BT6270: Computational Neuroscience

Assignment 1 - Report

By

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BE21B038

Note: Units of the quantities described are as follows: time in secs, voltage in mV, conductance in mmho/mm^2, capacitance in $\mu F/mm^2$, currents are in units $\mu A/mm^2$

Values:

Threshold values for the external applied current (in $\mu A/mm^2$) are:

1. I1 = 0.0224
2. I2 = 0.0624
3. I3 = 0.4578

These values were obtained by running input current values from 0 to 0.6 in intervals of 0.0001.

Observation:

1. No action potential is observed in the region between 0 to I1, i.e., 0 to 0.0224
2. Finite number of action potentials are observed in the region between I1 to I2, i.e., between 0.0224 to 0.0624
3. Limit cycle behaviour of action potentials is observed in the region between I2 and I3, i.e., 0.0624 to 0.4578
4. No action potential is observed for currents greater than I3, i.e., greater than 0.4578

Assumptions:

1. The threshold voltage is assumed to be 10mV. This means only the spikes with maximum voltage above 10mV will be considered as action potentials and added to the spike counter.
2. I1 is taken as the minimum current that causes the first non-zero voltage spike, i.e., input current that is slightly greater than the threshold current value.

3. I2 is taken as the input current when the difference in the spike count between the present and next input increases by more than 4.
4. I3 is taken as the input current when the difference in the spike count between the present and next input decreases by more than 2.

Plots:

