PATTERN FORMATION IN SOFT MATTER: EMERGENCE OF FARADAY INSTABILITY IN SOFT SOLIDS

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Recent experiments have observed the emergence of standing waves at the free surface of elastic bodies attached to a rigid oscillating substrate and subjected to critical values of forcing frequency and amplitude [6, 5]. This phenomenon, known as Faraday instability, is now well understood for viscous fluids [2], where primarily subharmoninc response dominates, but surprisingly eluded any theoretical explanation for soft solids. Recently, the elastic behaviour of the medium has been found to have a dramatic regularizing effect on some well-known dynamic phenomena in fluid mechanics, such as Rayleigh-Plateau [3] or Rayleigh-Taylor instabilities [4]. In this talk, we characterize Faraday waves in soft incompressible slabs using the Floquet theory to study the onset of harmonic and subharmonic resonance eigenmodes. We consider a ground state corresponding to a finite homogeneous deformation of the elastic slab. We transform the incremental boundary value problem into an algebraic eigenvalue problem characterized by the three dimensionless parameters, that characterize the interplay of gravity, capillary and elastic waves. Remarkably, we found that Faraday instability in soft solids is characterized by a harmonic resonance in the physical range of the material parameters. This seminal result [1] is in contrast to the subharmonic resonance that is known to characterize viscous fluids, and opens the path for using Faraday waves for a precise and robust experimental method that is able to distinguish solid-like from fluid-like responses of soft matter at different scales.

References

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