Coupling mechanics and chemical signaling in cells: from single cell to the collective

Abstract:
Single cells and cells in a tissue respond to stimuli by deforming, changing their shape, and/or moving. Some of these responses can be understood from the underlying biochemical signaling, a topic that has been of interest to both biologists and modelers. In our recent work, my group has studied the link between mechanical tension on cells and their internal chemical signaling. (Our primary focus has been, and remains, that of Rho proteins.) Here I will describe a simple "toy model" that captures key aspects of what is known biologically. The model is simple enough to understand mathematically, and yet capable of displaying several regimes of behavior consistent with experimental observations. I describe how we investigated the model in a single cell, and how this was then used to capture multiple cells that interact with one another mechanically. We find waves of expansion and contraction that sweep through the model "tissue" in certain parameter regimes. This work is joint with Cole Zmurchok and Dhanajay Bhaskar.