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The effects of harmonic and stochastic gravity modulation on fluid mixing V.K. SIDDAVARAM, G.M. HOMSY, Dept. of Mech. Engr., UCSB — We study the effects of zero-mean harmonic and stochastic vertical gravity modulations on the mixing characteristics of two miscible Boussinesq fluids initially separated by a thin horizontal diffusion layer. For harmonic modulation, the main parameter governing the flow is Grashof number, Gr, based on the viscous length scale, $l_\nu = \sqrt{\frac{\nu}{\omega}}$, where ω is the frequency of the modulation. Contrary to the case of constant gravity, for which the arrangement is unstable, we observe a critical Gr for the occurrence of Rayleigh-Taylor instability. This is explained on the basis of earlier work by Gresho & Sani (1970). As Gr is increased, we observe that the flow-field becomes chaotic. We investigate the route to chaos and compute various metrics to characterize it. The stochastic modulation is characterized by an exponentially damped cosine auto-correlation, $\langle g(t)g(t+\tau)\rangle / \langle g^2(t)\rangle = e^{-\lambda\tau} cos(\omega\tau)$, and has a power spectrum which is a Lorentzian with width λ and peak at ω, on which the Grashof number is based. We find that stochastic modulation leads to Rayleigh-Taylor instabilies at smaller equivalent Gr than harmonic modulation.

G. M. Homsy
Dept. of Mech. Engr., UCSB

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