PHYSICAL MATHEMATICS SEMINAR

Mathematical modeling of size and shape regulation in the cell wall and tumor spheroid growth

MIN WU

Worcester Polytechnic Institute

ABSTRACT:

Mathematical modeling of the flow, size, and shape regulation in living systems is central to understanding the growth and morphogenesis of cells, tissues, and organs.

I will first discuss our work on the shape regulation of the cell wall apical domain in self-similar cell tip growth. By developing a membrane theory of cell wall growth and utilizing the cell wall shape data from multiple walled cell species, we find two strategies to maintain a specific cell shape: morphing the secretion profile and moving the exocytosis hotspot. I will summarize the main idea from membrane theories in capturing the mechanics and kinematics of cell-wall steady flow in the self-similar growth regime.

I will then discuss our study on tumor spheroid size regulation. I will present a continuum model that describes the growth and mechanics in the tumor by considering its mechanical properties under finite elastic deformation and rearranging activities associated with stress dissipation in the presence of a graded growth-promoting chemical field. By nonlinear simulation of a growing tumor spheroid in the free boundary condition, we find that its compressibility and rearranging rate influence its equilibrium size. I will show this size regulation is a nonlinear effect due to the advection of the tissue density flow, which only occurs when both tissue compressibility and rearranging rate are small.

TUESDAY, OCTOBER 4, 2022
2:30 PM – 3:30 PM
Building 2, Room 449

http://math.mit.edu/seminars/pms/

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