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Lessons Learned from Numerical Simulations of Interfacial Instabilities[1] ANDREW COOK, LLNL — Rayleigh-Taylor (RT), Richtmyer-Meshkov (RM) and Kelvin-Helmholtz (KH) instabilities serve as efficient mixing mechanisms in a wide variety of flows, from supernovae to jet engines. Over the past decade, we have used the Miranda code to temporally integrate the multi-component Navier-Stokes equations at spatial resolutions up to 29 billion grid points. The code employs 10th-order compact schemes for spatial derivatives, combined with 4th-order Runge-Kutta time advancement. Some of our major findings are as follows: The rate of growth of a mixing layer is equivalent to the net mass flux through the equi-molar plane. RT growth rates can be significantly reduced by adding shear. RT instability can produce shock waves. The growth rate of RM instability can be predicted from known interfacial perturbations. RM vortex projectiles can far out-run the mixing region. Thermal fluctuations in molecular dynamics simulations can seed instabilities along the braids in KH instability. And finally, enthalpy diffusion is essential in preserving the second law of thermodynamics.

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Andrew Cook
LLNL

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