Linear Analysis of the Multi-layer Richtmyer-Meshkov Instability in the Presence of an Azimuthal Magnetic Field

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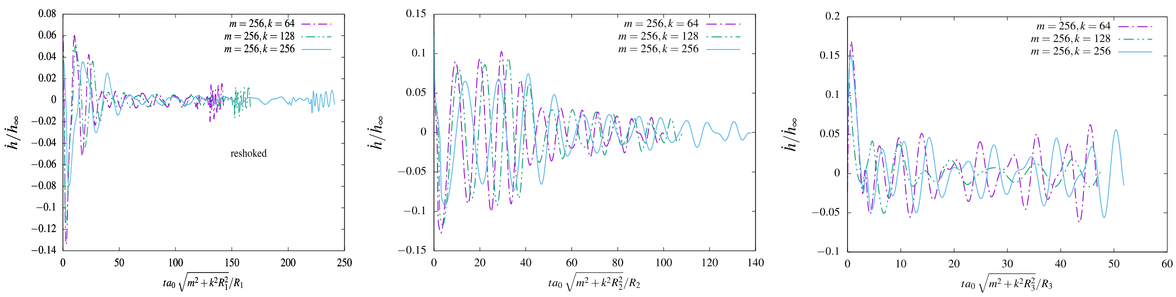
Abstract:

Richtmyer-Meshkov instability (RMI) grows when a perturbed density interface is accelerated by a shock. It occurs widely in technological applications and natural phenomena, such as supernovas and inertia confinement fusion (ICF). In ICF, a multi-material-layer capsule is heated by high-power lasers that drive an imploding shock into the capsule, compressing the fuel to a hotspot of sufficiently high temperature and pressure to initiate fusion reactions. RMI is one main reason for ignition failure in the ICF, and it should be suppressed.

In this work, by splitting the governing equations into base and perturbed parts, we numerically investigated the linear evolution of multi-layer RMI in the cylindrical geometry. The fluids are separated by the perturbed layers with a combined azimuthal (m) and axial (k) wavenumbers. The varying densities ratios are studied in this work. In addition, the effect of an external azimuthal magnetic field on RMI is investigated. Fig. 1 shows three-layer RMI results with varying wavenumbers in the presence of azimuthal magnetic field with strength β=4. Each contact discontinuities, denoted by 〖CD〗_1, CD〗_2 and 〖CD〗_3, are initialized at the positions R_1, R_2 and R_3, respectively. It shows that the growth rates of the instabilities are more stabilized by increasing the wavenumber in terms of the applied magnetic field.



a) CD_1 b) CD_2 c) CD_3

Figure1. Normalized growth rates of the perturbed contact discontinuities for m=256, k=64,128, 256 and β=4: a) 〖CD〗_1, b) 〖CD〗_2 and c) 〖CD〗_3.