Advanced Neural Networks - Homework 2

Carolyn Atterbury

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1 Baseline

Figure 1 illustrates the spike pattern in the Coupled Integrate and Fire Neuron model. Given constant input, the spikes start out close together and get father apart as time goes on. 2 illustrates the Risi with the Coupled Integrate and Fire Neuron model. We can see that the spike rate starts out high and then decreases over time.

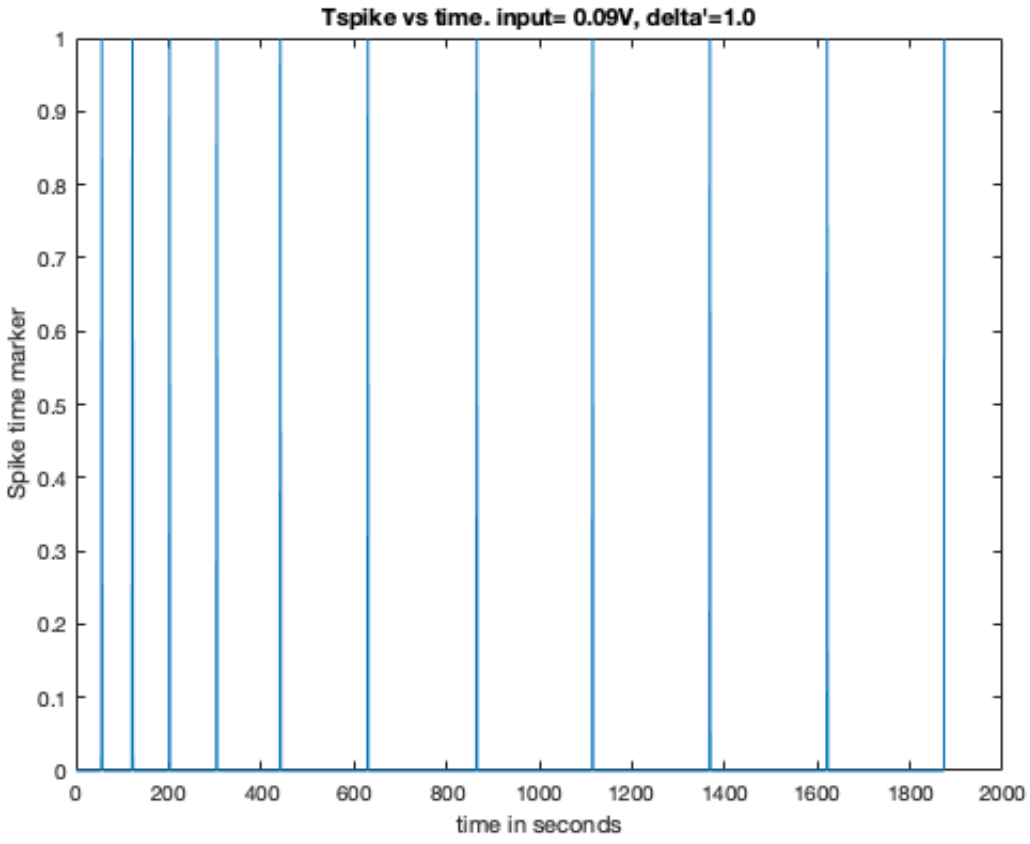

Figure 1: Spike pattern over time in milliseconds.

