Soft Living Active and Adaptive Matter

APS Division of Biological Physics
DBIO

Epithelial Mechanics Through the Lens of Learning and Adaptation

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Abstract:

During embryonic development, tissues undergo substantial transformations to sculpt the organism's body plan. This remarkable morphogenesis is facilitated by the tissue's ability to shift from a solid-like to a more fluid-like state, enabling extensive movement. Simple vertex models have been successful in capturing the mechanical properties of epithelial tissues, including these solid-to-fluid transitions. These models have parameters like target cell shapes that dictate the tissue's mechanical behavior. In this talk, I will demonstrate that introducing cell-scale properties as new adaptive degrees of freedom can significantly reshape the system's high-dimensional energy landscape, thereby shifting the rigidity transition of the tissue. Additionally, I will discuss how studying tissues within the framework of learning and adaptation offers valuable insights into another important developmental process: convergent extension. By using edge tensions as adaptive degrees of freedom, I will show that a simple local rule on these tensions induces a convergent extension flow, shedding light on the underlying mechanisms of this process.

Date:
9/9/2024

Time:
10:00 AM-11:15 AM
Pacific Time

About the speaker:

Sadjad Arzash is a theoretical physicist interested in understanding the emergent properties of biological tissues and biopolymer networks. His postdoctoral research focuses on the mechanics of epithelial tissues through the lens of learning and adaptation using theory and computation. Sadjad's work seeks to uncover simple, local biological rules that give rise to the complex macroscopic behaviors observed during embryonic development.

Sadjad is a postdoctoral researcher in the Physics Department at Syracuse University and the University of Pennsylvania, where he works jointly with Lisa Manning and Andrea Liu. He earned his PhD in Chemical & Biomolecular Engineering from Rice University in 2021, under the supervision of Fred MacKintosh. During his PhD, he investigated mechanical phase transitions and critical phenomena in biopolymer networks like collagen.

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