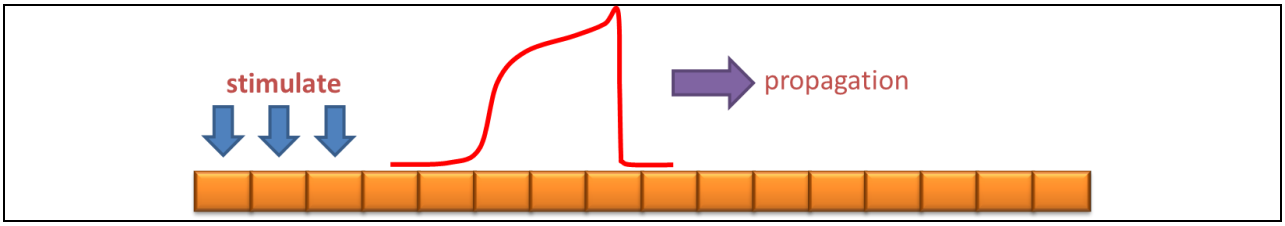
Sato Lab HW02 - Alternans in a 1D cable

1D tissue simulations



Part I: Download ekmodel1d.m from SatoLab Box

(1) Run the code to observe the space-time plot of v. Understand what the axes are, and what the different colors signify (Hint: the colors signify different voltage levels). What would be considered a single "beat"? Also identify which color(s) represent when APD occurs.

(2) Try setting PCL=140 ms (fast pacing; it was originally at PCL=200 ms, which is slow pacing). Rerun the code and compare with part(1). (Hint: what happened with the single cell when PCL was set to 140?).

(3) Change PCL back to 200 ms. Vary jsi (e.g. reduce jsi = reduce Ca current = administration of Ca channel blocker, or the slow inward current) by multiplying the equation with 0.8 and 1.2. You can try other values that are not equal to 1.

(on line 64) jsi=f.*dinf.*(v-1.4)/tausi; → jsi=0.8*f.*dinf.*(v-1.4)/tausi;

→ jsi=1.2*f.*dinf.*(v-1.4)/tausi;

Rerun the code to replot the surface plot. Describe the difference between the plots at the different jsi values. What's going on with APD (or the width of a certain color) when jsi is multiplied with a value less than 1? Greater than 1?

(4) Change the varying factor for jsi back to 1.Vary jfi (e.g. reduce jfi = reduce Na current = administration of Na channel blocker) by multiplying the equation with 0.5 and 0.1. You can try other values that are not equal to 1.

(on line 63) jfi=h.*minf.*(v-1.3)/taufi; → jfi=0.5*h.*minf.*(v-1.3)/taufi;

→ jfi=0.1*h.*minf.*(v-1.3)/taufi;

Rerun the code to replot the surface plot. Describe the difference between the plots at the different jfi values (Hint: think about what is going on with each beat with respect to the y-axis).

Measure the conduction velocity for each jfi (Hint: conduction velocity = propagation speed unit: cm/s. Think about what the axes signify to calculate this value).

(5) Change the varying factor for jfi back to 1. For this problem, please refer to your surface plots from part(1) and (2). Also refer to how you calculated the APD values from HW1 part(4).

Plot APD vs space (space is from cell 1 to cell 400) for the last 2 beats for PCL=200 ms and PCL=140ms. (Hint: these are not surface plots, additionally, each cell should have two APD values being graphed).

Compare the difference between the two graphs at different PCL. Relate the APD vs space plots with the surface plots.

(6) Reduce the stimulation current.

(on line 50) stim(1:5)=0.3; →stim(1:5)=0.25;

→stim(1:5)=0.22; and so on

Find the smallest value, which can still generate the action potential wave.

Part II: Repeat question (1) to (6) using C/C++/Python

(7) Using C/C++ and OpenMP, parallelized the code.
c.f. https://computing.llnl.gov/tutorials/openMP/