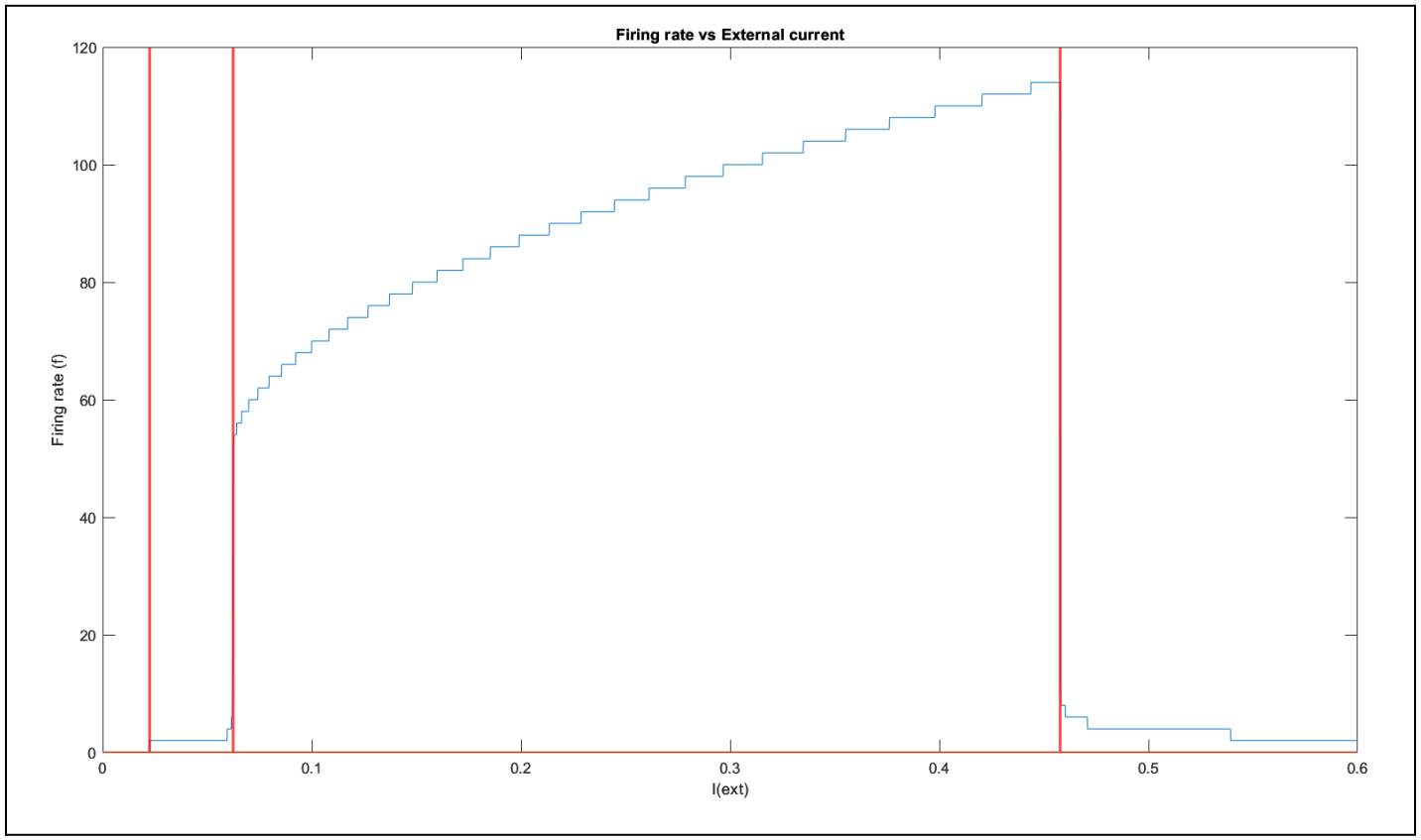


Fig 1: Change in firing rate (frequency) vs input external current. For each instance of external current, 50,000 iterations are performed. The threshold currents I1, I2 and I3 are indicated by the red vertical lines in that order.

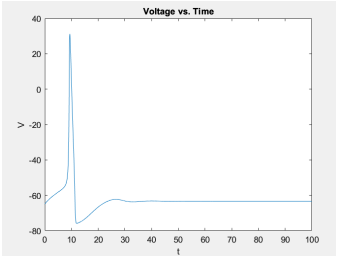
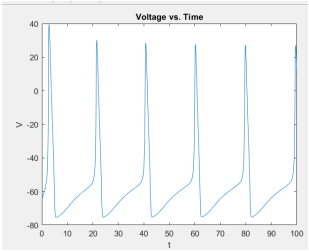
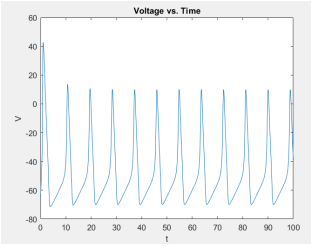
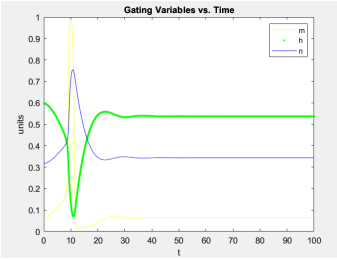
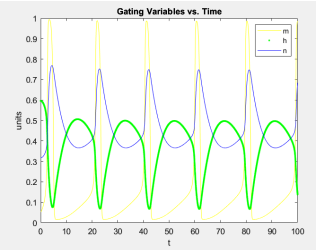
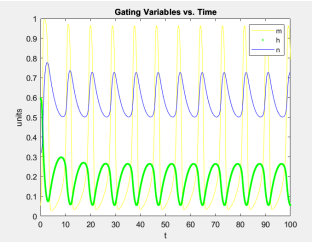
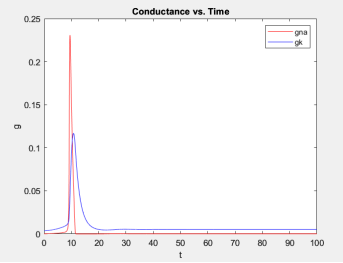
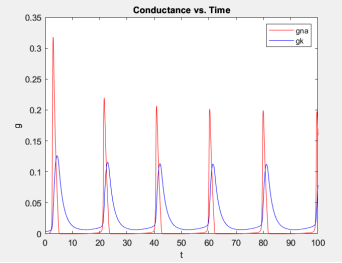
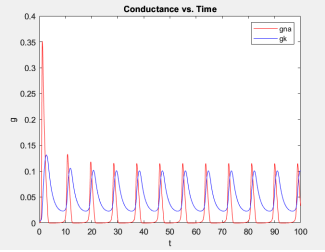
	I1	I2	I3
Voltage vs. time			
Gating variables vs. time			
Conductance vs. time			

Fig 2: Characteristics of threshold currents