BT6270 Computational Neuroscience

Computational Neuroscience Assignment 1

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Hodgkin Huxley Model

1. Threshold values for External Current

The threshold values for currents are as follows:

- $I_1 = 0.023\ \mu A/mm^2$
- $I_2 = 0.062\ \mu A/mm^2$
- $I_3 = 0.457\ \mu A/mm^2$

*These values are obtained with a current sampling interval of 0.001 from [0, 0.6]

2. Assumptions

The following are the assumptions made while plotting:

1. The voltage **threshold value of 10mV** is set as the voltage to be considered as a spike. (*All voltage peaks greater than 10mV are considered in the spike count.*)
2. I_1 , input current at which the spiking occurs is identified at the current when the number of spikes first becomes more than zero.
3. I_2 , current is identified at the current at which the number of spikes **increases by more than 4** in the next current instant.*
4. I_3 , current is identified at the current at which the number of spikes **decreases by more than 2** in the next current instant.

3. Plots

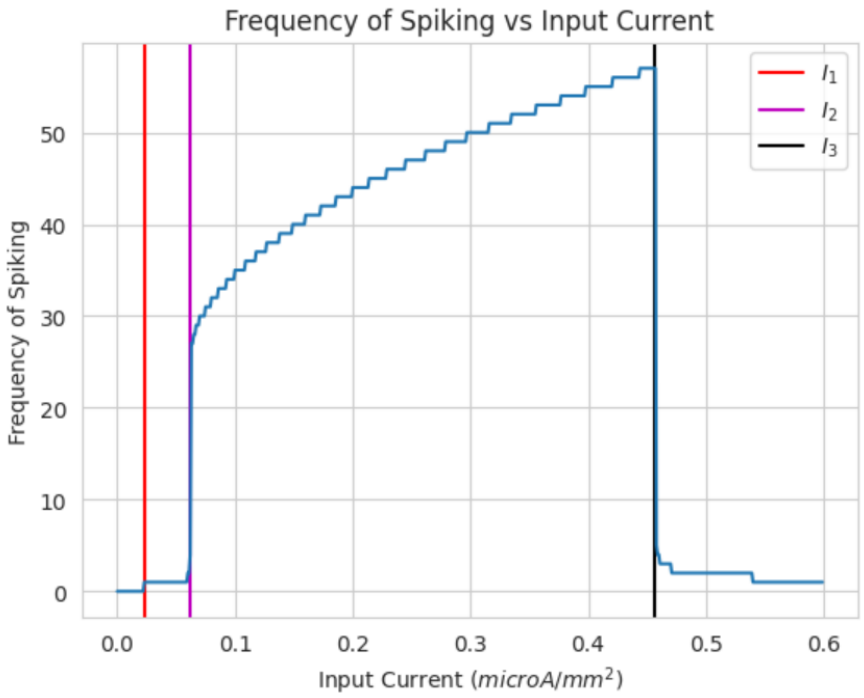

Figure 1: Change in frequency of firing as a function of Input current. The number of iterations performed for each current instance : $5x10^4$

