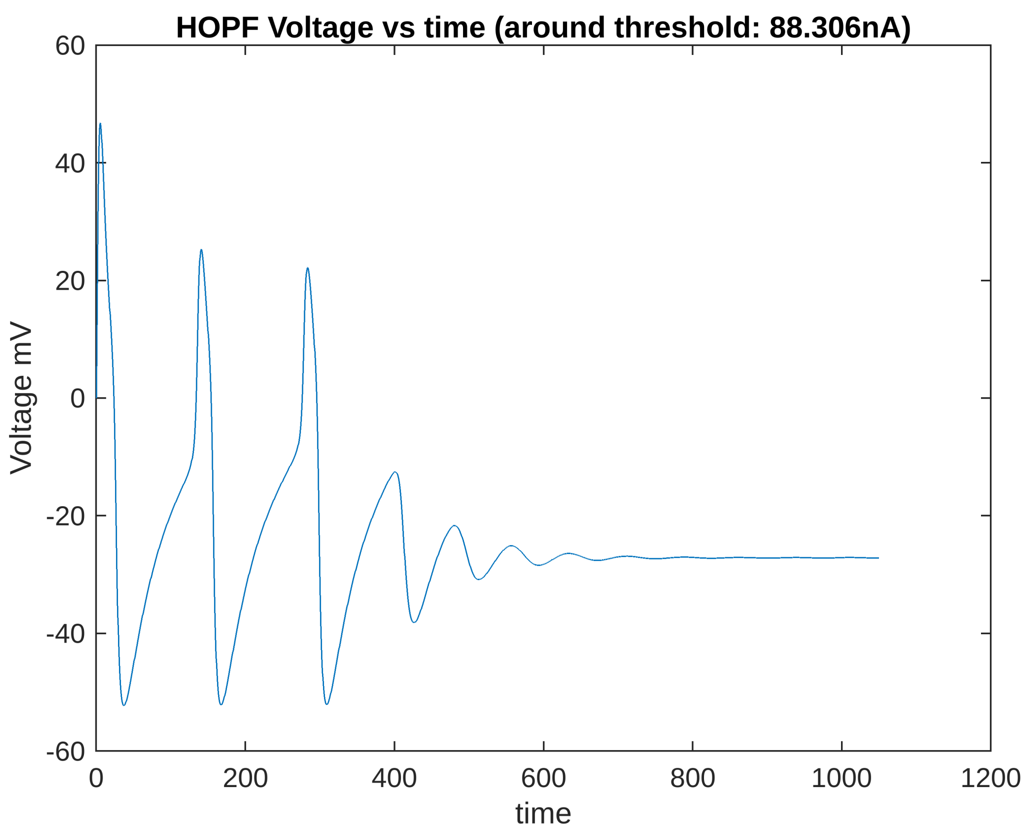
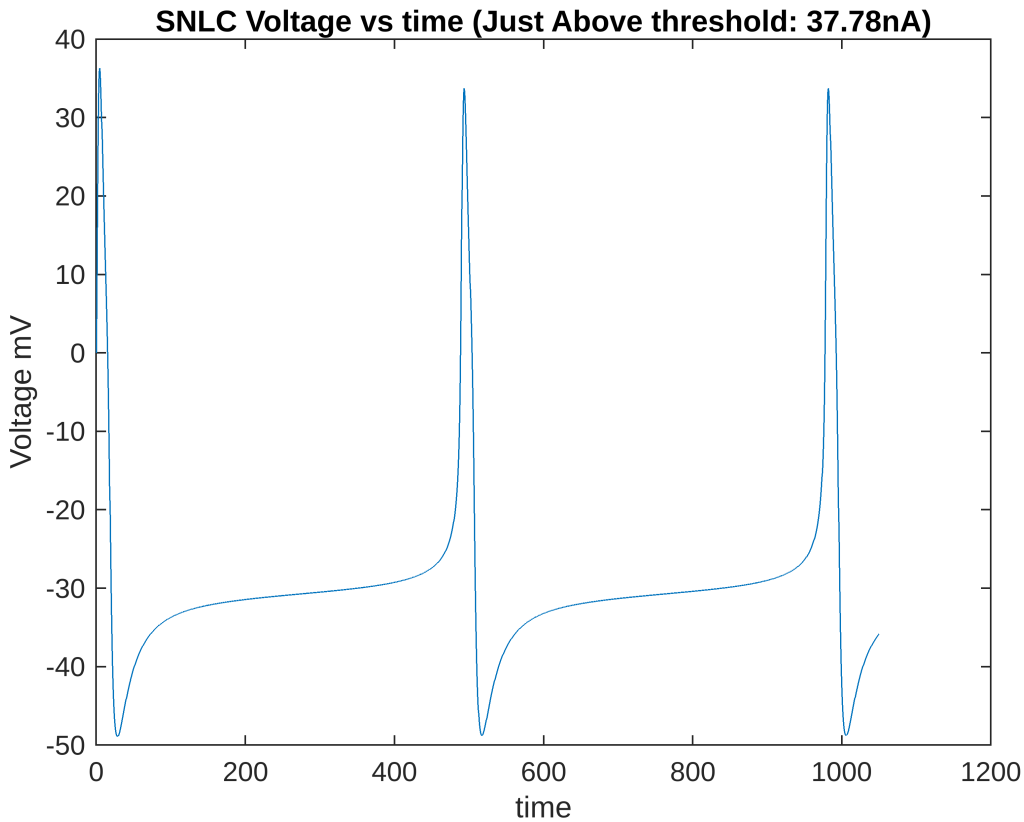
```
clear
%Initial Values
V0 = 0;
n0 = 0;
y0 = [V0;n0];
tspan = [0:2*10^-3:1050]; %time span

%%Test Threshold (1: HOPF, 2:SNIC)
[t, y] = ode45(@(t,y)Morris_Lecar_1(t,y,88.307),tspan, y0);
[t2, y2] = ode45(@(t,y)Morris_Lecar_2(t,y,37.78),tspan, y0);

