

PHYSICAL MATH SEMINAR

A kinematic atlas of tissue morphogenesis



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ABSTRACT:

Biological tissues often undergo complex shape changes during development as a result of both autonomous cell behaviors and mechanical inputs from neighboring tissues. Combinations of in-plane and out-of-plane deformations make a complete and biologically interpretable kinematic description of development challenging. I will show a quantitative framework to extract and analyze 3D time-dependent strain tensor fields from tracked nuclei in the embryonic fruit fly hindgut primordium, a ring of tissue that rapidly deforms into a complicated 3D structure. By computing time-resolved deformation gradients from nuclear trajectories and rotating strain tensors into a local tissue frame of reference, we generate a kinematic atlas of tissue morphogenesis. We find that the hindgut undergoes spatially heterogeneous and temporally ordered deformations, with adjacent regions exhibiting coordinated out-of-plane and circumferential strain. Notably, out-of-plane expansion in posterior subdomains precedes circumferential stretching in adjacent regions, suggesting a relay or coupling of deformations. This approach reveals the hindgut primordium to be a tissue with rich strain patterns and provides a generalizable method for interpreting complex tissue deformations in both in vivo and engineered systems.

TUESDAY, DECEMBER 2, 2025

2:30 PM – 3:30 PM

Building 2, Room 449