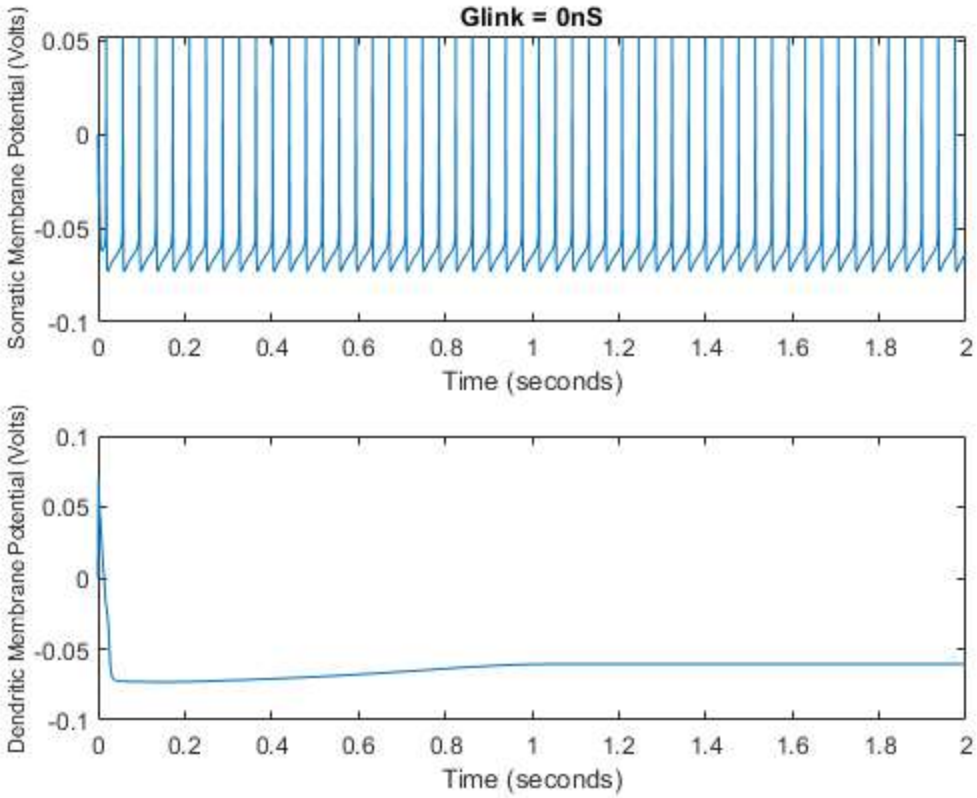
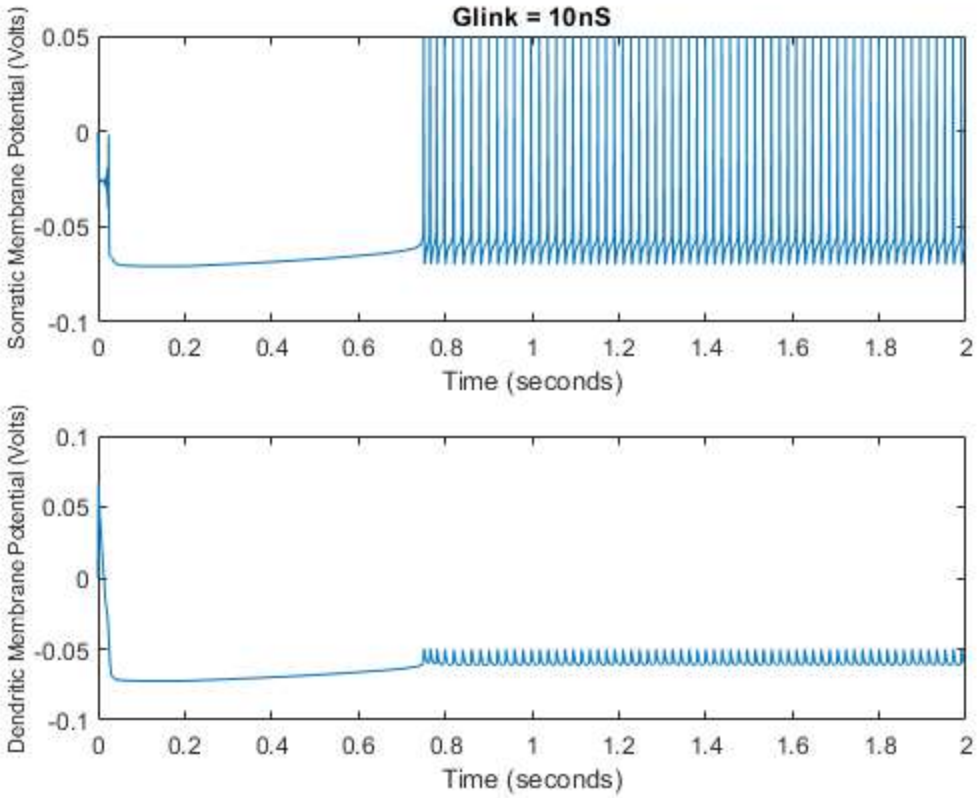
Contents

