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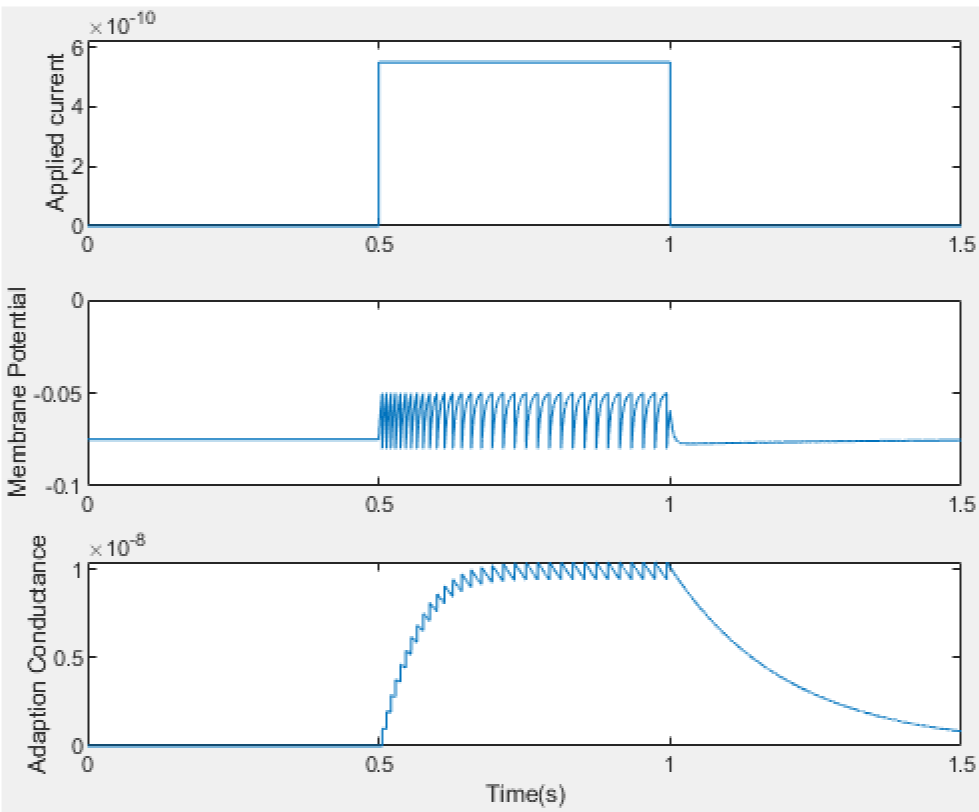
Tutorial 2.3 HW2

Q 1a: Simulate the model neuron for 1.5s… Plot your results in a graph using three subplots with current as a function of time, Vm as a function of time, and the adaption conductance as a function of time stacked on top of each other.

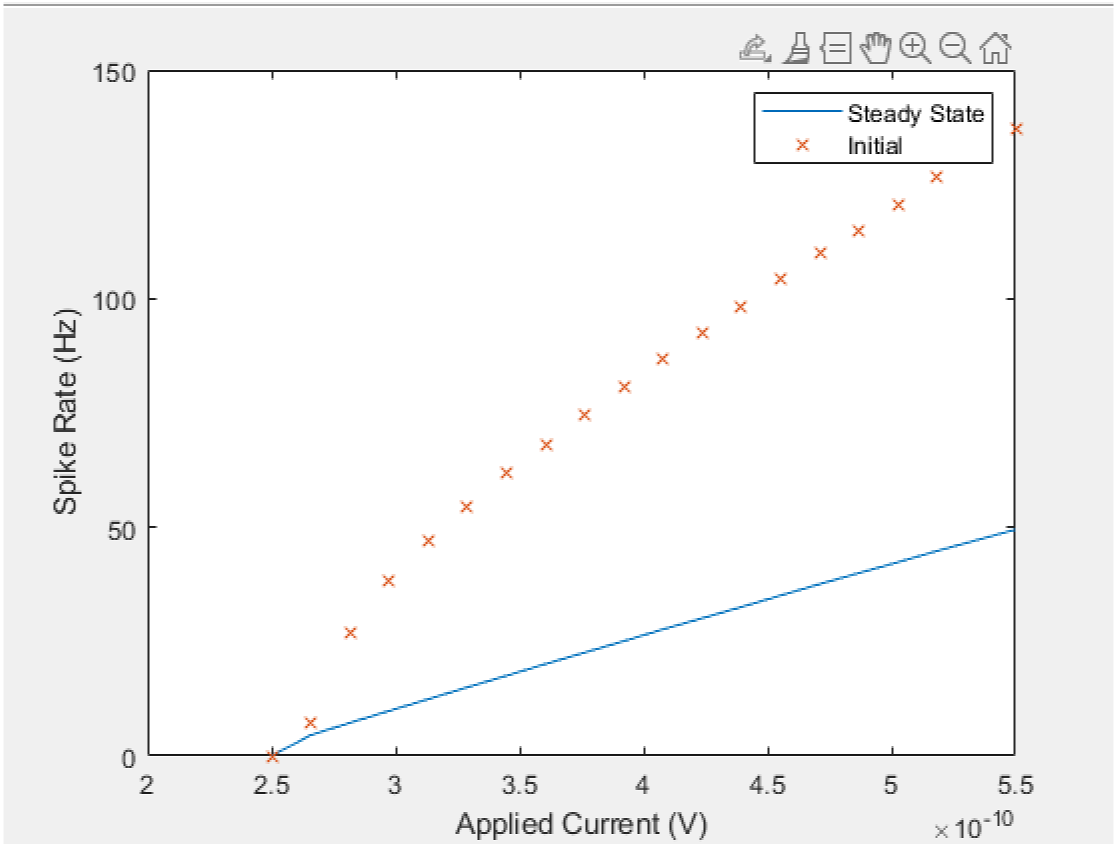
A 1a:



Everything appears as it should. Step pulse current from 0.5 to 1 second, spikes gradually decrease in frequency until steady state is reached, and adaption current ramps up with spikes and decays afterwards.

Q 1a: Now simulate for 5 seconds with a range of 20 different levels of constant applied current. For each applied current calculate first and steady ISI. On a graph plot the inverse of each to produce an f-I curve and comment on results.

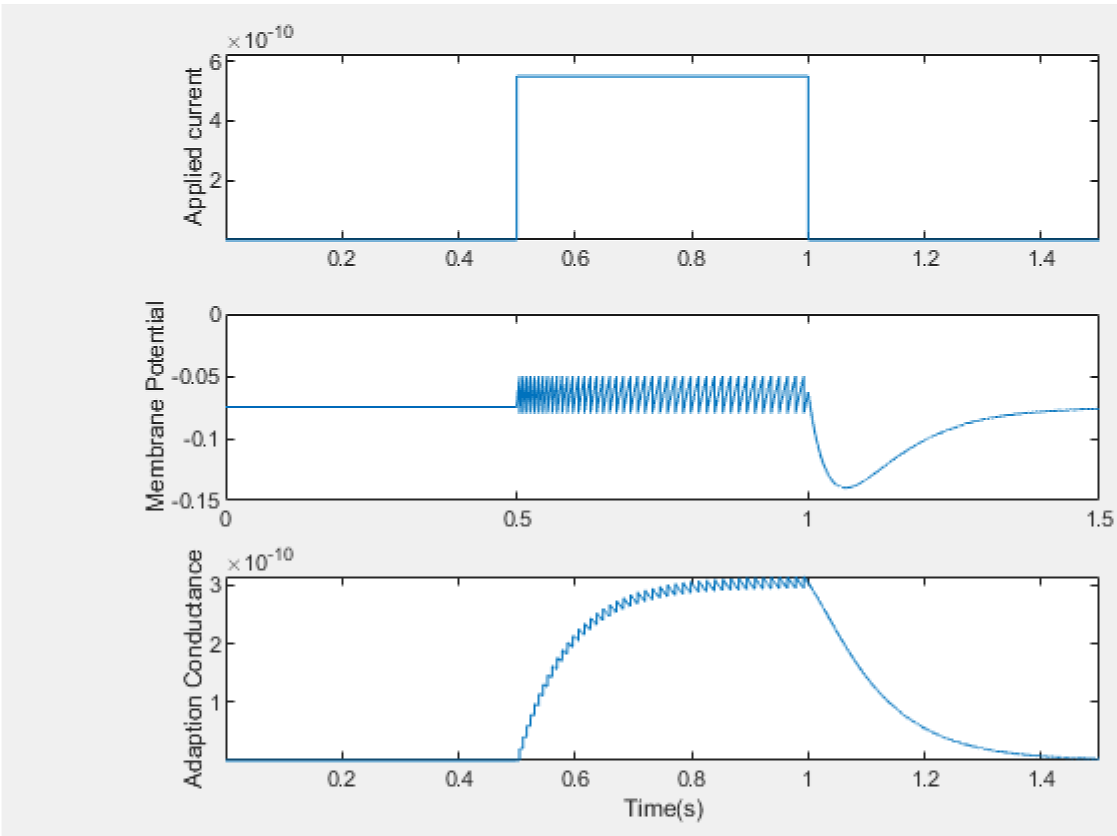
A 1a:



