filtered mass density function (FMDF) subgrid-scale (SGS) model is used for large-eddy simulation (LES) of turbulent spray combustion in internal combustion (IC) engines. The LES/FMDF is implemented via an efficient, hybrid numerical method. In this method, the filtered compressible Navier-Stokes equations in curvilinear coordinate systems are solved with a generalized, high-order, multi-block, compact differencing scheme. The spray and the FMDF are implemented with Lagrangian methods. The reliability and the consistency of the numerical methods are established for different IC engines and the complex interactions among mean and turbulent velocity fields, fuel droplets and combustion are shown to be well captured with the LES/FMDF. In both spark-ignition/direct-injection and diesel engines, the droplet size and velocity distributions are found to be modified by the unsteady, vortical motions generated by the incoming air during the intake stroke. In turn, the droplets are found to change the in-cylinder flow structure. In the spark-ignition engine, flame propagation is similar to the experiment. In the diesel engine, the maximum evaporated fuel concentration is near the cylinder wall where the flame starts, which is again consistent with the experiment.

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Date submitted: 31 Jul 2008 Electronic form version 1.4