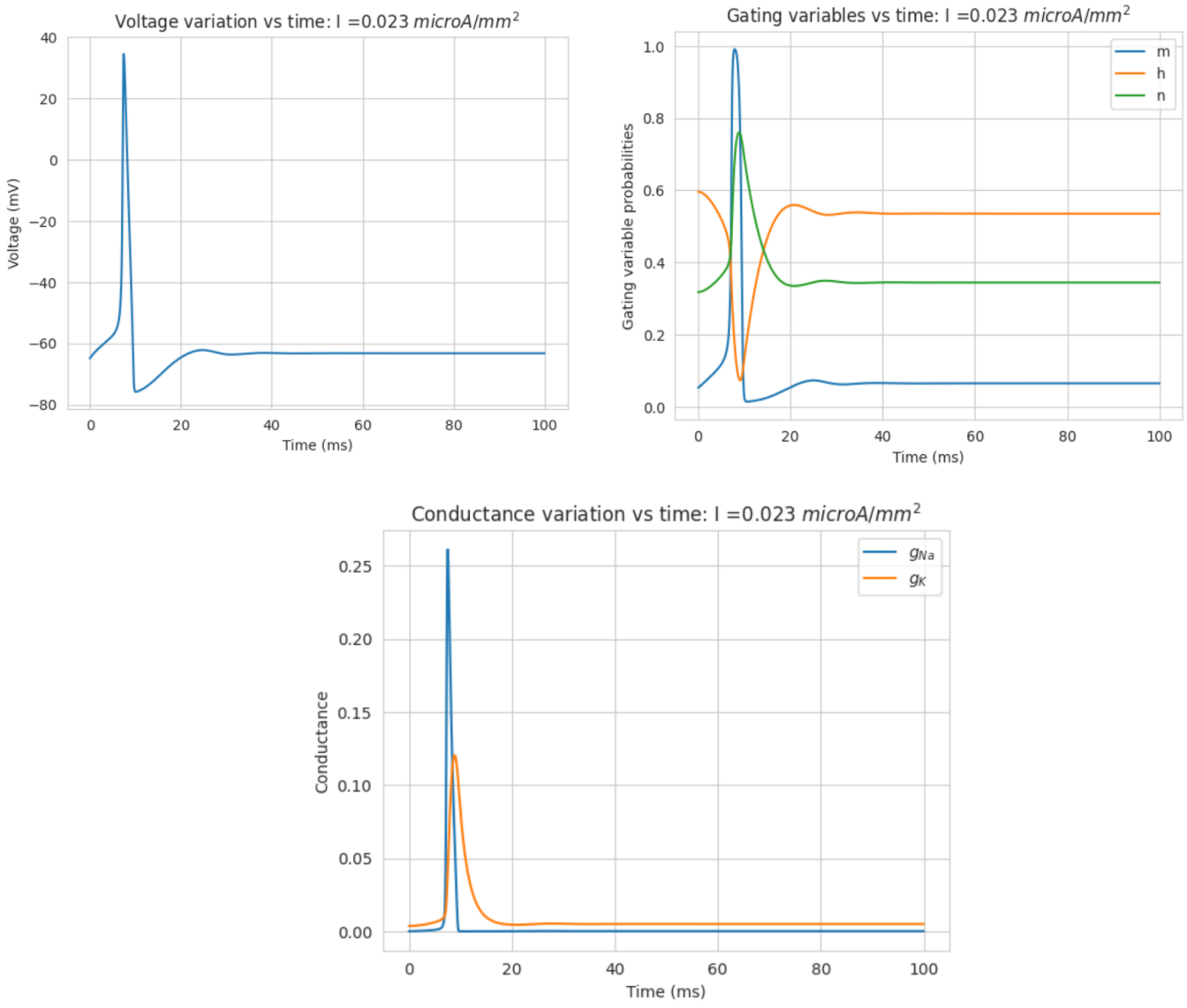

Figure 2: Variation of Voltage, Gating Variables and Conductance at current instant $\mathbf{I_1}$. A single voltage spike is observed. Number of iterations performed : 10^4