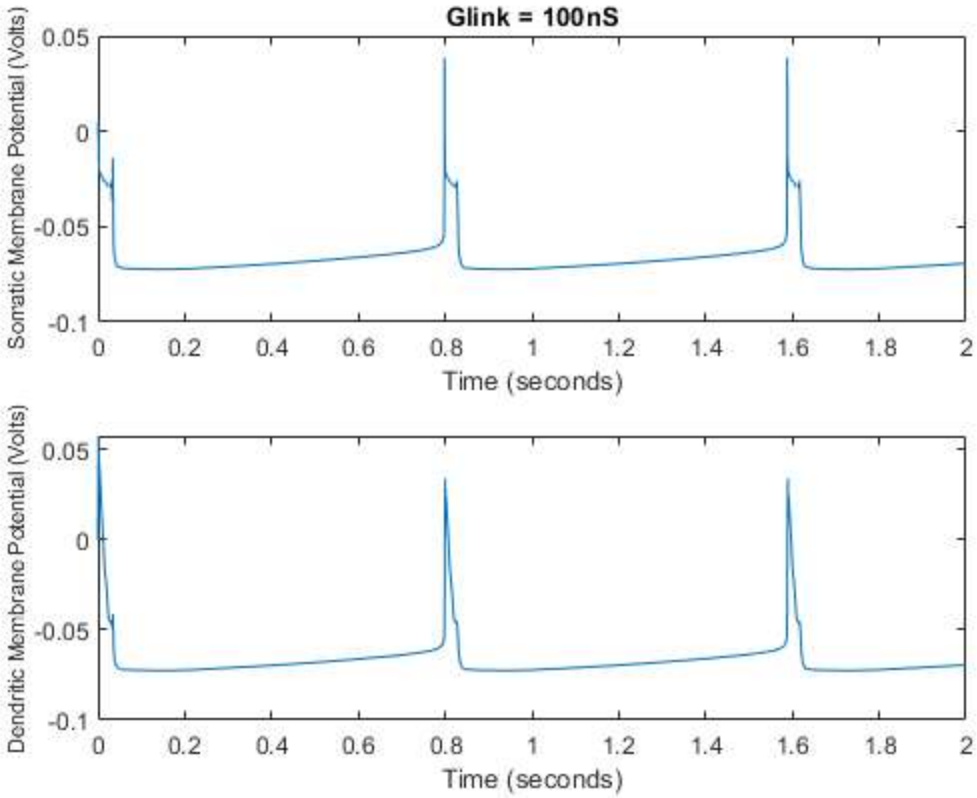
Problem 5: Alternating Glink values

```
tspan = [0:2*10^-6:2]; % time span in sec
%Initial Values
Vm_soma0 = 0;
m0 = 0;
h0 = 0;
n0 = 0;
Vm_dend0 = 0;
mca0 = 0;
mkca0 = 0;
mkahp0 = 0;
ca_conc0 = 0;
y0 = [Vm_soma0;m0;h0;n0;Vm_dend0;mca0;mkca0;mkahp0;ca_conc0];

%ODE45 Implementation
[t,y] = ode45(@(t,y) eric0nS(t,y),tspan,y0);
[~,y1] = ode45(@(t,y) eric10nS(t,y),tspan,y0);
[~,y2] = ode45(@(t,y) eric100nS(t,y),tspan,y0);

%Extract Vm of Dendrite and Soma
Vm_soma1 = y(:,1);
Vm_dend1 = y(:,5);
Vm_soma2 = y1(:,1);
Vm_dend2 = y1(:,5);
Vm_soma3 = y2(:,1);
Vm_dend3 = y2(:,5);

%Plot Results
%Glink = 0nS;
figure(1)
subplot(2,1,1)
plot(t,Vm_soma1);
ylabel("Somatic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
title("Glink = 0nS");
subplot(2,1,2)
plot(t,Vm_dend1);
ylabel("Dendritic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
%Glink = 10nS;
figure(2)
subplot(2,1,1)
plot(t,Vm_soma2);
ylabel("Somatic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
title("Glink = 10nS");
subplot(2,1,2)
plot(t,Vm_dend2);
ylabel("Dendritic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
%Glink = 100nS;
figure(3)
subplot(2,1,1)
plot(t,Vm_soma3);
```

```
ylabel("Somatic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
title("Glink = 100nS");
subplot(2,1,2)
plot(t,Vm_dend3);
ylabel("Dendritic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");

%Explanation
%If the link between the soma and the dendrite is zero, you can see that
%only the soma has action potentials while the dendrite has barely
%anything. If there is a little bit link, the soma didn't burst off action
%potentials until 0.8seconds while dendrite shows the same, this is
%probably because the leak to the dendrite doesn't allow the soma to have
%action potentials.When the link between the soma and dendrite is 100nS,
%the membrane potentials of soma and dendrite peaked at the same time.
```


