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CS 115 Computer Simulation

Diffusion Simulation

**Question:**Do the calcium diffusion sites (puffs) provide satisfactory information about the calcium activity in a cell, or are there invisible, individual receptor sites in the cell that create the uniform calcium wave we see in diffusion?

**Method:**I am basing my initial simulation parameters on the paper “Hindered cytoplasmic diffusion of inositol trisphosphate restricts its cellular range of action” by George D. Dickinson, Kyle L. Ellefsen, Silvina Ponce Dawson, John E. Pearson, and Ian Parker, Science Signaling Nov 2016  
Paper available at: [http://stke.sciencemag.org/content/9/453/ra108](http://stke.sciencemag.org/content/9/453/ra108%20)

Inositol triphosphate (IP3) receptors lead to the release of calcium ions from intracellular store sites. In my lab, we monitor calcium levels across cells and analyze the releases, aka “puffs”, at receptor cluster sites.

Monitoring calcium activity in a cell relies on the IP3 receptors to generate puffs of fluorescence. The calcium released from clusters of receptors diffuses outward across the cell with given parameters. Calcium diffuses outward from the cluster of receptors and sets off other clusters in a chain reaction. As the clusters go off, a uniform wave of calcium is visible within the cell. A kymograph can be used to measure the calcium level across a straight line and determine how uniform the “wave” is.

**Model:**Parameters:

* Cell shape: default to rectangle [width, height]
* Iterations: Number of iteration intervals to simulate
* Number of Clusters: Cluster count within cell, uniformly distributed as X,Y coordinates
* Distribution for initial calcium levels throughout the cell, as well as calcium levels in clusters
* Which cluster to activate first