

## BT6270 Assignment 1 – Hodgkin Huxley MATLAB Model Report

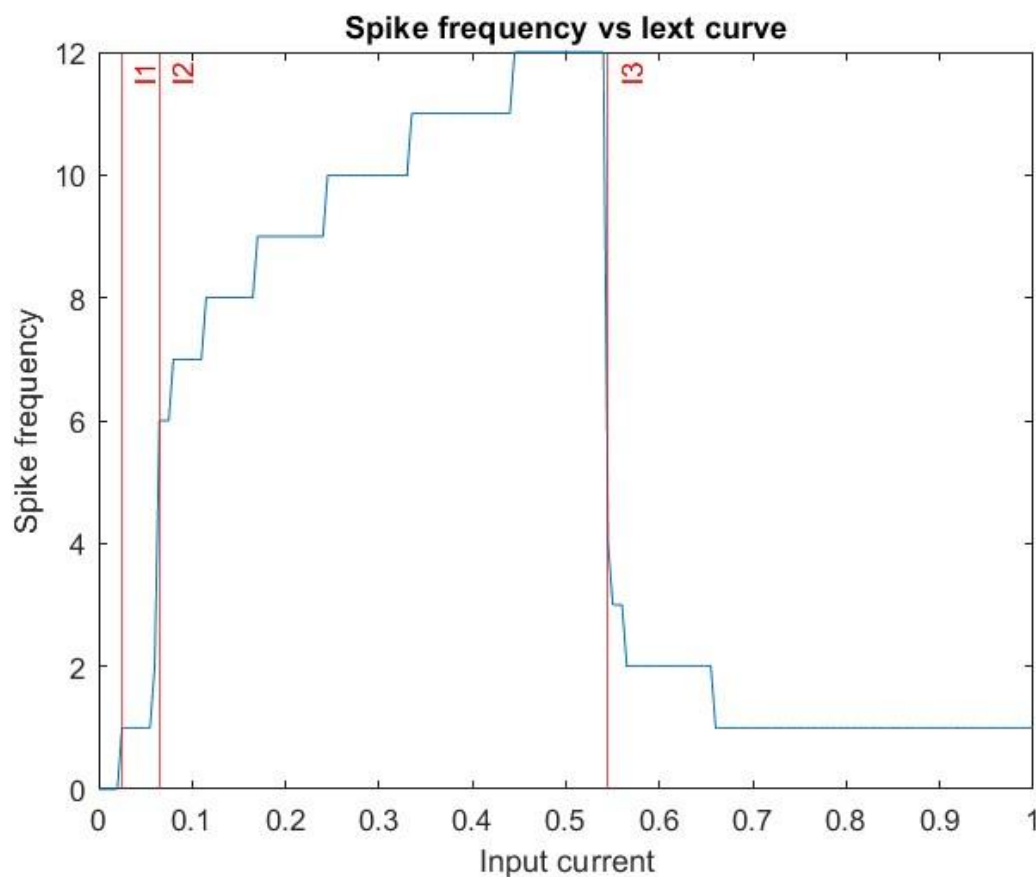
### Threshold values for:

First AP seen at  $2.500000 \times 10^{-2}$   $\mu\text{A}$  – I1

Limit cycles initiated at  $6.500000 \times 10^{-2}$   $\mu\text{A}$  – I2

Spike frequency decline seen at  $5.450000 \times 10^{-1}$   $\mu\text{A}$  – I3

### Graph depicting spike firing frequency vs input current:

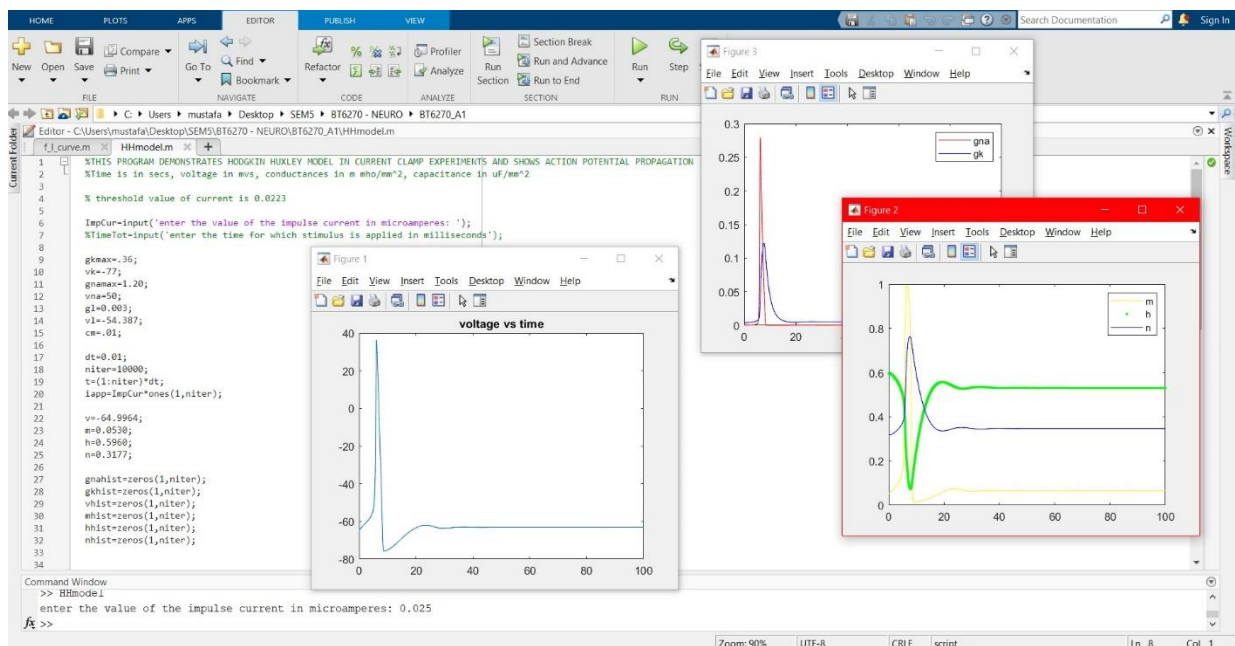


### Observations:

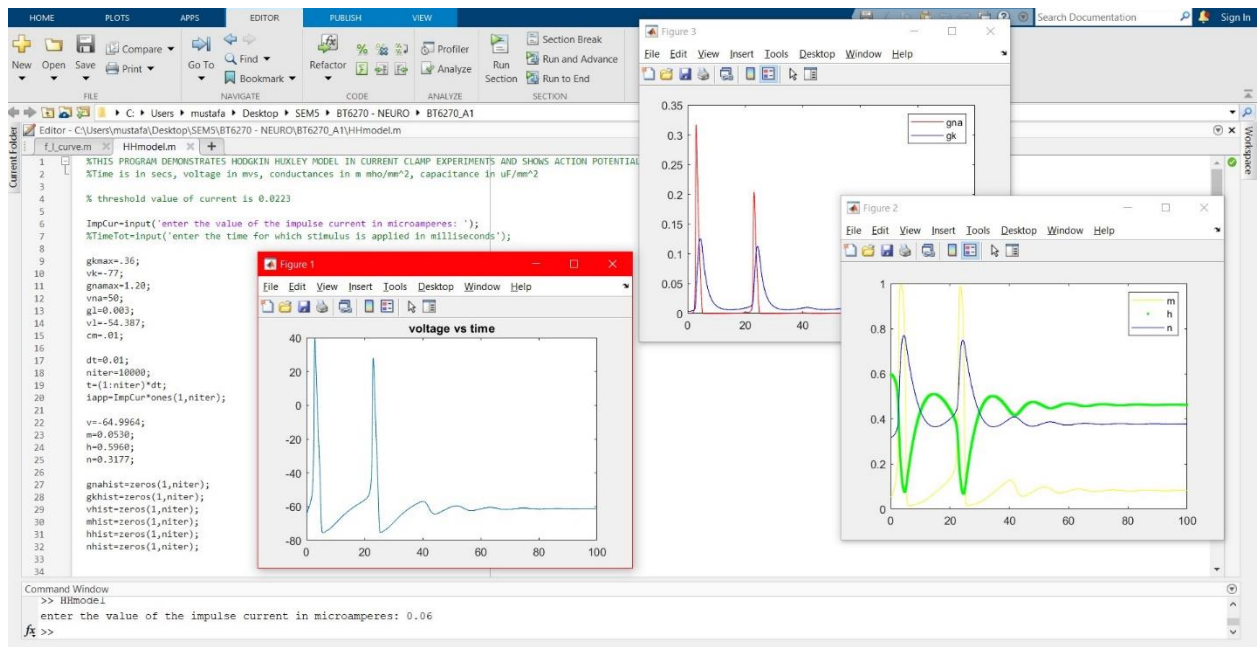
No APs are seen before I1. Finite number of APs are generated when input current is in the range [I1, I2]. In the next range [I2, I3], limit cycle behavior is observed with periodic APs. All