In the graph above, Steady state firing rate varies from 0 to 50Hz, and initial firing rate varies from 0 to nearly 150hz. The wider range and higher ceiling for initial firing rate makes sense, as the inter spike interval should be much shorter for the first to the second spike than to when it reaches steady state due to the inclusion of an adaption current. What is interesting however is how both initial and steady state seem to have a brief period near the beginning of their spike rate representation that “grow faster” (higher spike rate growth for same applied current increase). This is unlikely to be an artifact of too few trials, because when additional data points are tested, the trend is actually more observable.

Q 2a: Simulate AELIF model neuron and graph in the same way as in Q1a.

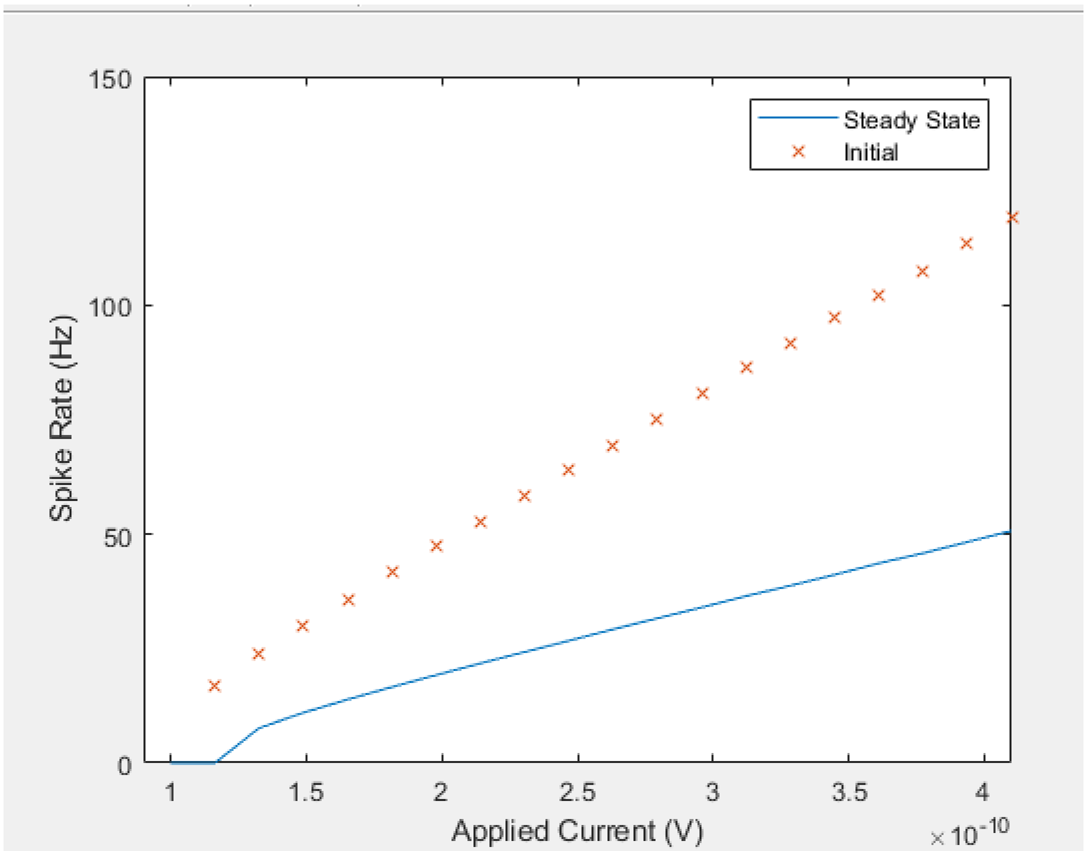
A 2a:



Notable differences from 1a include a faster spike rate and therefore faster adaption conductance ascension. Additionally, there seems to be a pronounced hyperpolarization event after current has stopped being applied.

Q 2b: Simulate AELIF model neuron and graph in the same way as in Q2a. Comment on results

A 2b:



The graph looks very similar to that of question 1b with a few key differences. Notably, the initial firing rate has more of a "head start" over steady state firing rate likely due to the increased threshold required to actually reach a steady firing rate over the time elapsed. It is also important to notice the difference in applied current values between the two graphs. In this model, it took significantly less applied charge to reach a 50hz steady firing rate. This happens to also lead to a slightly less overt difference in the final values of initial and steady firing rates.