

Math Modeling in Medicine

Computer Lab #2

The purpose of this exercise is to become familiar with the effects of spatial coupling and communication between cells.

1. The files `FHN_ode_coupled.m`, `MS_ode_coupled.m`, and `rHH_ode_coupled.m` are three files that simulate what happens when two different excitable cells are coupled. Here are some explorations you can do with these cells. (Warning: There is a bug in the nullclines for rHH - user beware.)
 - Familiarize yourself with the models by simulating them with $\text{coup} = 0$ (the coupling strength) and with coup nonzero.
 - Do the same for different parameter variations. Make one cell excitable and one self-oscillatory, or both self-oscillatory, but not identical. Which cell wins? Is the response periodic and if so what sets the period of oscillation?
 - Make the two cells identical, but start them with differing initial data. Do they synchronize? What effect does a change of the coupling strength have on this outcome?
 - If you are ambitious, you can make a coupled cell model for any of the dynamics that you have.
2. If you are feeling courageous, you might want to explore the program `CN_FHN_forced.m`. This program simulates the FHN equations along a continuous line with periodic forcing at one end. There are a vast number of things you can do with this code as a starting point.
3. The code `simple_diff_process.m` show how to do a Monte-Carlo simulation of a simple random walk diffusion process. Play with it if you wish.