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Impulse-driven Richtmyer-Meshkov instability in Hall-magnetohydrodynamics[1] NAIJIAN SHEN, DALE PULLIN, California Institute of Technology, VINCENT WHEATLEY, University of Queensland, RAVI SAMTANEY, King Abdullah University of Science and Technology —
We utilize the incompressible, Hall-MHD model for conducting fluids to investigate the effect of Hall current on the stability of an impulsively-accelerated, perturbed density interface, or contact discontinuity (CD) separating two fluids in the presence of a background magnetic field. This is used as a simple model, in a conducting fluid, of a Richtmyer-Meshkov (RM) flow that is characterized in a neutral-fluid by a shock-wave-density-interface interaction. The linearized equations of motion are formulated for a sinusoidal interface perturbation, and then solved as an initial-value problem using a Laplace transform method. The presence of the magnetic field is found to suppress the incipient interfacial growth associated with neutral-gas, RM instability (RMI). When the ion skin depth is finite, the vorticity dynamics that drive the suppression of the RMI differs markedly from the ideal MHD, RM flow. Hall MHD allows the presence of a tangential slip velocity leading to finite circulation deposition at the CD. Vorticity is produced by the perturbed magnetic fields and transported to infinity by a dispersive wave system leading to decay of the velocity slip at the interface with the effect that that interface growth remains bounded but distorted by damped oscillations.

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