Lab Assignement 0

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1 Answers for Lab 0

1. After our experiments, having conducted a parameter sweep of the factors we came to the conclusion that when we conduct a parameter sweep for Rin low values, the result is spare spikes and when the value gets increased, the spikes occur more often until Rin reaches a high value that turns v(n) to zero and in this case we have very few spikes. When we sweep tau, because he is the divisor in our equation, low values of tau give frequent spikes and the increase of tau has as a result to reach a point where we have no spikes. Finally, the sweep of theta, as it is the factor that limits our v(n), when it is about to become zero again, has as a result, small values of theta make the spike occurency higher and while theta gets increased, the frequency of spikes drops down.

2.

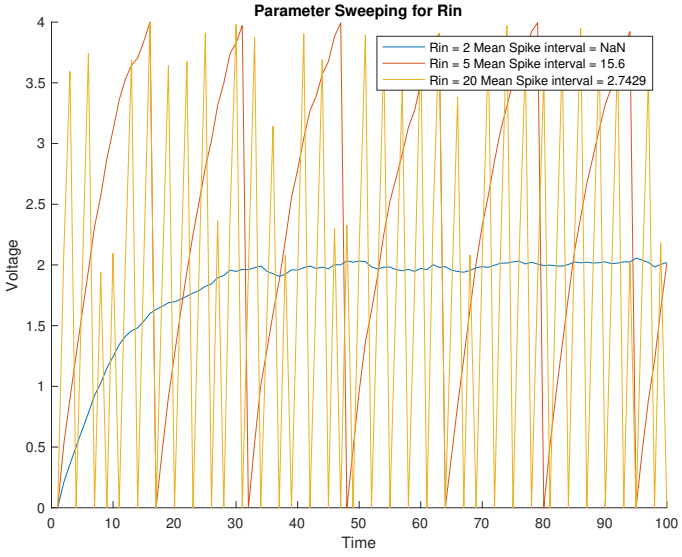

Figure 1: R-sweep

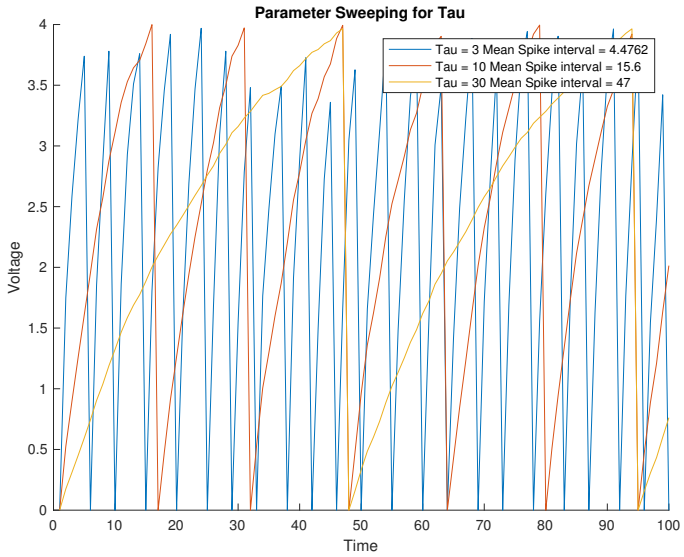

Figure 2: Tau-sweep

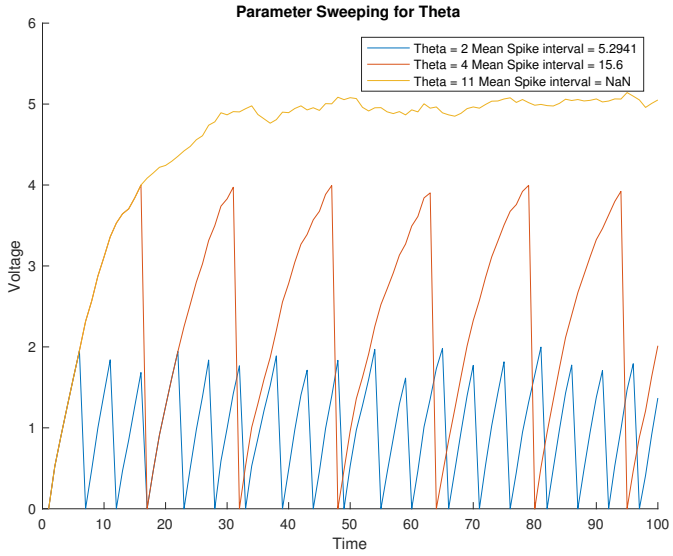

Figure 3: Theta-sweep

Listing 1: noisyifneuron.m

```
3. nstep =100; %Number of timesteps to integrate over
   Inoise = 0.1;
   IO = 1+Inoise*randn(1,nstep); %input current in nA
   dt = 1; % time step in ms
   tau_vector = [3 10 30] ; %membrane time constant in ns
   theta_vector = [2 4 11]; % threshold in mV
   Rin_vector = [2 5 20]; %Input resistance in M??hm
   v = zeros(1,nstep);
```

```
tspike = [];
t = (1:nstep)*dt;

figHandleTau = figure; %figure for Tau
figHandleTheta = figure; %figure for Theta
figHandleRin = figure; %figure for Rin

Rin = Rin_vector(2); %assigning starting values (middle) for the constants
theta = theta_vector(2);

legendInfo = cell(1,3); %initialization of legend cell for the figures
i=1; %initialization of i that counts the legends
     %that we are gonna have in our figure

for tau=tau_vector %sweep of tau value while keeping the
                   %other 2 variables constant
        for n=2:nstep
                v(n)=v(n-1) + dt*(-v(n-1)/tau + Rin*IO(n)/tau);
                if (v(n) > theta)
                        v(n) = 0;
                        tspike = [tspike t(n)];
                end
        end
        figure(figHandleTau) %use of figure command so that our plots for