Glink = 0nS
Somatic Membrane Potential (Volts)
0.05
0
-0.05
-0.1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Time (seconds)
Dendritic Membrane Potential (Volts)
0.1
0.05
0
-0.05
-0.1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Time (seconds)


Glink = 10nS
Somatic Membrane Potential (Volts)
0.05
0
-0.05
-0.1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Time (seconds)
Dendritic Membrane Potential (Volts)
0.1
0.05
0
-0.05
-0.1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Time (seconds)

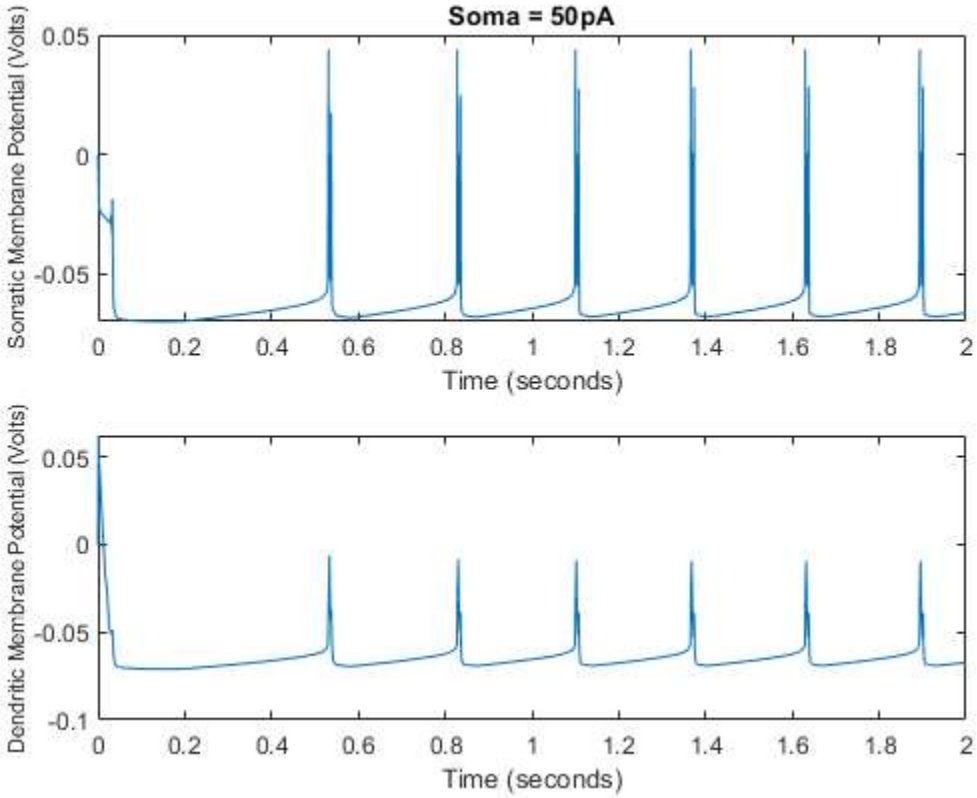


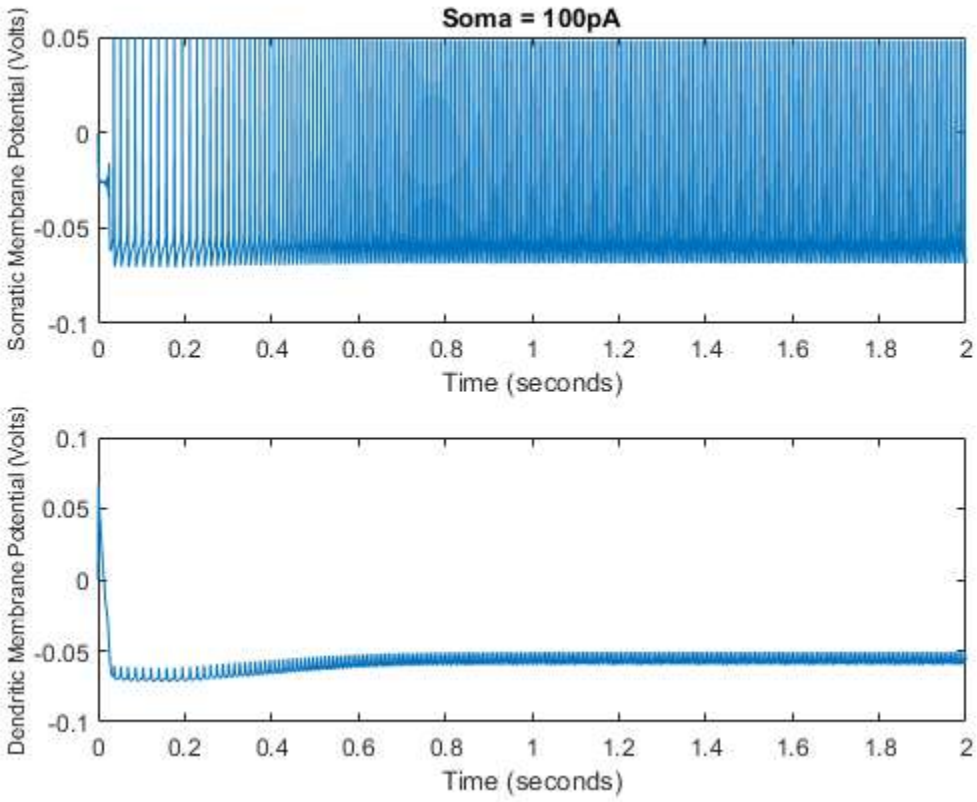
Problem 6-Changing current

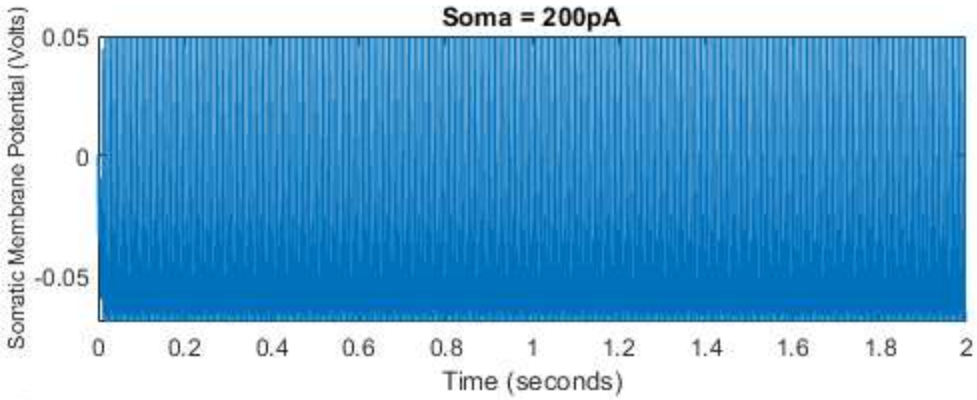
```
%ODE45 Soma change current
[t,y] = ode45(@(t,y) zeroS(t,y),tspan,y0);
[~,y1] = ode45(@(t,y) oneS(t,y),tspan,y0);
[~,y2] = ode45(@(t,y) twoS(t,y),tspan,y0);
%ODE 45 Dendrites change current
[~,y3] = ode45(@(t,y) zeroD(t,y),tspan,y0);
[~,y4] = ode45(@(t,y) oneD(t,y),tspan,y0);
[~,y5] = ode45(@(t,y) twoD(t,y),tspan,y0);
%Plot Results
%Extract Vm of Dendrite and Soma
Vm_soma1 = y(:,1);
Vm_dend1 = y(:,5);