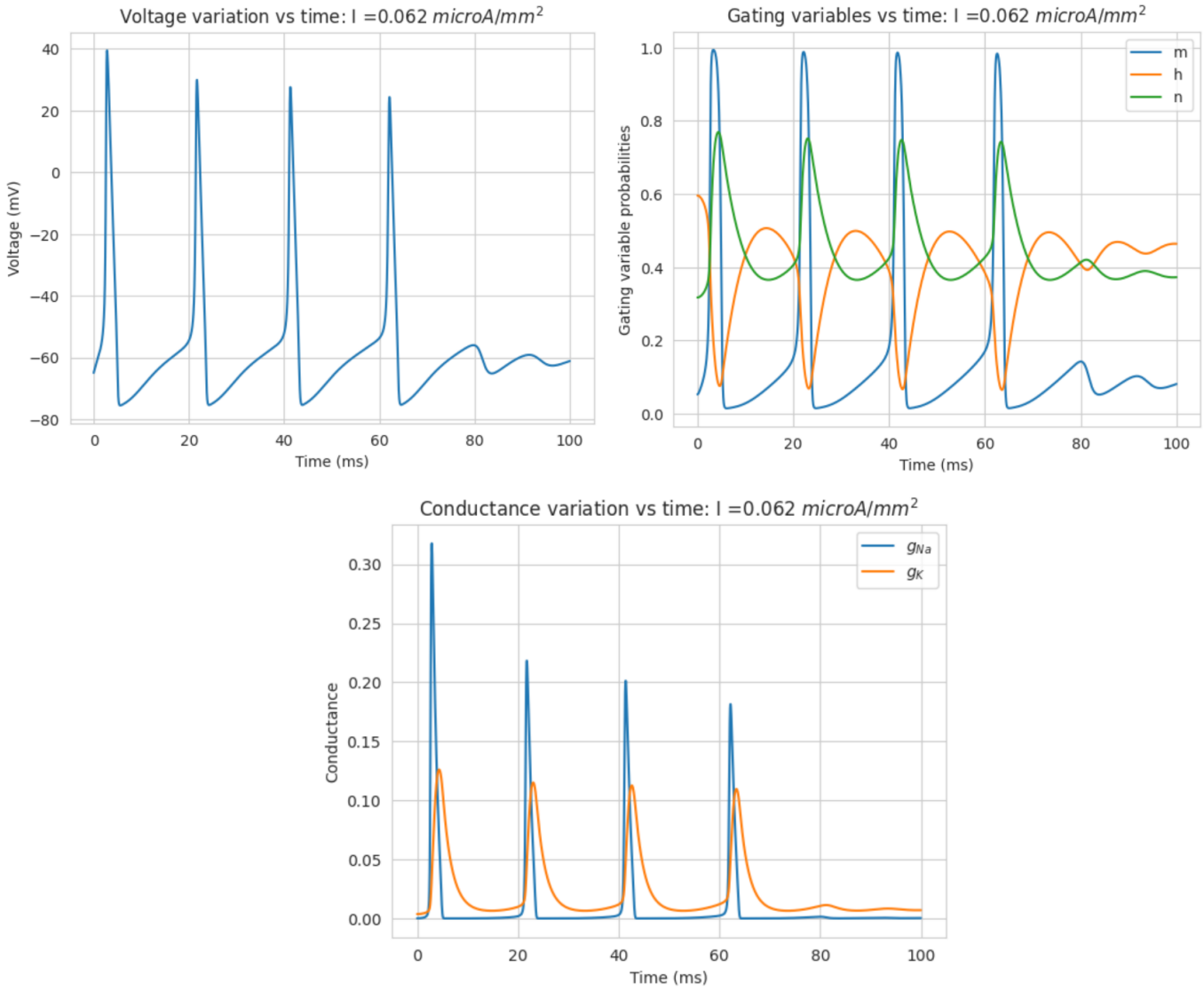

Figure 3: Variation of Voltage, Gating Variables and Conductance at current instant $\mathbf{I_2}$. Finite number of voltage spikes are observed. Number of iterations performed : 10^4

