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Investigation of the hydrodynamic instability induced by multi-acceleration of a contact surface between two fluids

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Abstract

The hydrodynamic instability, which develops on the contact surface between two fluids, has crucial importance in achieving ignition condition in inertial confinement fusion (ICF), and better understanding astrophysical phenomena. In those applications acceleration waves pass across a material interface and initiate and enhance unstable conditions in which small perturbations grow dramatically. During the past decade efforts have been made to develop understanding on the instability evolution in the single wave situation. However, in those applications the contact surface experiences several acceleration waves.

In the present study a multi-acceleration condition has been created in a shock tube apparatus in order to mimic experimentally, in more convenience measurement conditions, the hydrodynamic instability. To achieve the multi-accelerate waves, different gas configurations were used. In shock tube experiments the incident shock wave initiate the Richtmyer-Meshkov instability; the reflected shock hits again the contact surface and enhances the mixing process. The passage of the reflected shock through the contact surface creates a secondary reflected wave, which can be either a refraction wave or a compression wave (a shock wave) depending on the gas combination. This wave hits the unstable contact surface once again after reflecting from the end-wall. The end-wall distance from the initial contact surface position controls the duration of the above-described interaction with waves.

In the present study the experimental technique will be described, it will be followed by the experimental results in the multi-mode initial conditions and single-mode initial conditions. A comparison of the experimental results with numerical simulations and analytical models will be presented.