Universidad Carlos III de Madrid

Seminario del Instituto Gregorio Millán

Vibrated fluids: Faraday waves, cross-waves, and vibroequilibria

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Abstract

The behavior of vibrated fluids and, in particular, the surface of interfacial instabilities that commonly arise in these systems have been the subject of continued experimental and theoretical attention since Faraday's seminal experiments in 1831. Both orientation and frequency are critical in determining the response of the fluid to excitation. Low frequencies are associated with sloshing while higher frequencies may generate Faraday waves or cross-waves, depending on whether the axis of vibration is perpendicular or parallel to the interface. In addition, high frequency vibrations are known to produce large scale reorientation of the fluid (vibroequilibria), an effect that becomes especially pronounced in the absence of gravity. We describe the results of experimental and theoretical investigations into the effect of vibrations on fluid interfaces, particularly the interaction between Faraday waves and cross-waves.

Experiments utilize a dual-axis shaker configuration that permits two independent forcing frequencies, amplitudes, and phases to be varied. Theoretical results, based on the analysis of reduced models, and on numerical simulations, are described and compared to experiment. In particular, the nonlinear Schrödinger equation models used to study cross-waves since Jones (JFM 138, 1984) are extended to include surface tension and to allow the inhomogeneous forcing term to vary on the same lengthscale as the cross-wave modulation, an assumption that is needed for high frequency (large aspect ratio) experiments such as ours.

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