                             %the diffeerent sweeps be in different figures
        legendInfo{i} = ['Tau = ' num2str(tau) ... %add the values of
        ' Mean Spike interval = ' num2str(mean(isi(tspike)))];
        %the sweeping var as legend + the mean of interval spikes
        tspike = []; %initialization of tspike table for the next sweep
        hold all %hold all command so that all plots of this iteration
                 %are represented at the same figure
        title('Parameter Sweeping for Tau');
        xlabel('Time');
        ylabel('Voltage');
        plot(t,v)
        i=i+1; %increment of legend count
end
% downwards we have 2 same iterations for Rin and theta

theta = theta_vector(2);
tau = tau_vector(2);
i=1;
legend(legendInfo)
for Rin=Rin_vector
         for n=2:nstep
                 v(n)=v(n-1) + dt*(-v(n-1)/tau + Rin*IO(n)/tau);
                 if (v(n) > theta)
                         v(n) = 0;
                         tspike = [tspike t(n)];
                 end
         end
         figure(figHandleRin)
         legendInfo{i} = ['Tau = ' num2str(tau) ...
```

```
        ' Mean Spike interval = ' num2str(mean(isi(tspike)))];
        tspike = [];
        hold all
        title('Parameter Sweeping for Rin');
        xlabel('Time');
        ylabel('Voltage');
        plot(t,v)
        i=i+1;
end
legend(legendInfo)

Rin = Rin_vector(2);
tau = tau_vector(2);

i=1;
legend(legendInfo)
for theta=theta_vector
        for n=2:nstep
                v(n)=v(n-1) + dt*(-v(n-1)/tau + Rin*IO(n)/tau);
                if (v(n) > theta)
                        v(n) = 0;
                        tspike = [tspike t(n)];
                end
        end
        figure(figHandleTheta)
        legendInfo{i} = ['Theta = ' num2str(theta) ...
        ' Mean Spike interval = ' num2str(mean(isi(tspike)))];
        tspike = [];
        hold all
        title('Parameter Sweeping for Theta');
        xlabel('Time');
        ylabel('Voltage');
        plot(t,v)
        i=i+1;
 end
 legend(legendInfo)
```

Listing 2: isi.m

```
function isi_result=isi(spiketimes)
% ISI produces interspike intervals from spike times
% ISI(spiketimes) returns the interspike intervals
% of SPIKETIMES
if (length(spiketimes)>1)
    isi_result = diff(spiketimes);
else
    isi_result = [];
end
```