**Report for tutorial 4.3**

Question 1 (README). Both files are saved in the file. The main file is intrinsic\_burster.m

Function gating\_variable.m is used to calculate change of gating variable in each time step. PR\_dend\_gating.m and PR\_soma\_gating.m are downloaded from online material. Edit variable question\_number in intrinsic\_burster.m to view plots from different questions in the tutorial. Accepted values for question\_number are 2, 3, 5, and 6. The figures returned for each question number are illustrated as follow:

question\_number=2 will return plots of rate constants’ relationship to either membrane potential or Ca concentration in fig. 1.

question\_number=3 (or 4) will return both somatic and dendritic membrane potential in fig. 2, simulating the Rinsky-Rinzel model for 2 seconds. There will be a count of spikes returned in the command window.

question\_number=5 will return the plot as question 3 (fig. 3-6). It will additionally return plot (fig. 7) showing the correlation between G\_link value (0-100nS) and spike number in 2 second in the model from question 3.

question\_number=6 will return plots as in question 3 (fig. 8-10). It will additionally return plot (fig. 11) showing the correlation between dendritic applied (0-200pA) current and spike number in 2 second in the model from question 3.

To view membrane potential plots with designated G\_link and Iapp values at question 5 or 6, edit the G\_link and Iapp\_D values in at line 121-138.

Question 2.

Fig.1

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Question 3.

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Fig.2

Question 4.

Number of peaks detected in question 3 plot is 8 when G\_link is 50nS.

Question 5

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Fig. 3 fig. 4

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Fig. 5 fig. 6

Without any external applied current, the number of somatic peaks in 2 seconds is 52 when G\_link is 0 nS. (fig. 3)

When G\_link is 10 nS, the number of somatic peaks in 2 seconds is 67. (fig. 4)

When G\_link is 100nS, there are only 2 somatic spikes in two seconds. (fig. 6)

There isn’t a linear relationship between G\_link value and number of spikes. The number of spikes would maximize when G\_link is around 10-13nS at 67. The spike number would suddenly drop when G\_link increases from 15 to 18nS. It will then fluctuates at low number (<=10 spikes) when G\_link is 20-60nS. When G\_link is greater than 60nS (less than 100nS), the spike number would stabilize at 2. (fig. 6)

The spike numbers are plotted in the following graphs. Left (7A) has G\_link range from 0 to 20 nS, right (7B) has range from 0 to 100 nS to show the general trend.

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Fig. 7 (A) (B)

When G\_link = 0-14nS, there’s continuous firing throughout the simulation with increasing inter-spike intervals (reaching a constant firing rate).

There’s huge drop when G\_link >= 15nS, because the somatic compartment starts to reveal the behavior of an intrinsically bursting neuron (fig. 6). There’s a firing burst, with more than 100ms interval between each burst. The firing is no longer continuous. Within each burst, there are multiple condensed spikes within each burst, fires at a high firing rate.

When G\_link is greater than 60nS, the number of spikes stabilizes because there is only spike within each burst. Within a burst, the somatic membrane potential oscillates after the spike, but it is unable to reach the upper threshold for spiking.

Question 6.

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Fig. 8 fig. 9

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Fig. 10 fig. 11

There are 15 somatic spikes when the dendritic applied current is 50 pA, 23 somatic spikes when dendritic applied current is 100 pA, and 115 somatic spikes when Iapp is 200 pA. There’s a positive correlation between dendritic applied current and number of spikes.