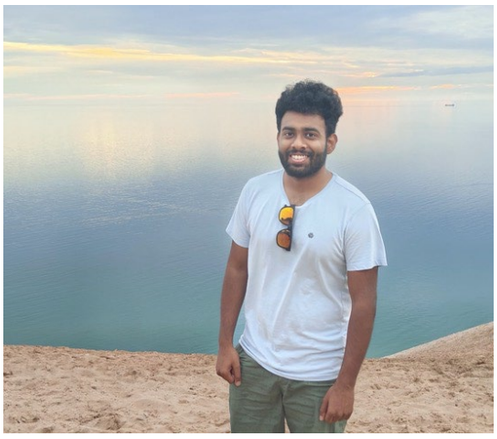
PHYSICAL MATH SEMINAR

Bend it like Kirchhoff: Fabricating slender structures using fluid physics



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ABSTRACT:

Slender structures are prevalent around us: the hair on your head, the syrup you pour on your pancakes are only a few examples. Slender structures, both solid and liquid, are well-described using Kirchhoff rod theory. In this talk, I will discuss how we can use inherent fluid phenomena to fabricate slender structures and how we can model deformations in slender systems using Kirchhoff rod theory.

In the first half of my talk, I will demonstrate how we can transform an initially formless elastomeric film into an array of elastic drops and then into an array of slender structures. In a lab setting, we stack multiple instances of Rayleigh-Taylor instabilities of curable elastomeric films coated onto the underside of a flat plate. The interplay of solidification and hydrodynamics produces corrugated, slender structures, which we refer to as flexicles due to their resemblance to icicles. We will discuss the subtle combination of chaos and order that confers our flexicles, their structure, shape, arrangement, and, ultimately, deformability.

In the second half of my talk, I will demonstrate how submerged miscible fluid jets can be utilized to produce microfibers with sub-100-micron thicknesses. The fabrication method utilizes two jets submerged in a bath: a fast, assistive water jet and an adjacent slow prefiber jet of a photopolymerizable solution. The prefiber jet is bent, entrained, and thinned through the influence of the adjacent water jet, and then polymerized using UV light. The ensuing dynamics enable the production of fibers that are significantly thinner than the jet nozzles used. I will talk about ongoing work in modeling thin, submerged, viscous jets within a flow field.

TUESDAY, SEPTEMBER 30, 2025

2:30 PM – 3:30 PM

Building 2, Room 449