Vm_soma2 = y1(:,1);
Vm_dend2 = y1(:,5);
Vm_soma3 = y2(:,1);
Vm_dend3 = y2(:,5);
Vm_soma4 = y3(:,1);
Vm_dend4 = y3(:,5);
Vm_soma5 = y4(:,1);
Vm_dend5 = y4(:,5);
Vm_soma6 = y5(:,1);
Vm_dend6 = y5(:,5);
%Soma = 50pA;
figure(4)
subplot(2,1,1)
plot(t,Vm_soma1);
ylabel("Somatic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
title("Soma = 50pA");
subplot(2,1,2)
plot(t,Vm_dend1);
ylabel("Dendritic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
```

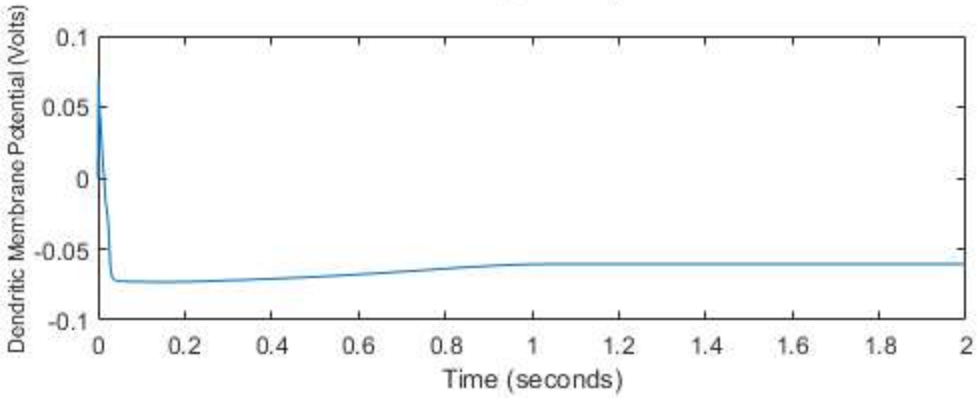
```
%Soma = 100pA;
figure(5)
subplot(2,1,1)
plot(t,Vm_soma2);
ylabel("Somatic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
title("Soma = 100pA");
subplot(2,1,2)
plot(t,Vm_dend2);
ylabel("Dendritic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
%Soma = 200pA;
figure(6)
subplot(2,1,1)
plot(t,Vm_soma3);
ylabel("Somatic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
title("Soma = 200pA");
subplot(2,1,2)
plot(t,Vm_dend3);
ylabel("Dendritic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
%Dendrite = 50pA;
figure(7)
subplot(2,1,1)
plot(t,Vm_soma4);
ylabel("Somatic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
title("Dendrite = 50pA");
subplot(2,1,2)
plot(t,Vm_dend4);
ylabel("Dendritic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
%Dendrite = 100pA;
figure(8)
subplot(2,1,1)
plot(t,Vm_soma5);
ylabel("Somatic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
title("Dendrite = 100pA");
subplot(2,1,2)
plot(t,Vm_dend5);
ylabel("Dendritic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
%Dendrite = 200pA;
figure(9)
subplot(2,1,1)
plot(t,Vm_soma6);
ylabel("Somatic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
title("Dendrite = 200pA");
subplot(2,1,2)
plot(t,Vm_dend6);
ylabel("Dendritic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");

%Explanation
%When the current is applied on the Soma, it's pretty clear that the more
%current you add onto the Soma the more spikes it's going to emit. While
%the current is applied to the dendrite, the spike counts did not change
%much, rather, the peaks of the dendrites are much higher when there is
%more current applied to the dendrites. The only thing that changed in the
```

