Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

The Rayleigh-Taylor Instability driven by an accel-decel-accel profile[1] PRAVEEN RAMAPRABHU, VARAD KARKHANIS, University of North Carolina at Charlotte, ANDREW LAWRIE, University of Bristol, United Kingdom — We describe numerical simulations of the miscible Rayleigh-Taylor (RT) instability driven by a complex acceleration history, g(t), with initially destabilizing acceleration, $g > 0$, an intermediate stage of stabilizing deceleration, $g < 0$, and subsequent destabilizing acceleration, $g > 0$. Initial perturbations with both single wave-number and a spectrum of wave-numbers (leading to a turbulent front) have been considered with these acceleration histories. We find in the single-mode case that the instability undergoes a so-called phase inversion during the first acceleration reversal from $g > 0$ to $g < 0$. If the zero-crossing of g(t) occurs once the instability growth has reached a state of nonlinear saturation, then hitherto rising bubbles and falling spikes reverse direction and collide, resulting in small-scale structures. For multi-mode perturbations, we find that bubbles and spikes collide during phase inversion, the interfacial region is turbulent, and undergoes a period of enhanced structural breakdown. This is accompanied by a rapid increase in the rate of molecular mixing, and increasing isotropy within the region. During the final stage of $g > 0$ acceleration, self-similar RT mixing re-emerges, together with a return to anisotropy.

[1]This work was supported in part by the (U.S.) Department of Energy (DOE) under Contract No. DE-AC52-06NA2-5396.

Praveen Ramaprabhu
University of North Carolina at Charlotte

Date submitted: 01 Aug 2013 Electronic form version 1.4