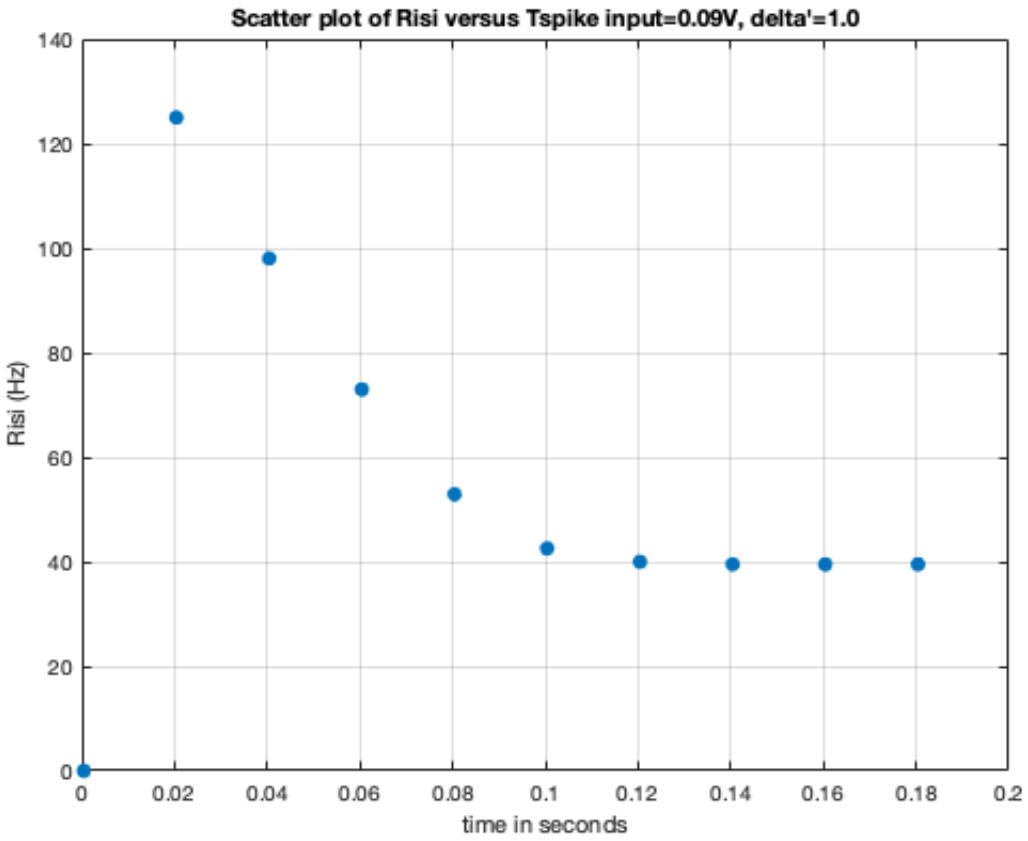

Figure 2: Average Risi over time in milliseconds.

2 Varying Threshold

Figure 3 illustrates the spike pattern when the threshold voltage has been changed from -0.05 to -0.04. With a higher threshold, the spikes are less frequent overall.

Figure 4 illustrates how our original baseline risi changes with varying threshold values. With a threshold value set at -0.06mV, the neuron has a higher firing rate overall than the models with a threshold of -0.05 and -0.04.

