Neural Networks

Assignment 0

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Note up front, There is no **isi** function in Matlab, and therefore we were not able to perform that task. We have guessed the mean spike interval time per setting by looking at the graphs created by matlab. Although this isn't as precise, it still shows the effect.

1 Setup

We created a function, *plotNeuron* which calculates and returns a vector containing t and v, which was given in the text. This function is called in our other script, which uses the vectors to plot the three graphs (with low, medium and high settings). These plots are then used by us to observe what the effect is of the particular variable. We chose not to plot them in one graph, because it became very messy. We found this a cleaner solution.

2 Variables

2.1 Tau

The graphs below show the influence of changes in *Tau*. When *Tau* decreases, the frequency of the spikes increases. When it increases, the frequency decreases. The changes aren't very drastic. We guess the mean time in between peaks is 15 ms for medium, about 12 for low and about 20 for high.

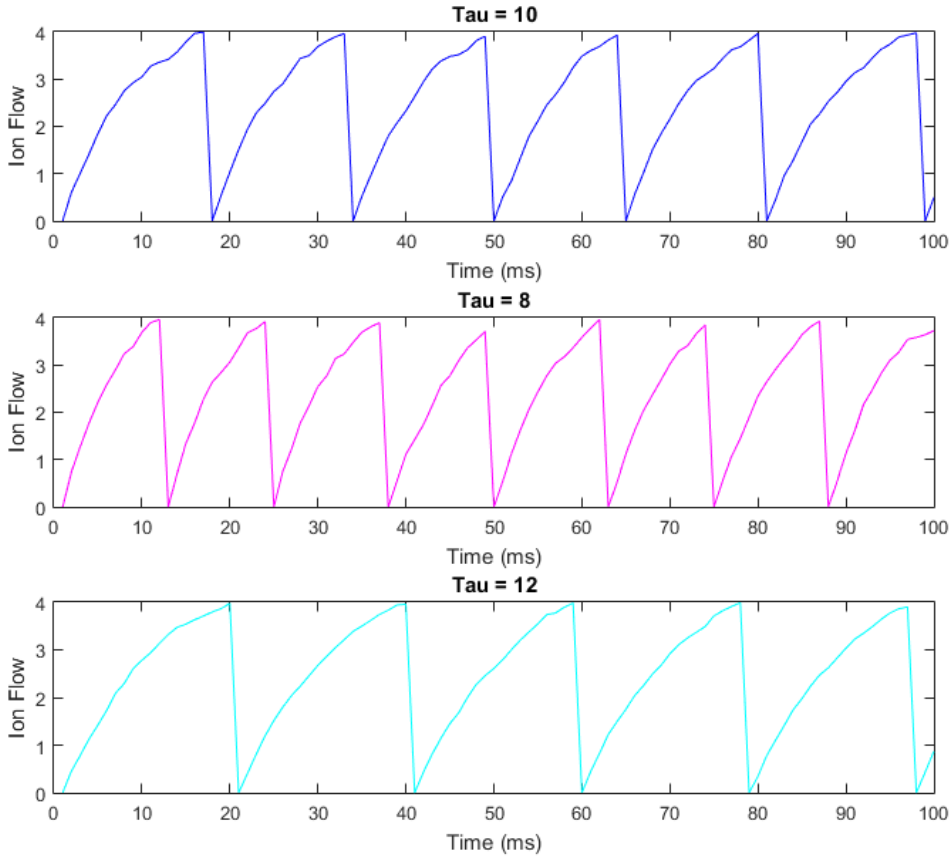

Figure 1: The influence of tau on the activity of the neuron

2.2 Rin

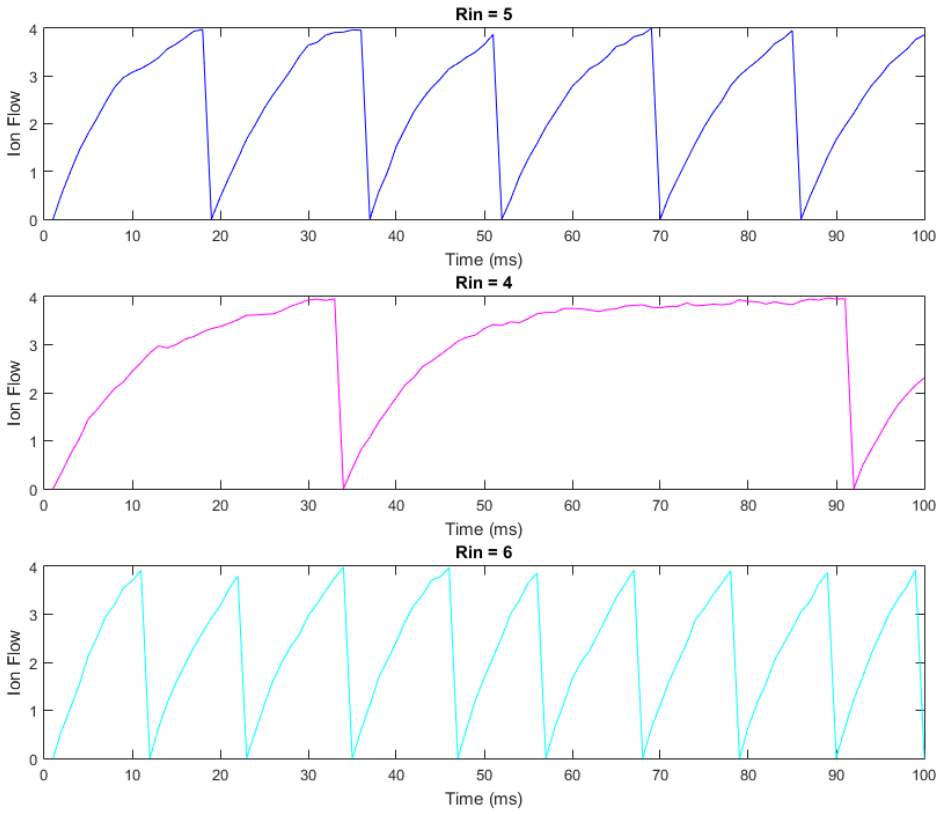

Figure 2: The influence of Rin on the activity of the neuron

2.3 Theta

Decreasing *Theta* increases the frequency of the neuron. Increasing it greatly decreases the frequency, while also lowering the amplitude. We guess the mean time in between peaks is 15 ms on medium, about 8-10 on low and about 45 on high. Again, we see a huge difference between low and high. It seems that a small change in theta has a rather big effect on the times in between the peaks.

