

PHYSICAL MATHEMATICS SEMINAR

Mechanical Instabilities in Growing Biological Systems: Wrinkling and Branching

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ABSTRACT:

Morphological shape transformations in biological systems often arise from patterned biochemical processes, which can produce mechanical forces either directly via molecular motors or indirectly via differential growth of connected tissues. The growth mismatch produces internal stresses, which can be released via shape transformations and mechanical instabilities. In this talk I will focus on mechanical instabilities that cause the wrinkling of *Vibrio cholerae* bacterial biofilms and branching in developing lungs. Bacterial biofilms grown on substrates form wrinkled patterns that can be manipulated by modifying the substrate stiffness. We showed that the wavelength of wrinkles is consistent with the mechanical stability of compressed films on soft substrates. Furthermore, we demonstrated that the spatiotemporal pattern of wrinkles can be predicted by a continuum chemo-mechanical model that incorporates diffusion of nutrients and their uptake by bacteria, growth of the biofilm, surface friction, and the ensuing mechanical stresses and deformations of the biofilm. In the second part, I will discuss the branching morphogenesis of lungs. By combining experiments and modeling we showed that the patterned formation of stiff smooth muscles and their contractions physically sculpt new branches of growing epithelium. I will also comment on how we are going to use these insights to design an optogenetic system to engineer artificial lung organoids.

TUESDAY, FEBRUARY 8, 2022

2:30 PM – 3:30 PM

Building 2, Room 449

<https://math.mit.edu/sites/pms/>

ZOOM Link....

<https://mit.zoom.us/j/95597721876>

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