Soft Living Active and Adaptive Matter

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Flow singularities in soft materials: from thermal motion to active molecular stresses

Mehdi Molaei
University of Chicago

Abstract:

The motion of passive or active agents in soft materials generates long ranged deformation fields with signatures informed by hydrodynamics and the properties of the soft matter host. These signatures are even more complex when the soft matter host itself is an active material. Measurement of these fields reveals mechanics of the soft materials and hydrodynamics central to understanding self-organization. In this talk, I first introduce a new method based on correlated displacement velocimetry, and use the method to measure flow fields around particles trapped at the interface between immiscible fluids. These flow fields, decomposed into interfacial hydrodynamic multipoles, including force monopole and dipole flows, provide key insights essential to understanding the interface's mechanical response. I then extend this method to various actomyosin systems to measure local strain fields around myosin molecular motors. I show how active stresses propagate in 2d liquid crystalline structures and in disordered networks that are formed by the actin filaments. In particular, the response functions of contractile and stable gels are characterized. Through similar analysis, I also measure the retrograde flow fields of stress fibers in single cells to understand subcellular mechanochemical systems.

Date:
8/16/2021

Time:
9:00 AM-10:15 AM (PT)

About the speaker:

Dr. Mehdi Molaei is a postdoctoral fellow at the Pritzker School of Molecular Engineering at the University of Chicago. Prior to this, he was a postdoctoral researcher at the Department of Chemical and Biomolecular Engineering at University of Pennsylvania. Dr. Molaei obtained his Ph.D. in mechanical engineering from the Texas Tech University. He has also received a master's degrees in aerospace engineering from University of Minnesota and in mechanical engineering from the Sharif University of Technology. In his research career, he has been associated with Gulf of Mexico Research initiative and Materials Research Science and Engineering Centers.

Dr. Molaei's research focuses on understanding the physics of soft materials with application in the fields of human health and bio-inspired materials. He integrates a broad range of experimental techniques and statistical tools in colloid and interface science including advanced microscopic imaging and particle tracking. In his current position, he tries to identify relationships that govern structure formation and dynamics responses of actomyosin systems and heterogeneous intracellular structures.

For more information, contact: Kinjal Dasbiswas, Madhuvanthi Athani
kdasbiswas@ucmerced.edu, mathani@ucmerced.edu

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