

Graduate Student Research Seminar

Spring 2022

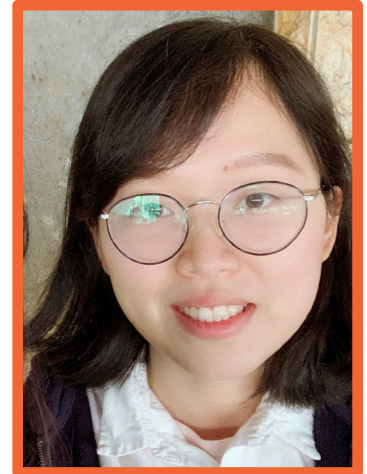
Linear Oscillations of Sessile Bubbles and Flux Drop

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Advisor: Dr. Joshua Bostwick

Monday, April 4th

3:00 pm (EST) – 132 Fluor Daniel Building



Abstract

The resonant behavior of bubbles in contact with a partially-wetting substrate and drops connected to a fluid reservoir is important for many industrial applications, such as ultrasonic-assisted soldering and drop-on-demand printing. Theoretical analyses were carried out to investigate the linear natural oscillations of a compressible sessile bubble on a planar solid support and a flux drop connected to a reservoir in an ambient fluid. We consider small disturbances to the spherical-cap interface whose three phase contact line is either (i) pinned or (ii) moves freely with a fixed contact angle. The governing equations for the inviscid incompressible liquid are reduced by a normal-mode expansion to a functional eigenvalue problem on linear operators using a boundary integral. We use inverse operators to construct Green's function for these two contact line conditions, and the Rayleigh-Ritz method to find the characteristic oscillation frequencies and related modal shapes, which are characterized by the mode number pair (k, l) . We show how the characteristic oscillation frequencies, modal shape, and the flow field depend upon the contact angles (α) , and the dimensionless equilibrium bubble pressure inside the bubble (Π) or the dimensionless empirical constant χ relating the reservoir pressure to volume exchanged. Instabilities of axisymmetric and the non-axisymmetric rocking mode will be highlighted either.



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