Cleveland State University
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COLLOQUIUM

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Roles of Cellular Anisotropy and Heterogeneity in Life

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https://csuohio.zoom.us/j/91945126460

Bio: Dr. Qixuan Wang got her PhD in 2012 from the Mathematics Department at University of Minnesota, advised by Dr. Hans Othmer. After that, she joined Dr. Qing Nie's group in University of California, Irvine as a postdoctoral scholar. In 2018, she joined the Department of Mathematics, Riverside. Her research interests focus on mathematical biology, where she uses computational and analytical tools to study questions that arise in life sciences, particularly in two areas – cell swimming and biological growth.

Abstract: Cells can be structurally anisotropic, and they can be heterogeneous due to either genetic or environment clues. Cellular anisotropy and heterogeneity might lead to interesting behaviors of both an individual cell and a collection of cells. In this talk we will discuss the roles of cellular anisotropy and heterogeneity in two systems. In the first part, we will discuss how anisotropic flagella bending rigidity affects the flagellar beating dynamics. Flagellar beating is controlled by molecular motors that exert forces along the length of the flagellum and are regulated by a feedback mechanism coupled to the flagellar motion. We build on previous work on sliding-controlled motor feedback to develop a fully three-dimensional description of flagellar beating, accounting for both bending and twist. We show that with isotropic bending, three-dimensional spiral modes are spontaneously generated beyond a critical molecular activity. On the other hand, when a bias in the bending directions presents, the three-dimensional spiral modes give way to planar beating. In the second part, we will discuss how hair follicle heterogeneous responses to signals regulate the follicle temporal growth dynamics. Hair follicles are mini skin organs rich of stem cells, and they undergo cyclic growth. The growing phase – anagen of a hair follicle is tightly controlled by a group of epithelial transient amplifying (TA) cells. Using an interdisciplinary approach combined of multi-scale modeling and lineage tracing experiments, we show that cellular heterogeneity based on cell division generations generates the clonal drift phenomenon that prolongs the anagen.