Rayleigh-Taylor experiments for low Atwood numbers with Multimodal Initial conditions

Sarat chandra Kuchibhatla[1], **Peter Koppenberger** [1], **Bhanesh babu Akula** [1], **Jacob McFarland**[1], **Malcolm Andrews**[2], **& Devesh Ranjan**[1*]

1. Department of Mechanical Engineering, Texas A&M University, College Station, TX USA
*dranjan@tamu.edu

2. Los Alamos National Laboratory, Los Alamos, NM USA

Rayleigh-Taylor Experiments were carried out in the Water Tunnel facility of TAMU with Multimodal initial conditions. A servo-motor actuated flapper mechanism was utilized to precisely control the amplitude and wavelength of the initial perturbation. The design and working of this flapper mechanism has been described in detail in the master's thesis of Doron (2009). Preliminary experiments with single-mode initial conditions were performed to replicate the characteristic behavior of RT instabilities. The uniqueness of these experiments lies in the accuracy and repeatability of the initial conditions which has been generated by a high-precision servo motor. Observations of the buoyancy driven mixing layer was performed by making one stream with a Nigrosene dye. High quality image of the mixing layer were obtained using a high resolution digital camera.

We will present results from our recent experiments in which the prescribed initial conditions are multi-modal sinusoidal waves with different phase angle and amplitudes. When a phase shift of 90 degrees is introduced between the two modes, we see a leaning phenomenon as the perturbations grow in time. Characteristics of the interactions such as dominant modes, superposition and saturation in bubble and spike growth are explored from our experiments which consisted of more than three modes. Study of visualized flow structures and statistical analysis of mixing characteristics of the flow were performed for each experimental scenario. During our presentation we will highlight the effects of phase-shift and amplitude variation on the developing buoyancy-driven turbulent mixing region. Bubble and spike velocities are also compared with Goncharvov's velocity model(2002).

References

Doron, Y., "Effect of Single Mode Initial Conditions in Rayleigh-Taylor Turbulent Mixing"; *M.S Thesis, Texas A&M University*,(2009).

Goncharov, N.A, "Analytical model of Non-linear, Single-mode, Classical Rayleigh-Taylor instability at arbitrary Atwood numbers"; *Physical Review Letters* **88, 13**, 001-004 (2002).