APPLIED MATHEMATICS SEMINAR SERIES:
Active and collective dynamics in fluid membranes

Dr. Harishankar Manikantan
University of California Davis

Date:
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Time:
3:00 PM – 4:15 PM

Location:
COB1 105

About The Speaker:

Harishankar Manikantan is an assistant professor of Chemical Engineering at the University of California, Davis. He earned his masters in Theoretical and Applied Mechanics at the University of Illinois at Urbana-Champaign in 2012, and his Ph.D. in Applied Mechanics at the University of California, San Diego in 2015 working with David Saintillan. He then began his northward migration in the UC system, stopping at UC Santa Barbara as a postdoc for 3.5 years working with Todd Squires before ending up in Davis where he is now a Hellman Fellow. His research interests include the mathematical modeling of microscope flows, rheology, biophysics, and dynamical systems.

Abstract:

The typical cell membrane is a crowded assembly of molecular motors and biomolecules embedded in a 2D fluid mosaic. Active molecular motors perform complex cellular tasks by binding, inserting, polymerizing, and changing conformations, inducing disturbance flows in the membrane and the surrounding fluid. These long-ranged hydrodynamic fields perturb neighboring inclusions, potentially leading to coordinated motion. I will build on classic theories of Newtonian fluid dynamics of viscous membranes to illustrate unique oscillations and aggregation dynamics in pairs of active membrane inclusions. The phase behavior of the pair problem reveals the underlying mechanisms and suggests novel hydrodynamic strategies to tune large-scale aggregation. I will also show numerical simulations of large numbers of interacting inclusions whose collective dynamics can be tuned based on these basic insights. Building on these insights, I will then describe the first steps in the analysis of (i) inclusions in membranes with a complex surface viscosities that are typical in phospholipid membranes, and (ii) elongated inclusions whose orientations couple with their movement and with each other. I will highlight the qualitative differences that ensue, and potential implications in crowded membranes.

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