%Output Variables
Vm_hopf = y(:,1);
n_hopf = y(:,2);
Vm_SNLC = y2(:,1);
n_SNLC = y2(:,2);

figure()
plot(t,Vm_hopf)
xlabel('time')
ylabel('Voltage mV')
title('HOPF Voltage vs time (around threshold: 88.306nA)')
hold off
```

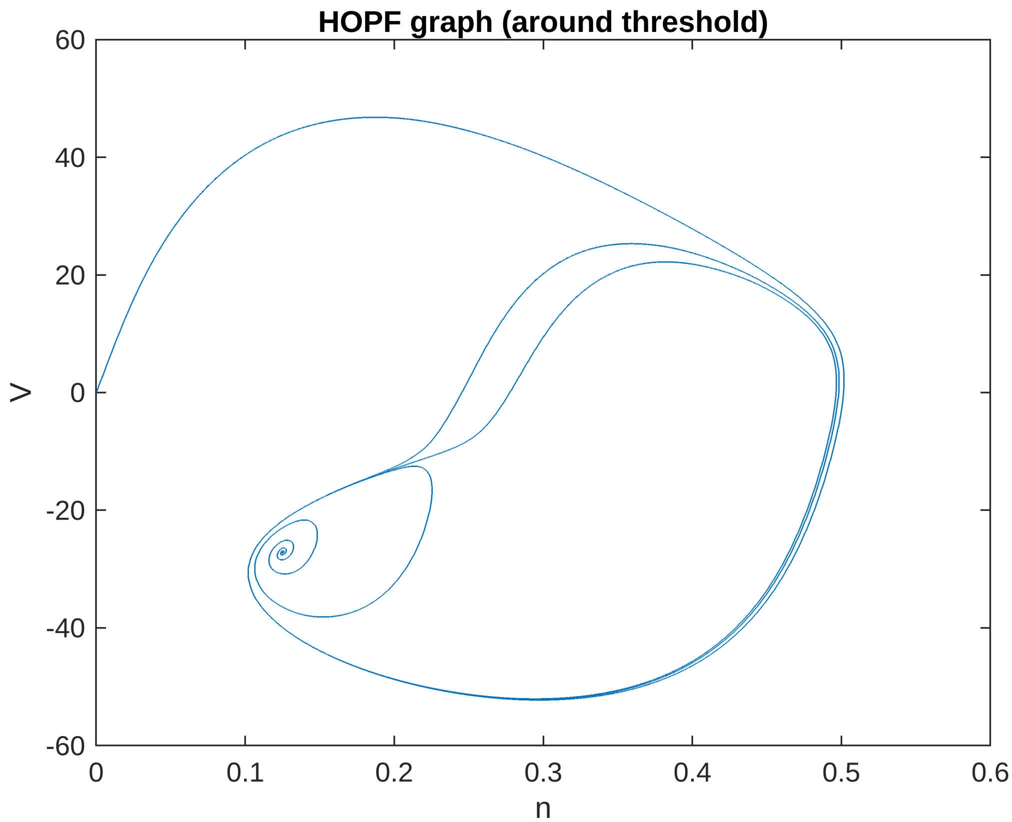



```
figure()
```