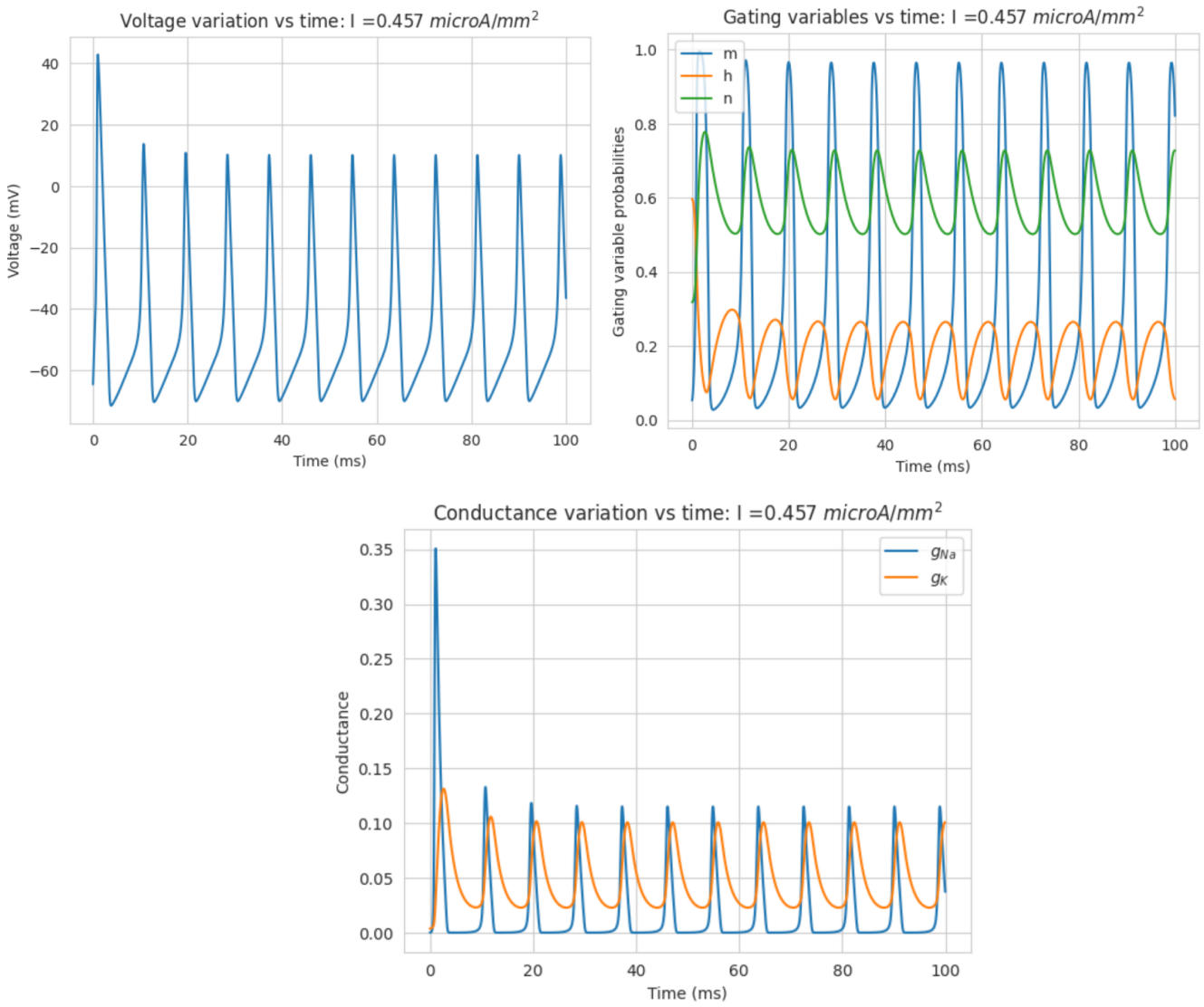

Figure 4: Variation of Voltage, Gating Variables and Conductance at current instant $\mathbf{I_3}$. Behavior similar to limit cycles is observed by the voltage spikes. Number of iterations performed : 10^4

