BME665/565 – Assignment 3 February 2, 2007

Due: Thursday, February 8th

Purpose:

1) To investigate the relationship between theoretical models of synaptic plasticity and empirical findings.

Deliverables:

Answers to the questions below, and appropriate screens shots (e.g. graphs or plots of activities or synaptic weights) of any Matlab results. Note that the first question does not require any simulation.

You are strongly encouraged to work together to obtain the results, but you must submit your own write-up, discussion and interpretation of those results.

Experiments and questions:

1) Explain (in terms of the biophysics) why high-frequency stimulation can lead to long-term potentiation whereas low-frequency stimulation leads to long-term depression.

2) Create a simulation of synaptic plasticity based on the BCM rule (chapter 8.2). You should assume 1000 synapses, start with random weight values, and model the presynaptic firing rate as a Poisson process. Show the effect of the presynaptic firing rate on the field potential amplitude of the post-synaptic cell (as is shown for empirical data in figure 8.1).
    a. Using a constant θ_v with saturation constraints for stability.
    b. Use a sliding threshold for stability.

    Can the sliding threshold model, in which the postsynaptic activity is used to modify the threshold, be explained in biophysical terms? If so, how? If not, why not?