INTIALIZATION OF TURBULENT MIXING WITH RICHTMYER-MESHKOV INSTABILITY

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Abstract

Numerical simulations of turbulent mixing (TM) that develops owing to Richtmyer-Meshkov instability at interfaces in stratified systems are faced with the problem of correct initialization of TM. The difficulty of modeling the instability development phase and transition to TM arise from the absence of reliable theoretical and experimental data on both interface initial perturbation characteristics and shock front, and also by uncertainty of initial energy of turbulence resulting from shock passage across an interface.

An approach to TM initialization is discussed based on defining kinetic energy of turbulence and dissipation rate after shock passage through an interface. TM zone width at time t_0 (TM onset time in calculations) is set to $L_0 \approx |a_s| + |a_b|$, where a_s, a_b are the amplitudes of bubbles and spikes. The bubble and spike amplitudes are calculated from a theoretical model. The time of transition from the instability phase to TM is found as $t_0 = t_{SW} + \Delta t$, where t_{SW} is the moment of interaction between shock and interface, Δt is the time after which the amplitude reaches the asymptotic phase. The values of turbulent quantities in the initial zone with width L_0 are found from the specified turbulence intensity. The efficiency of this initialization approach is demonstrated by numerical simulations of TM occurring at interfaces in stratified systems in three model experiments. The simulations of these experiments were performed using the VIKHR code with Nikiforov's model.