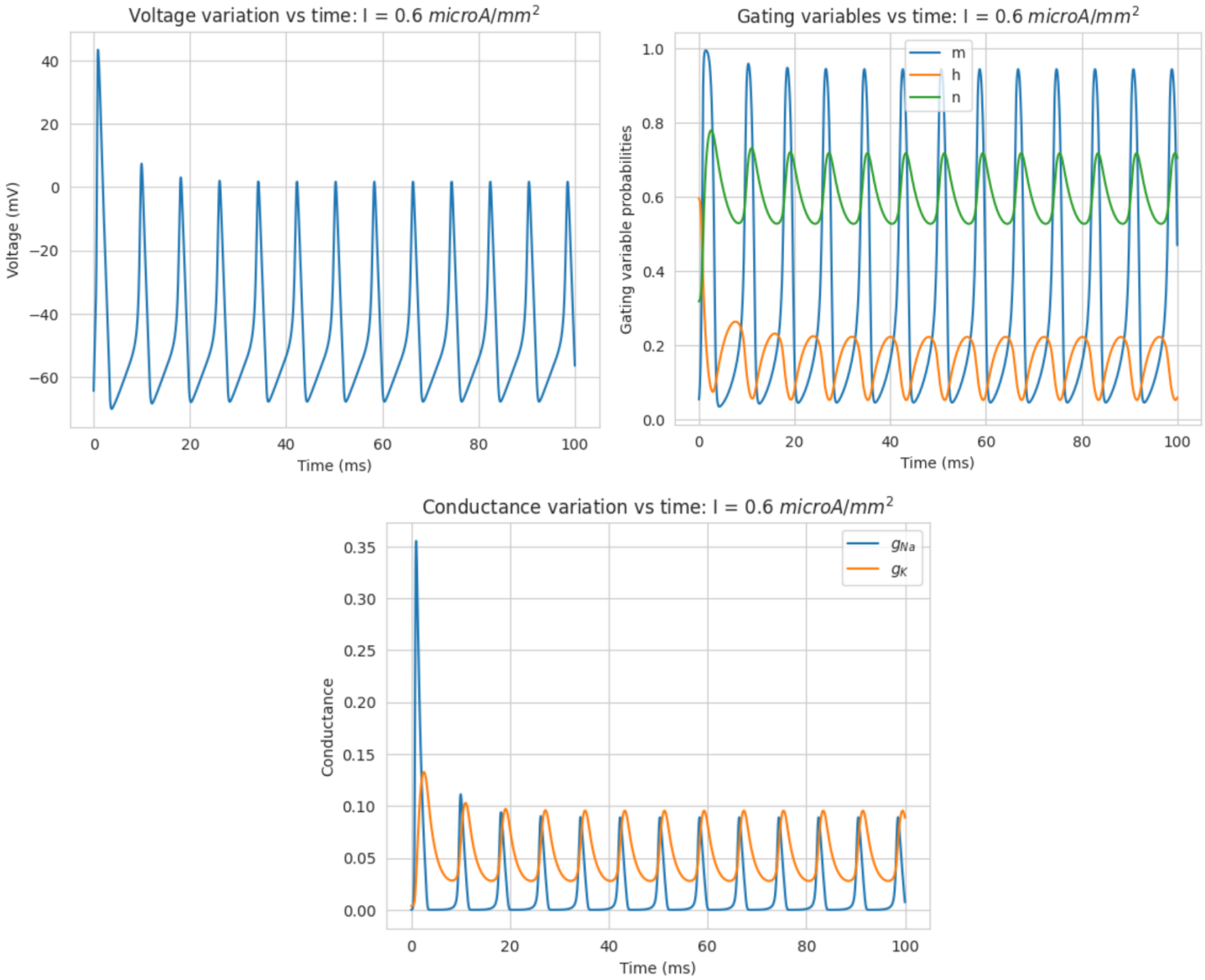

Figure 5: Variation of Voltage, Gating Variables and Conductance at an instant after $\mathbf{I_3}$ ($0.6\mu A/mm^2$). The number of spikes with amplitudes greater than 10mV has reduced drastically. Number of iterations performed : 10^4

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