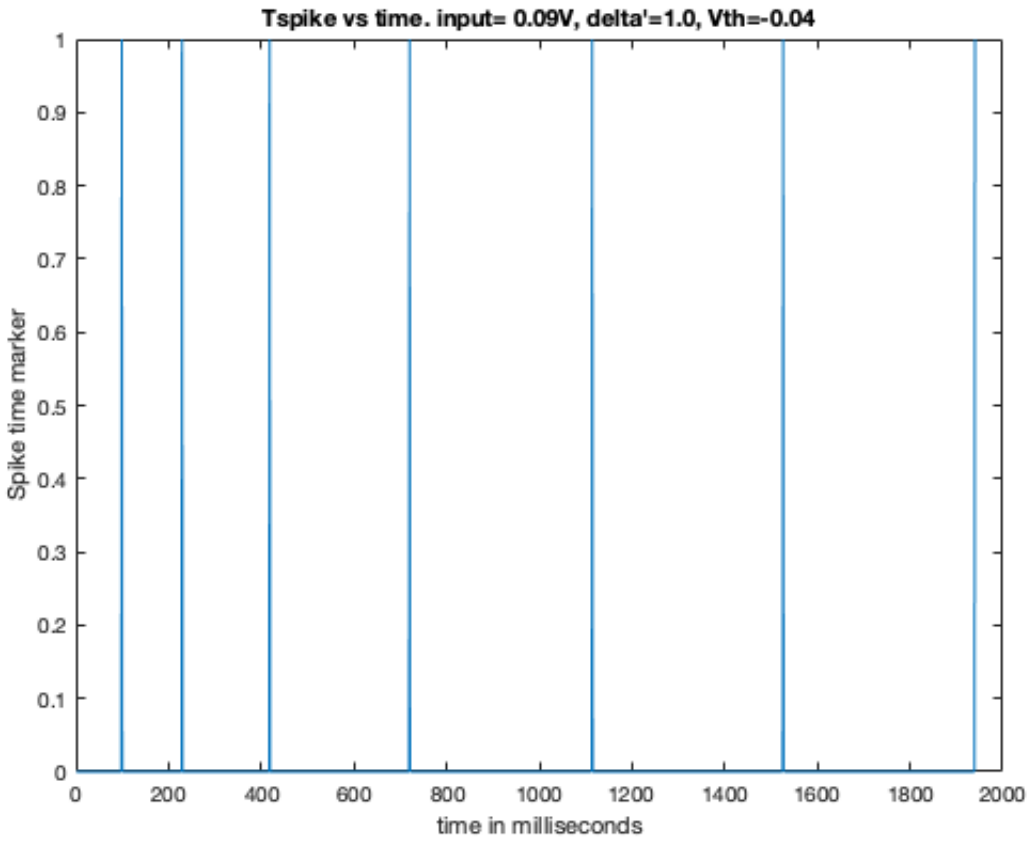

Figure 3: Spike pattern with a threshold of -0.04

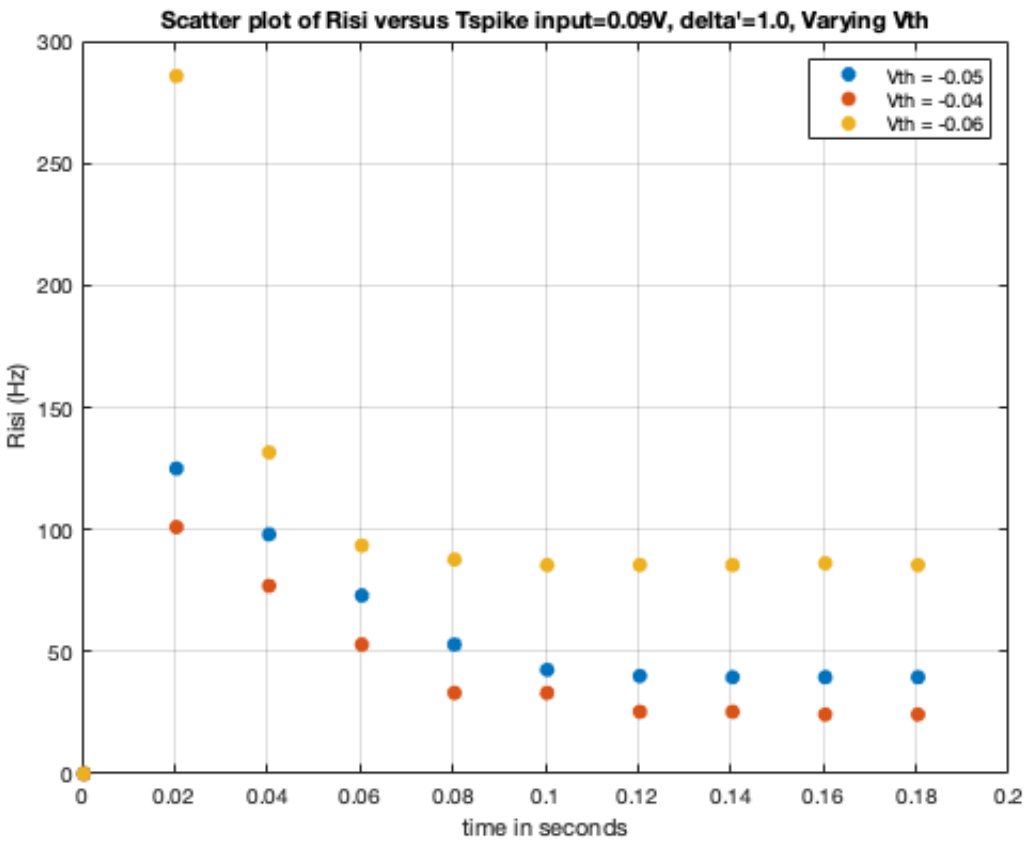

Figure 4: Average Risi with different Vth values.