the APs completely die down beyond I3, yet there is one residual peak left which is the input current impulse response.

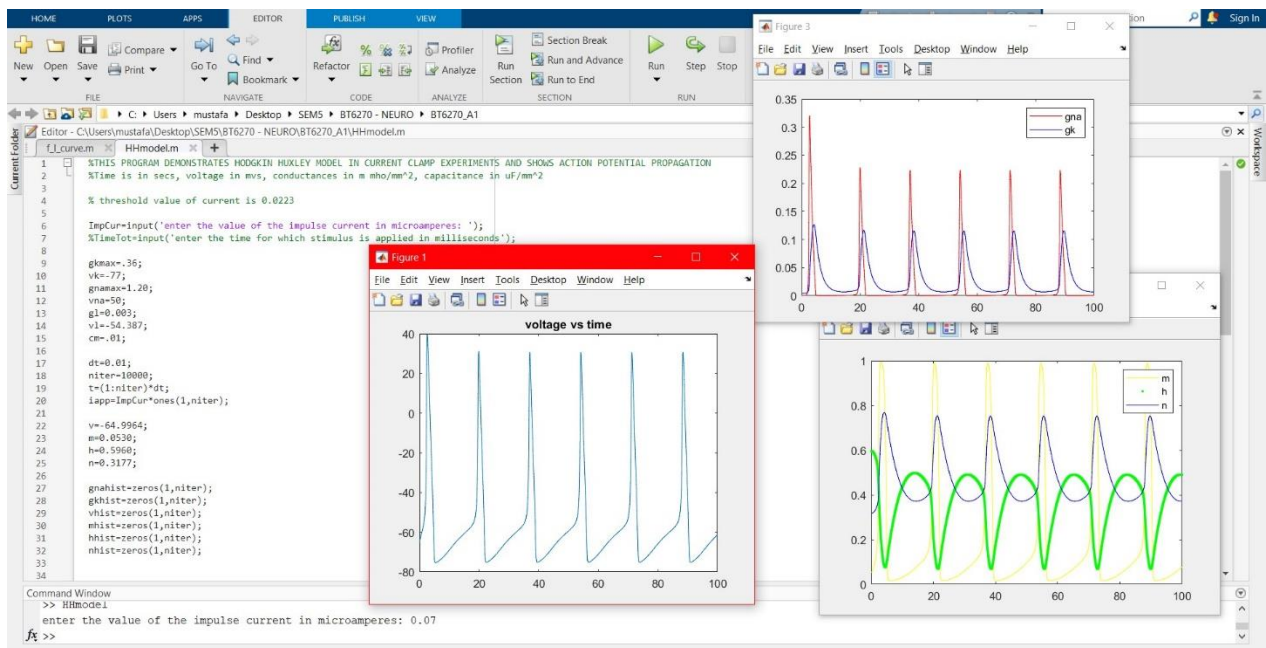
First AP at I1:



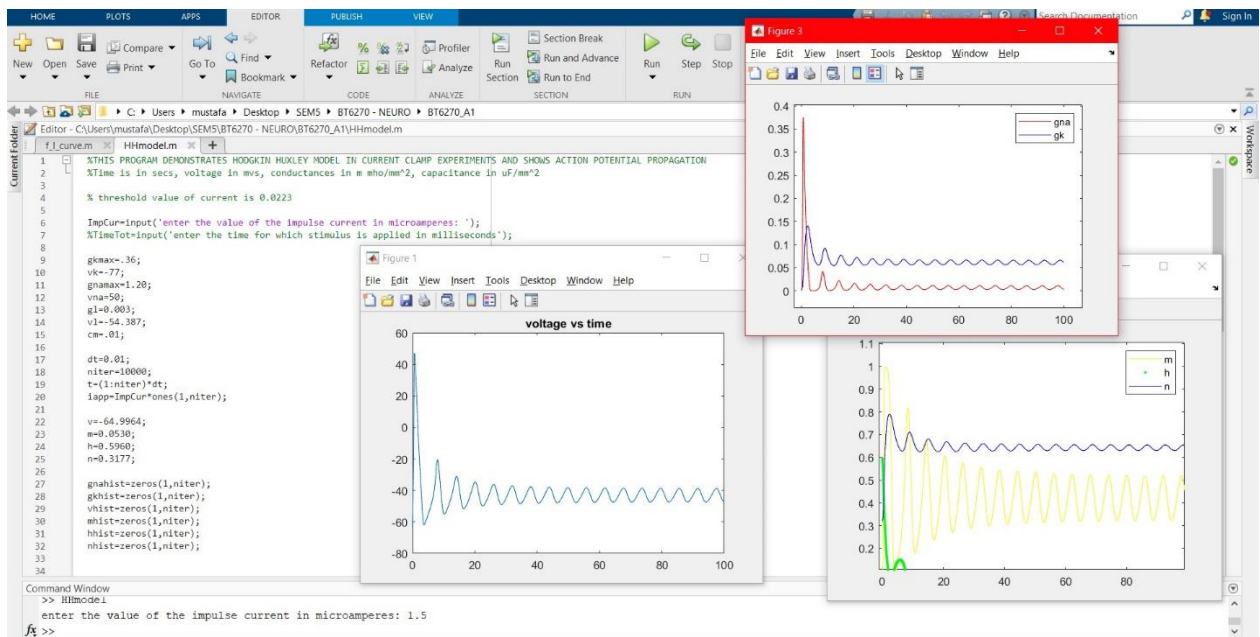
Two AP in [I1,I2] :



Multiple AP in [I2, I3] :



Declining AP beyond I3:



**My procedure for this assignment was:**

The HHmodel matlab code provided to us was completely functional and fast, since it did not involve an ODE solver for the 4 HH differential equations. It sped up repetitive computations quite a bit and hence, I used the same code to calculate  $V_{hist}$  for each input current in the range 0-1 uA in steps of 0.005 uA. The actual threshold value  $I_1$  is 0.023 uA, whereas here it is 0.025 uA since I used a time step resolution of 0.005.

Counting the number of spikes generated in Vhist was achieved with matlab's findpeaks() function and the peakcount array was used to store spike frequency for every current value. The 'MinPeakProminence' and 'MinPeakHeight' parameters were adjusted to avoid detecting smaller peaks as erroneous APs. Few elseif conditions were imposed to calculate the threshold values I1, I2, I3 and display them. Everything was incorporated into the f\_I\_graph.

## References:

<https://www.bonaccorso.eu/2017/08/19/hodgkin-huxley-spiking-neuron-model-python/>

[https://en.wikipedia.org/wiki/Hodgkin%E2%80%93Huxley\\_model](https://en.wikipedia.org/wiki/Hodgkin%E2%80%93Huxley_model)