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LES/filtered-density function approach for turbulent spray combustion VENKATRAMANAN RAMAN, HEESEOK KOO, The University of Texas at Austin, OLIVIER DESJARDINS, Stanford University — Spray systems provide a unique challenge in that both non-premixed and premixed regimes can coexist in the same flow. The nature of flame propagation is determined by, among other factors, the spray dispersion in the gas-phase and the rate of mixing prior to reaction. This leads to a rich variety of flame structures and compounds the modeling process. While much of the work on spray combustion has focused on understanding spray dispersion, a comprehensive model for the combustion process is yet to be formulated. In this work, we propose a novel large-eddy simulation/filtered-density function (LES/FDF) approach to modeling the spray combustion process. Here, unlike other methods, the chemical source appears closed. This unique property allows different combustion regimes to be represented using a single model. However, the sub-filter mixing term needs to be modeled. A Monte-Carlo based stochastic method is used along with novel algorithms to ensure temporal accuracy and theoretical consistency of the coupled LES/FDF approach. The liquid spray droplets are simulated using a Lagrangian particle tracking scheme. Canonical flow configurations are used to demonstrate the feasibility of this new approach. Further, experiments from the University of Sydney are used to understand the impact of sub-filter models on predictive accuracy of the method.

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