Poster 2 Vold

Compressible aspects in simulations of multi-mode Rayleigh-Taylor mixing

Erik L. Vold

Los Alamos National Laboratory
elv@lanl.gov

Compressible aspects of the Rayleigh-Taylor mixing layer are explored in 2-D (x-y) multi-mode IC resolved scale simulations solving the multi-fluid Euler equations with interface reconstruction. R-T mix layer growth rates are computed in an 'incompressible limit' and found to be in agreement with experimental data across the range of Atwood numbers (0.04-0.96) for bubbles and for spikes. Fluctuation contributions to mixing are examined in contour plots, profiles of transverse averaged quantities, and in spectra of pressure and pressure components, momentum components, and the advection and compressible terms in the density and energy equations.

Results show pressure fluctuations are driven by density fluctuations with a comparable contribution from the energy fluctuations omitted in incompressible formulations. Transverse planar averaged magnitudes of fluctuations for density over that for internal energy are less than unity in the bubble growth region and greater than unity in the spike growth region, implying fluctuations are dominated by different contributions in each region. The magnitudes of compressible terms compared to the incompressible advection terms in the density and in the energy equations show significant trends averaged across the mix layer. Compressible contributions to fluctuations are most important for density in the bubble growth region and for internal energy in the spike growth region. Long wave length modes in the initial conditions, which have been proposed by others as a mechanism for enhanced mix layer growth rates, are seen to be inescapable in the present multi-fluid compressible formulation. Vorticity and other fluctuating components play key roles in dissipating the instability acceleration into the transverse plane and thus establishing the characteristic gradient scale lengths across the mix layer and the effective mix layer growth rates within each fluid region.

The results together show that density and internal energy fluctuations, including the compressibility terms, are significant contributions to the dynamics. This supports the concept that mix layer growth is driven by interface physics which depends upon discontinuities in both density and in internal energy. It is hypothesized that this physics must be properly represented in a multi-fluid simulation in order to match multi-mode growth rates in experiments even in the 'incompressible limit'.