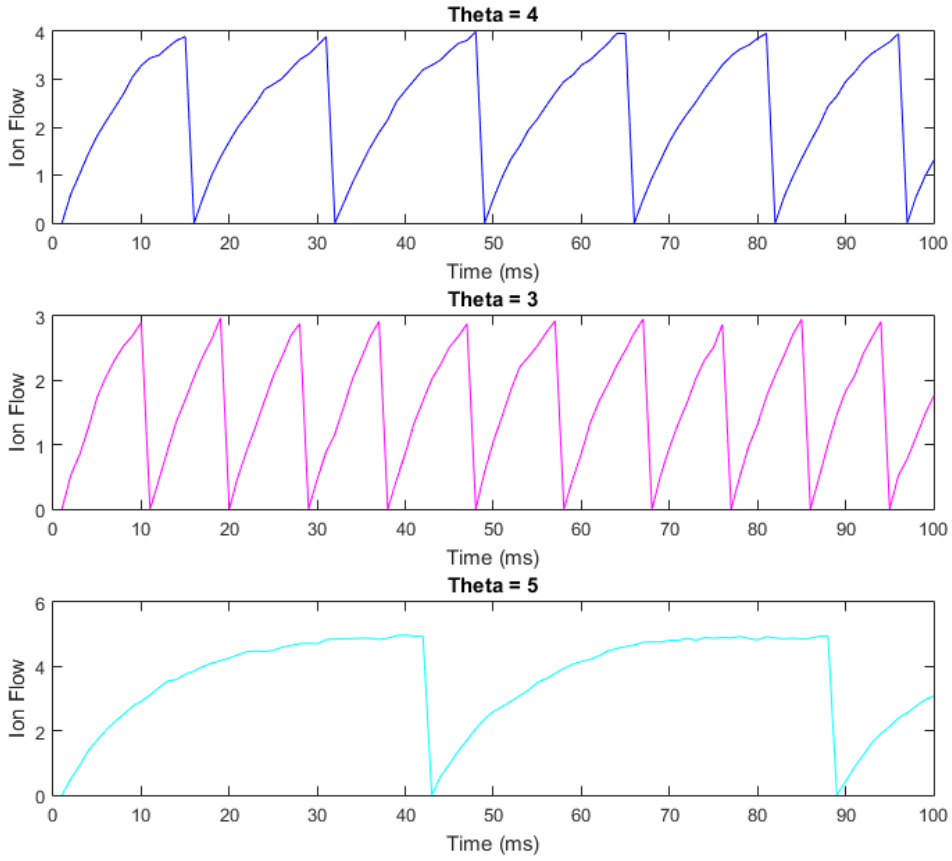

Figure 3: The influence of theta on the activity of the neuron

3 Conclusion

We can conclude by saying that theta and Rin seem to have a bigger impact on the spikes than Tau does. This can be seen by the graphs and by the mean time in between spikes.

4 Code

```
clear v;

% calculate the three different vectors which will be plot. The variables
% have to be changed by hand
[t0,v0] = plotNeuron(10,5,4);
[t1,v1] = plotNeuron(10,5,3);
[t2,v2] = plotNeuron(10,5,5);
figure(1)
%plot the first (medium) graph
subplot(3,1,1);
plot(t0,v0, 'b');
title('Theta = 4');
```

```
xlabel('Time (ms)');
ylabel('Ion Flow');

%plot the second (low) graph
subplot(3,1,2);
plot(t1,v1, 'm');
title('Theta = 3');
xlabel('Time (ms)');
ylabel('Ion Flow');

%plot the third (high) graph
subplot(3,1,3);
plot(t2,v2, 'c');
title('Theta = 5');
xlabel('Time (ms)');
ylabel('Ion  Flow');
hold off
```

Listing 1: plot.m

```
function [t,v] = plotNeuron(tau, Rin, theta)
    nstep = 100; % Number of timesteps to integrate over
    Inoise = 0.1;
    I0 = 1+Inoise*randn(1,nstep); % Input current in nA
    dt = 1; % time step in ms
    v = zeros(1,nstep);
    tspike = [];
    t = (1:nstep)*dt;
    for n=2:nstep
        v(n) = v(n-1) + dt*(- v(n-1)/tau + Rin*I0(n)/tau);
        if (v(n) > theta)
            v(n) = 0;
            tspike = [ tspike t(n) ];
        end
    end
end
```

Listing 2: plotNeuron.m