

Abstract Submitted
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Framework for simulating droplet vaporization in turbulent flows

JOHN PALMORE, OLIVIER DESJARDINS, Cornell University — A framework for performing direct numerical simulations of droplet vaporization is presented. The work is motivated by spray combustion in engines wherein fuel droplets vaporize in a turbulent gas flow. The framework is built into a conservative finite volume code for simulating low Mach number turbulent multiphase flows. Phase tracking is performed using a discretely conservative geometric volume of fluid method, while the transport of mass fraction and temperature is performed using the BQUICK scheme. Special attention is given to the implementation of transport equations near the interface to ensure the consistency between fluxes of mass, momentum, and scalars. The effect of evaporation on the flow appears as a system of coupled source terms which depend on the local thermodynamic equilibrium between the phases. The sources are implemented implicitly using an unconditionally stable, monotone scheme. Two methodologies for resolving the system's thermodynamic equilibrium are compared for their accuracy, robustness, and computational expense. Verification is performed by comparing results to known solutions in one and three dimensions. Finally, simulations of droplets vaporizing in turbulence are demonstrated, and trends for mass fraction and temperature fields are discussed.

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