Graduate Student Research Seminar

Fall 2024

Extending Our Understanding of Granular Rafts: From Monolayers to Multilayers

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Monday, November 11th
3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

Granular rafts at liquid-gas interfaces increase interfacial resistance to rupture. In the first part of this talk, we present experimental and theoretical analyses of the load-bearing capacity of buoyant multilayer granular rafts subjected to deformation by heavy grains through either (1) quasi-static pouring or (2) particle jet impact. By balancing destabilizing and restoring forces at the onset of collapse, we derive a mathematical model to predict the number of grains required for destabilization based on the geometric and material properties of this multiphase system. The experimental data agrees well with the modeling, and the limiting cases align with prior simplified models.

The second part explores cavity formation by the vertical impact of hydrophilic spheres into buoyant multilayer granular rafts, revealing that even a monolayer raft enhances cavity formation significantly relative to impacts on pure liquid surfaces. We compare the regime diagrams, time, and cavity dimensions at pinch-off for impacts on pure liquid, monolayer, and multilayer rafts by systematically varying sphere size and its impact velocity. A notable observation is small grains filling the cavity and creating a stable cusp-shaped structure underside the raft at low impact inertia and a sufficient raft-to-sphere size ratio.

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