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Lagrangian analysis of premixed turbulent combustion in hydrogen-air flames[1] RYAN DARRAGH, University of Colorado - Boulder, ALEXEI POLUDNENKO, Texas A&M University, PETER HAMLINGTON, University of Colorado - Boulder — Lagrangian analysis has long been a tool used to analyze non-reacting turbulent flows, and has recently gained attention in the reacting flow and combustion communities. The approach itself allows one to separate local molecular effects, such as those due to reactions or diffusion, from turbulent advective effects along fluid pathlines, or trajectories. Accurate calculation of these trajectories can, however, be rather difficult due to the chaotic nature of turbulent flows and the added complexity of reactions. In order to determine resolution requirements and verify the numerical algorithm, extensive tests are described in this talk for prescribed steady, unsteady, and chaotic flows, as well as for direct numerical simulations (DNS) of non-reacting homogeneous isotropic turbulence. The Lagrangian analysis is then applied to DNS of premixed hydrogen-air flames at two different turbulence intensities for both single- and multi-step chemical mechanisms. Non-monotonic temperature and fuel-mass fraction evolutions are found to exist along trajectories passing through the flame brush. Such non-monotonicity is shown to be due to molecular diffusion resulting from large spatial gradients created by turbulent advection.

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