Mixing fluids by shaking is a common human activity, yet the basic mechanisms remain incompletely understood. We study the effects of harmonic and stochastic gravity modulation on the mixing characteristics of two miscible fluids initially separated by a thin vertical diffusion layer. The 2-D time-dependent equations are solved numerically. The flow is characterized by a Grashof number, \( \text{Gr} = \frac{g}{(\frac{2}{3})^{\frac{1}{2}}}, \) where \( g \) is a frequency defined through the power spectrum, the Schmidt number, \( \text{Sc} \), and geometric parameters. For harmonic modulation, we observe three different flow regimes: smooth propagation of a gravity current, Kelvin-Helmholtz instabilities, and combined Kelvin-Helmholtz and Rayleigh-Taylor instability. When the phase angle of the harmonic modulation is 0 or \( \pi \), we also observe self-similar propagation of the interfacial folds. When the modulation is stochastic, we observe two different flow regimes: smooth propagation of the gravity current and both Kelvin-helmholtz and Rayleigh-Taylor instabilities on the gravity current. The mixing is found to suppressed in the case of stochastic modulation, which is explained on the basis of reduced stretching and folding of material lines. The talk ends with some comments on the work of Abdel Zebib and some personal reminiscences.

Professor Zebib joined Rutgers University in January 1977, after his doctoral and post-doctoral work at the University of Colorado, Boulder, Colorado. He was a distinguished researcher in fluid mechanics, a field to which he made many seminal contributions. He was a true scholar and had extensive collaborations with researchers from around the world in areas such as microgravity flows, instability, and buoyancy-driven flows. He also spent a sabbatical at Stanford University and interacted extensively with Bell Labs on cooling of electronic systems. He was active in the Fluid Dynamics Division of the American Physical Society (APS). He was a Fellow of APS, a distinction bestowed on only a select few. As an academic, Professor Zebib wrote and lectured extensively. He guided the research of a large number of doctoral students. Abdel also served extensively in administration. He was the Chairman of the Department from 1989 to 2000, and was the Deputy Dean of the School of Engineering from 2000-08. As Chairman, his influence lives on in the many young faculty members he recruited and in the research and academic standards he nurtured. As Deputy Dean, he was responsible for a wide array of duties and had a very substantial impact on the School. In November 2009, the department dedicated the MAE Computer Laboratory for Analysis and Design (CoLAD) to Professor Abdel Zebib, in recognition of his outstanding contributions to the department and his leadership and vision over many years.

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