EEN 582: Bioelectrics

Course Project (Due 11/28)

This project is only for EEN582 students. However, EEN482 students may attempt it for extra credit.

Consider a 3cm x 3cm square piece of tissue with the lower left corner on the origin. The electrical potentials, ϕ, in the tissue are governed by the equation

$$\nabla^2\phi = \frac{\phi}{R} + C_m\frac{\partial\phi}{\partial t}$$

where R is a resistance and $C_m$is the capacitance.

Assume the following boundary conditions: $\frac{\partial\phi}{\partial n} = \frac{\phi}{4}$ on the right edge, and no flux boundary conditions along the other edges.

Assume an initial state of $\phi(x,y) = -80$ mV. At t=0, electrodes are applied at the following locations and held at the constant value: $\phi = +100$ mV for the 4 upper right corner nodes and $\phi = -100$ mV for the 4 lower right corner nodes.

Implement an accurate **Finite Difference** scheme and assign the value of 1 to R and C_m. Determine a suitable grid spacing for numerical stability. Simulate the tissue potentials for the first 25 time steps.

1) Plot the evolution of the potential w.r.t time.

2) Change the grid spacing to 150% of your chosen value and discuss your findings.

3) Compare the largest time steps that maintain stability in each of the above simulations to the theoretical values.