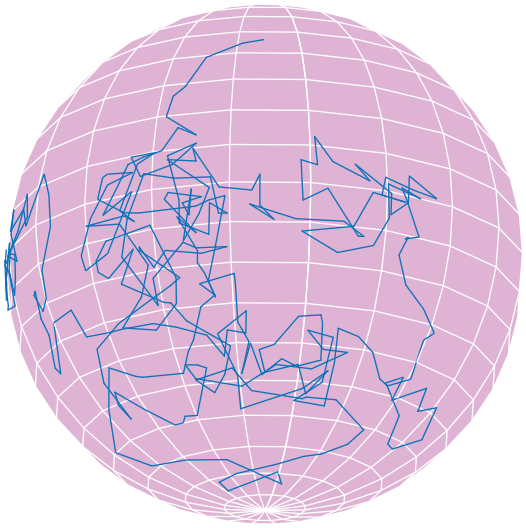
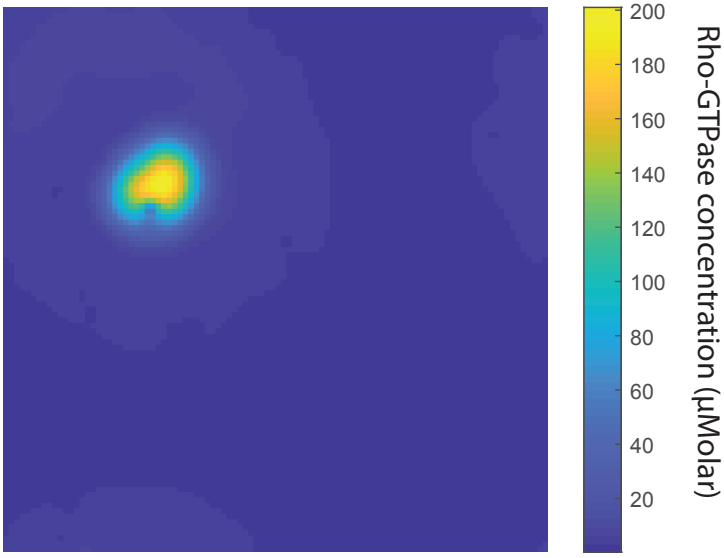
# Modeling Biological Systems Mechanistically

Debraj Ghose (debraj.ghose@duke.edu)



Model of a protein diffusing along the surface of a spherical cell




Partial differential equation model coupled with stochastic processes to study pattern formation on a cell's plasma membrane

Biological systems often have many interacting components, and describing them mathematically allows us to formalize our (often pathetic) description of a given system. The mathematical model can then be used to make predictions or develop a better intuition about the biological system's behavior. This workshop will teach you to utilize simple numerical tools from computational physics and chemistry to mechanistically model processes seen in biological systems. The material covered will include modelling well-mixed biochemical reactions, microscopic diffusion, macroscopic diffusion, and reaction-diffusion systems. There will be a total of two sessions and each session will last between 2 to 3 hours. We will use the programming language MATLAB to execute all simulations, but if you feel confident about replicating MATLAB's matrix and rendering capabilities on another platform, feel free to do so. Prerequisites: Some familiarity with differential equations, matrix algebra, molecular biology, and programming. You will need to bring your own laptop to run MATLAB code (you can get a licensed version through Duke). If you are new to programming with MATLAB, the MATLAB onRamp course is an excellent resource: https://matlabacademy.mathworks.com.

A fun read: "Models in biology: 'accurate descriptions of our pathetic thinking'" by Jerermy Gunwardena is a nice essay on forward modeling to uncover biological mechanisms.