Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Adjoint-based approach to Enhancing Mixing in Rayleigh-Taylor Turbulence ALI KORD[1], JESSE CAPECELATRO[2], Univ of Michigan - Ann Arbor — A recently developed adjoint method for multi-component compressible flow is used to measure sensitivity of the mixing rate to initial perturbations in Rayleigh-Taylor (RT) turbulence. Direct numerical simulations (DNS) of RT instabilities are performed at moderate Reynolds numbers. The DNS are used to provide an initial prediction, and the corresponding space-time discrete-exact adjoint provides a sensitivity gradient for a specific quantity of interest (QoI). In this work, a QoI is defined based on the time-integrated scalar field to quantify the mixing rate. Therefore, the adjoint solution is used to measure sensitivity of this QoI to a set of initial perturbations, and inform a gradient-based line search to optimize mixing. We first demonstrate the adjoint approach in the linear regime and compare the optimized initial conditions to the expected values from linear stability analysis. The adjoint method is then used in the high Reynolds number limit where theory is no longer valid. Finally, chaos is known to contaminate the accuracy of the adjoint gradient in turbulent flows when integrated over long time horizons. We assess the influence of chaos on the accuracy of the adjoint gradient to guide the work of future studies on adjoint-based sensitivity of turbulent mixing.

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Date submitted: 27 Jul 2016 Electronic form version 1.4