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Surfactant- and elasticity-induced inertialess instabilities in vertically vibrated liquids SATISH KUMAR, BALRAM SUMAN, University of Minnesota — We investigate instabilities that arise when the free surface of a liquid covered with an insoluble surfactant is vertically vibrated and inertial effects are negligible. In the absence of surfactants, the inertialess Newtonian system is found to be stable, in contrast to the case where inertia is present. Linear stability analysis and Floquet theory are applied to calculate the critical vibration amplitude needed to excite the instability, and the corresponding wavenumber. A previously reported long-wavelength instability is found to persist to finite wavelengths, and the connection between the long-wavelength and finite-wavelength theories is explored in detail. The instability mechanism is also probed and requires the Marangoni flows to be sufficiently strong and in the proper phase with respect to the gravity modulation. For viscoelastic liquids, we find that instability can arise even in the absence of surfactants and inertia. Mathieu equations describing this are derived and these show that elasticity introduces an effective inertia into the system.

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