3 Varying RmIe

By varying the electrical input (RmIe) to the neuron from 0.09 to 0.07, we can see how the spike pattern decrease in frequency in Figure 5.

In Figure 6, we can see how the Risi changes with varying electrical input levels. Overall, the higher the input, the higher the firing rate, but also higher inputs correspond to a steeper curve. Higher input values decrease faster than lower input values.

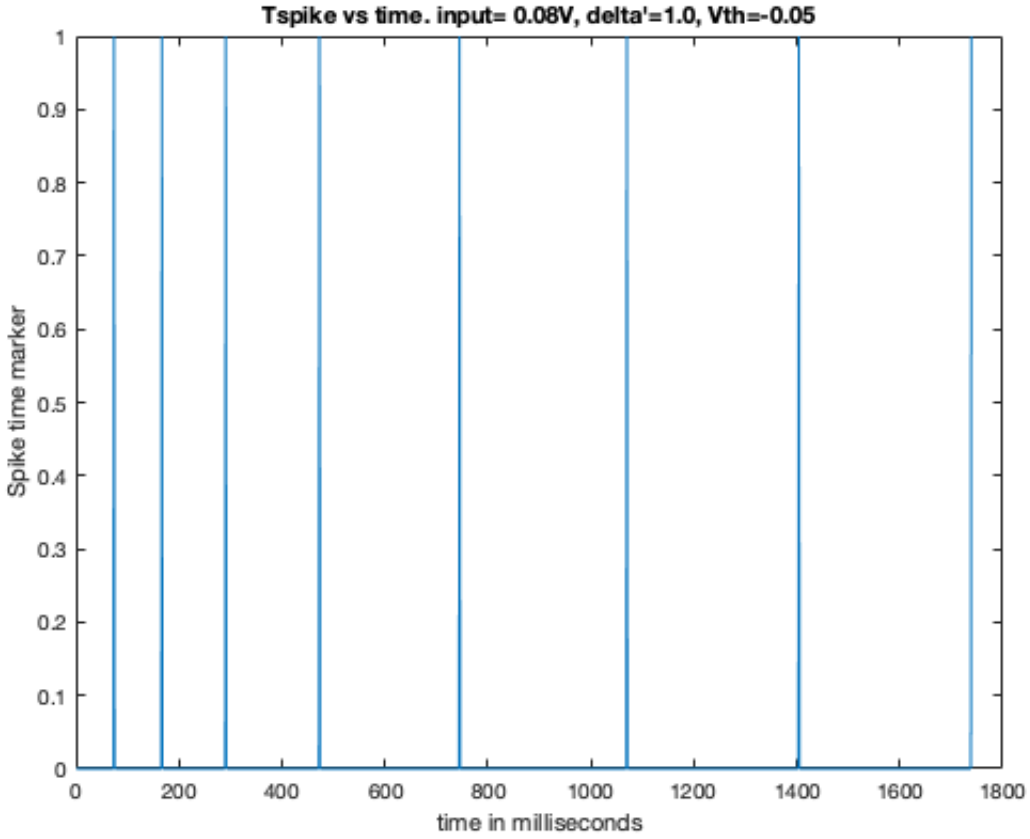

Figure 5: Neuron spike pattern where input RmIe=0.07mV.