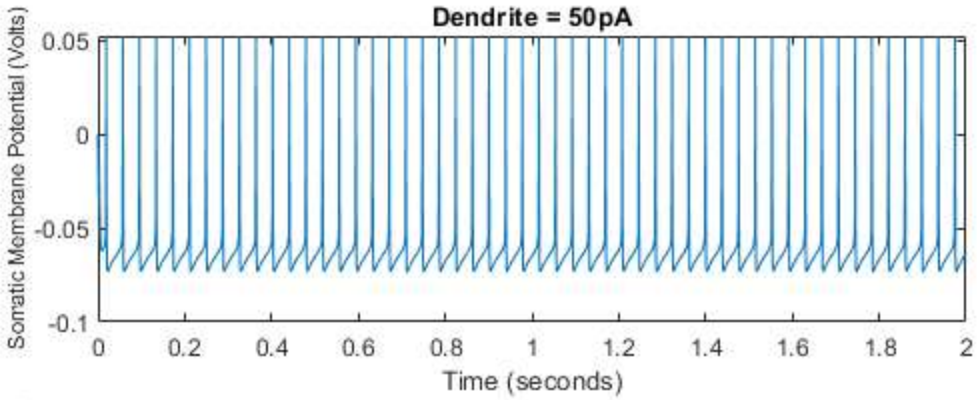
```
%soma is that the during 50pA the soma had that did not fire as crowded where
%as the case of the other two the Soma firing rates are much higher after
%some time.
```

