Graduate Student Research Seminar

Spring 2025

Stability of Holes in Granular Raft

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Monday, February 3rd
3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

A granular raft at an oil–water interface exhibits unique mechanical properties, including the ability to form and sustain stable holes. In this study, we experimentally investigate the formation, stability, and collapse dynamics of holes in particle rafts composed of millimeter-sized particles. Holes are created using a hollow cylinder, which generates menisci that inhibit particle motion, forming both stable and unstable holes. We track holes with varying initial sizes and shapes, identifying a critical size below which holes shrink over time, while larger holes persist. Using a local bond orientation number, we further explore particle rearrangements in both stable and unstable holes, finding that meniscus forces, rather than jamming, primarily govern hole stability and collapse behavior. The collapse dynamics of shrinking holes are analyzed in detail, revealing logarithmic trends influenced by particle size and interfacial tension. Additionally, an extended model incorporating a scaling factor for multi-particle interactions has been developed, aligning closely with experimental data and providing a robust framework for analyzing particle behavior in complex systems.

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