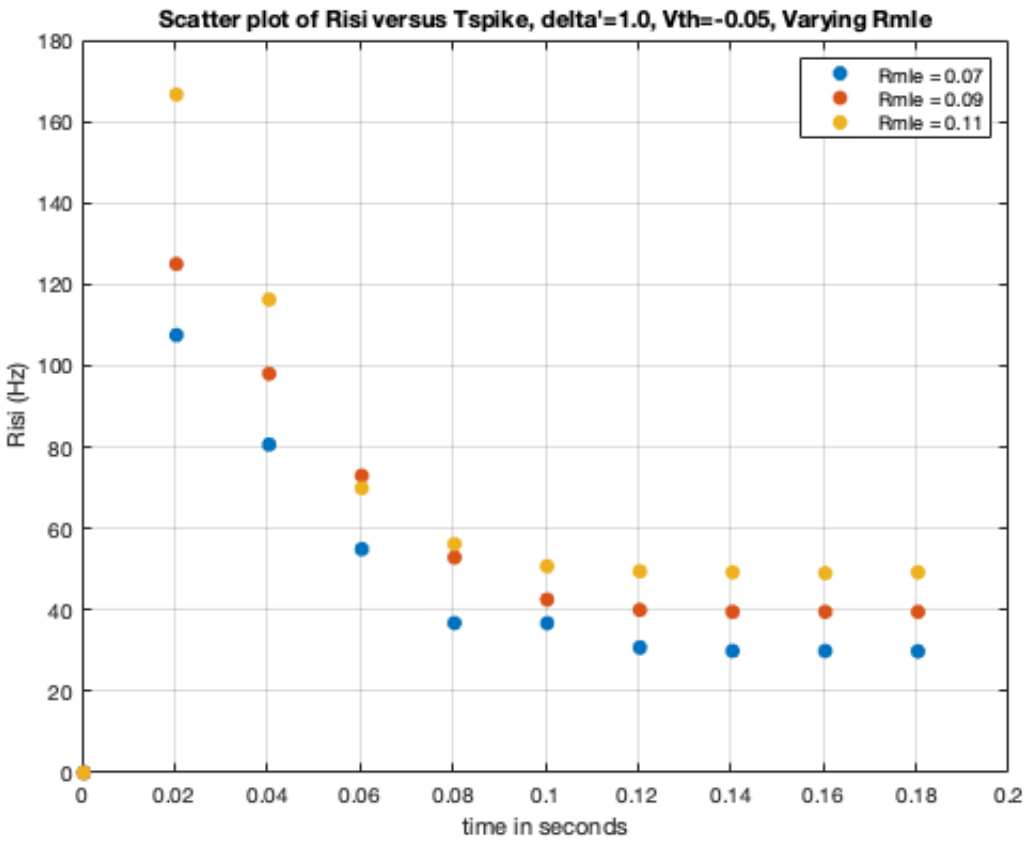

Figure 6: Average Risi with varying electrical input (RmIe values)

4 Varying $\Delta g'rsa$

In Figure 7 we can see the spike pattern as we change $\Delta g'rsa$ from 1.0 to 2.0. With the larger $\Delta g'rsa$ value, the spikes seem to decrease rapidly and fire overall at a lower rate.

Figure 8 shows the Risi with varying $\Delta g'rsa$ values. Overall, lower $\Delta g'rsa$ values correspond to a higher spike rate, and a more gentle curve. Higher $\Delta g'rsa$ values cause the Risi to decrease more rapidly.