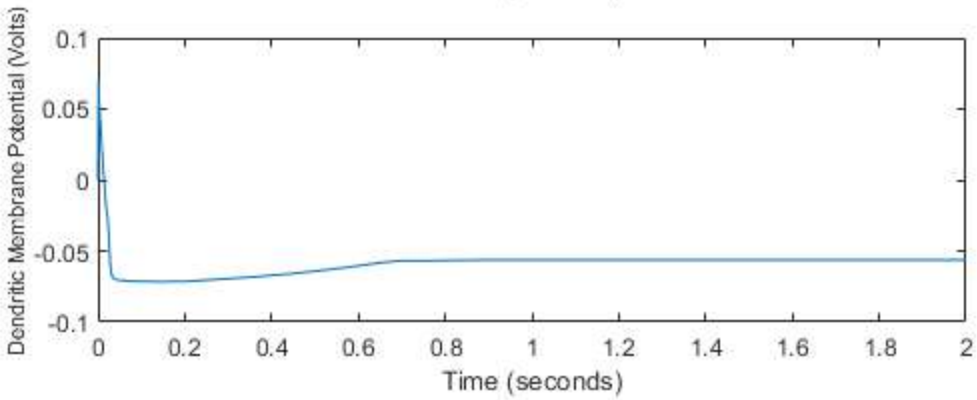


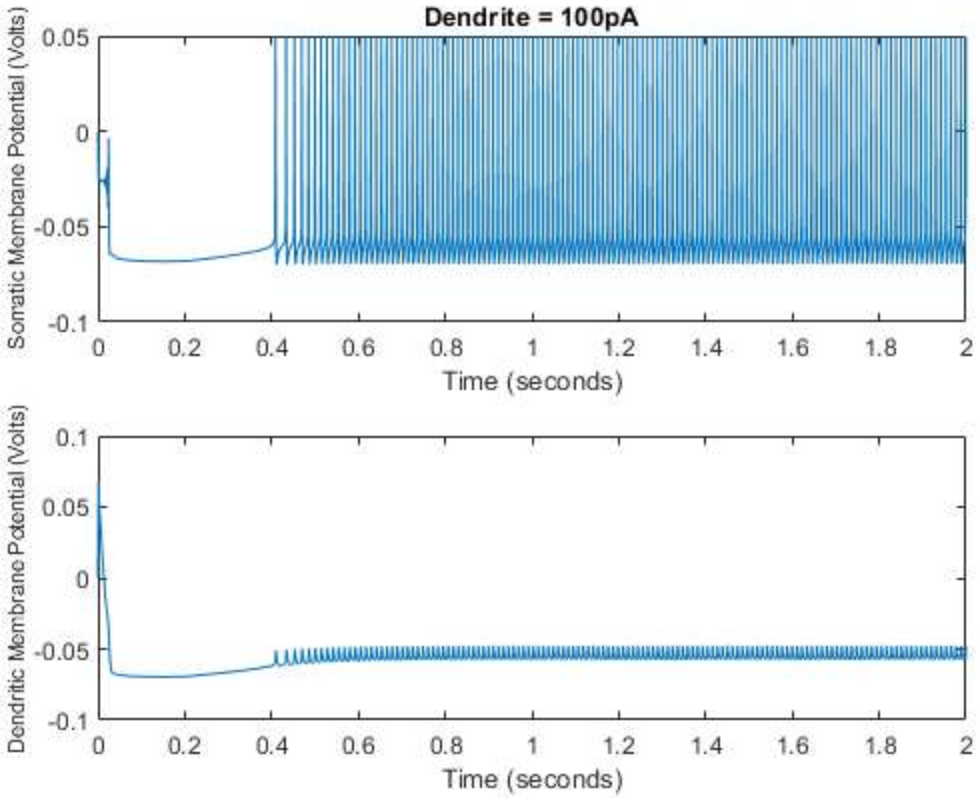


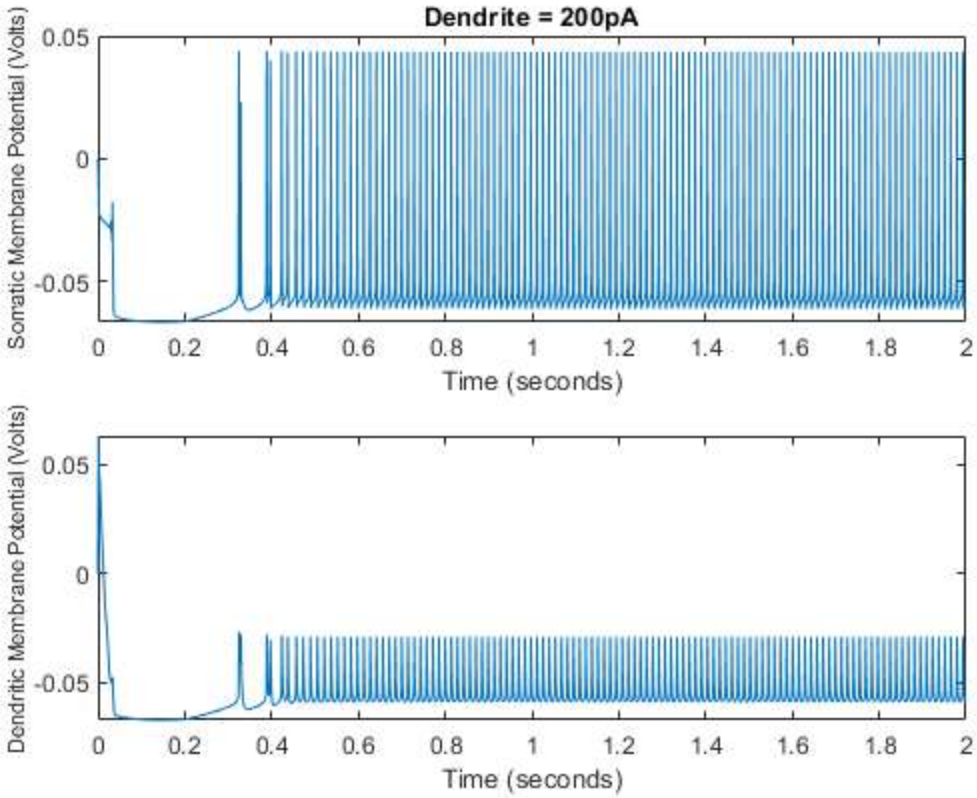

Soma = 200pA
Somatic Membrane Potential (Volts)
0.05
0
-0.05
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Time (seconds)


Dendritic Membrane Potential (Volts)
0.1
0.05
0
-0.05
-0.1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Time (seconds)


Dendrite = 50pA
Somatic Membrane Potential (Volts)
0.05
0
-0.05
-0.1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Time (seconds)


Dendritic Membrane Potential (Volts)
0.1
0.05
0
-0.05
-0.1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Time (seconds)





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