PHYSICAL MATH Seminar

The tug-of-war at cell junctions: synchrony of symmetry breaking

CALINA COPOS

Northeastern University

ABSTRACT:

Symmetry breaking, which is ubiquitous in biological cells, underlies phenomena such as directed cellular movement in wound healing and morphological polarization in embryogenesis. At the onset of collective migration, stationary cells must undergo a drastic intracellular reorganization to acquire the migratory phenotype with a front-to-back polarity due to asymmetric distribution of proteins, lipids, and other molecules. Symmetry breaking has been studied theoretically extensively as an example of pattern formation, but much less is known about how symmetry breaking is coordinated, communicated, and synchronized across cell groups. Just as charge dipoles align in an external electric field, the question we ask here is how does a pair of cells organize to give rise to the observe tissue-scale symmetry breaking without an external stimulus?

Within an established coupled stochastic-deterministic model for pattern formation along the cell boundary, we study the nature of the interaction at the cell-cell junction to ensure co-alignment of the polarity axes of the cells within a group. We exhaustively search the entire parameter space of both biochemical and mechanical pathways (along with both excitatory and inhibitory interactions). We find that synchronized pattern formation is established through a tug-of-war of forces at the cell-cell junction either directly mechanically or through differential regulation of signaling molecules. The same interactions lead to supracellular organization as well. We also contextualize our findings within a larger effort to understand the intercellular interactions for collective behavior.

TUESDAY, NOVEMBER 7, 2023
2:30 pm – 3:30 pm
Building 2, Room 449

http:math.mit.edu/seminars/pms

Massachusetts Institute of Technology