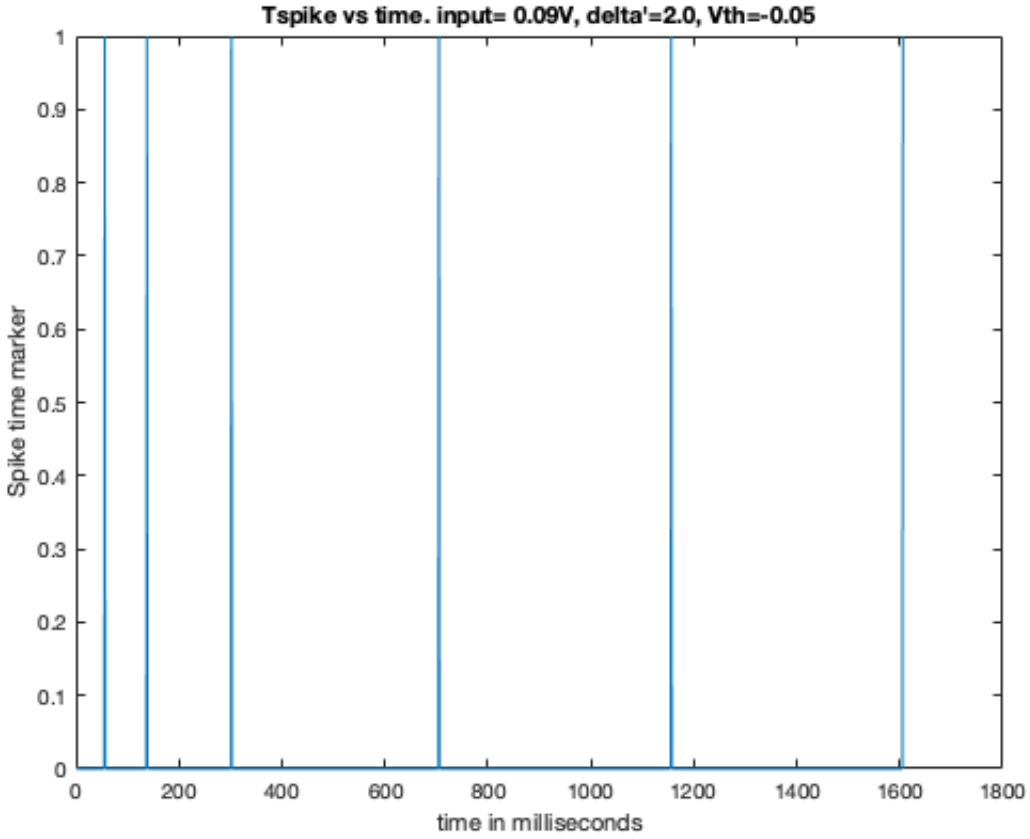

Figure 7: Neuron spike times with a $\Delta g'rsa = 2.0$

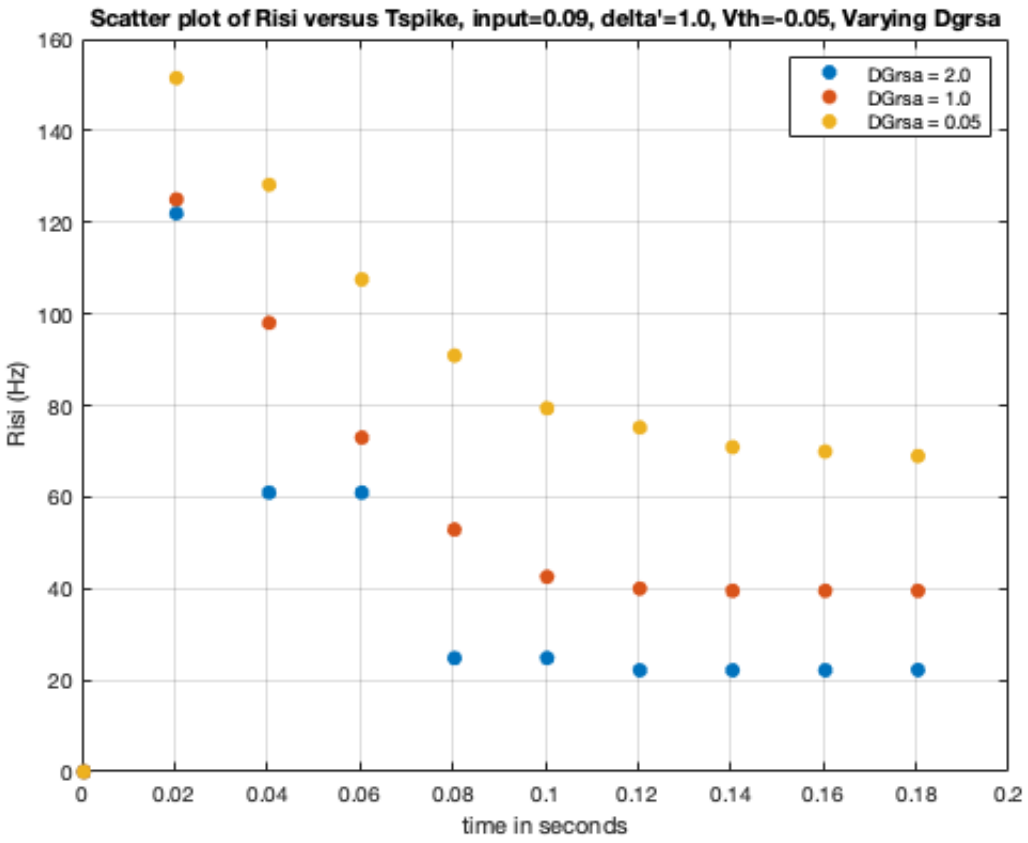

Figure 8: Risi for various $\Delta g'rsa$ values