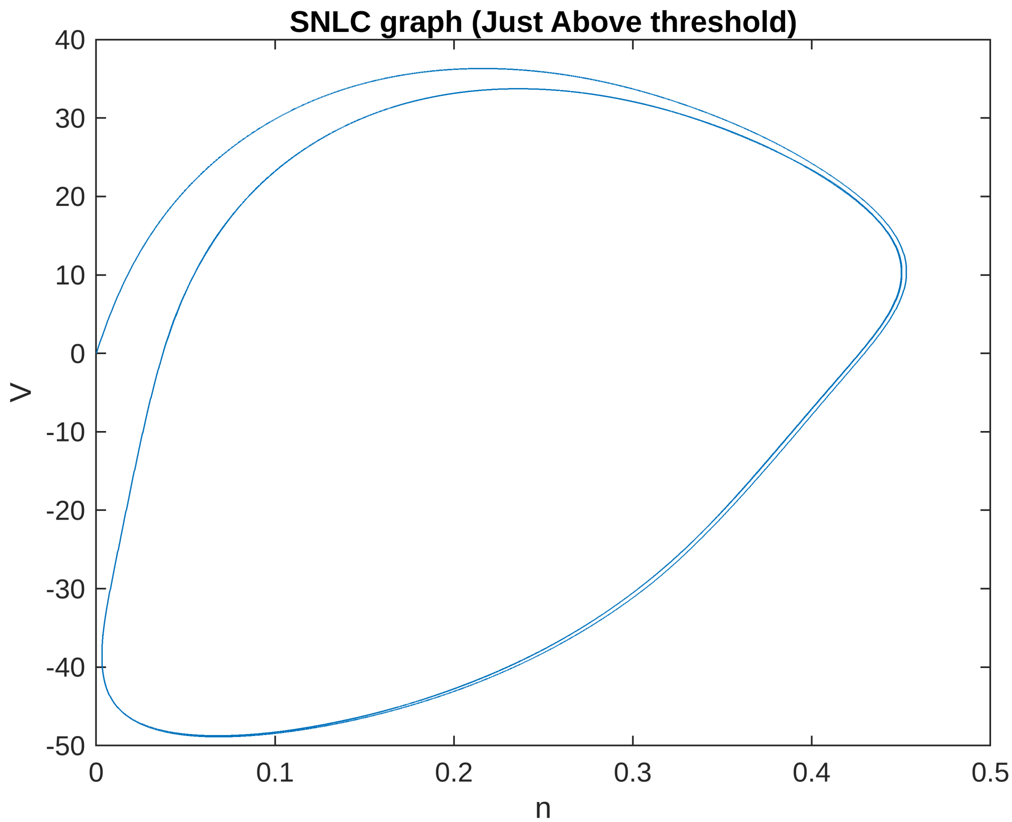
```
plot(t,Vm_SNLC)
xlabel('time')
ylabel('Voltage mV')
title('SNLC Voltage vs time (Just Above threshold: 37.78nA)')
hold off
```



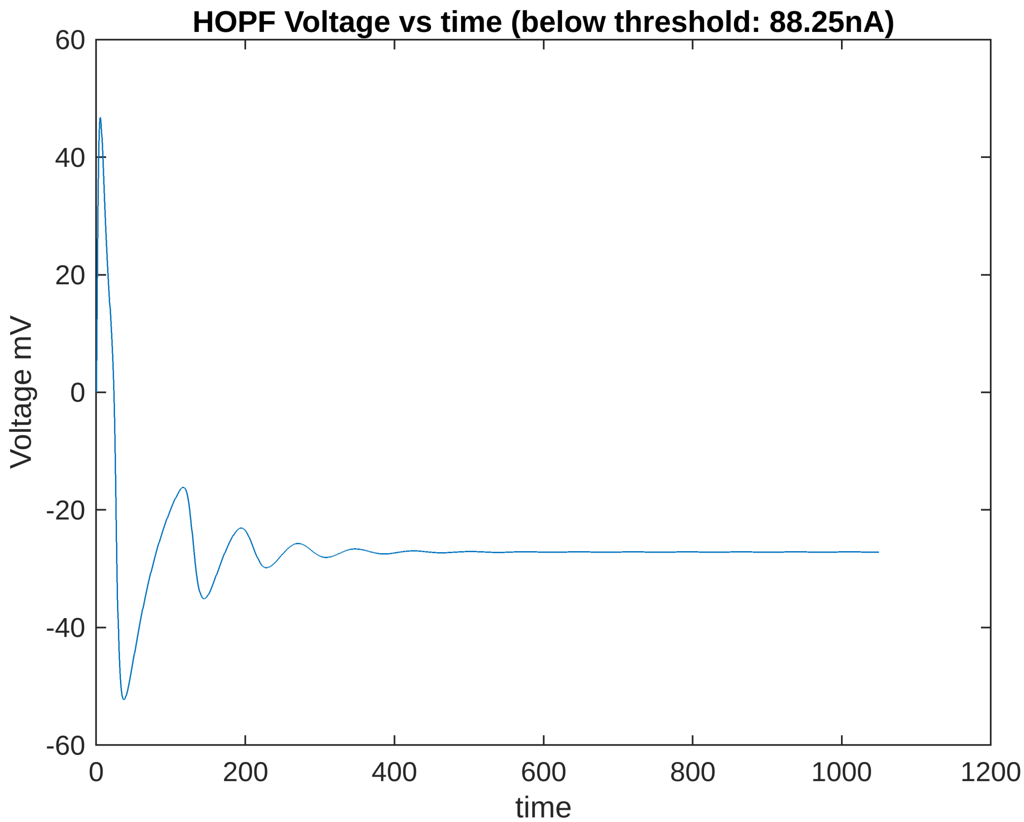

```
figure()
plot(n_hopf,Vm_hopf)
xlabel('n')
ylabel('V')
title('HOPF graph (around threshold)')
```



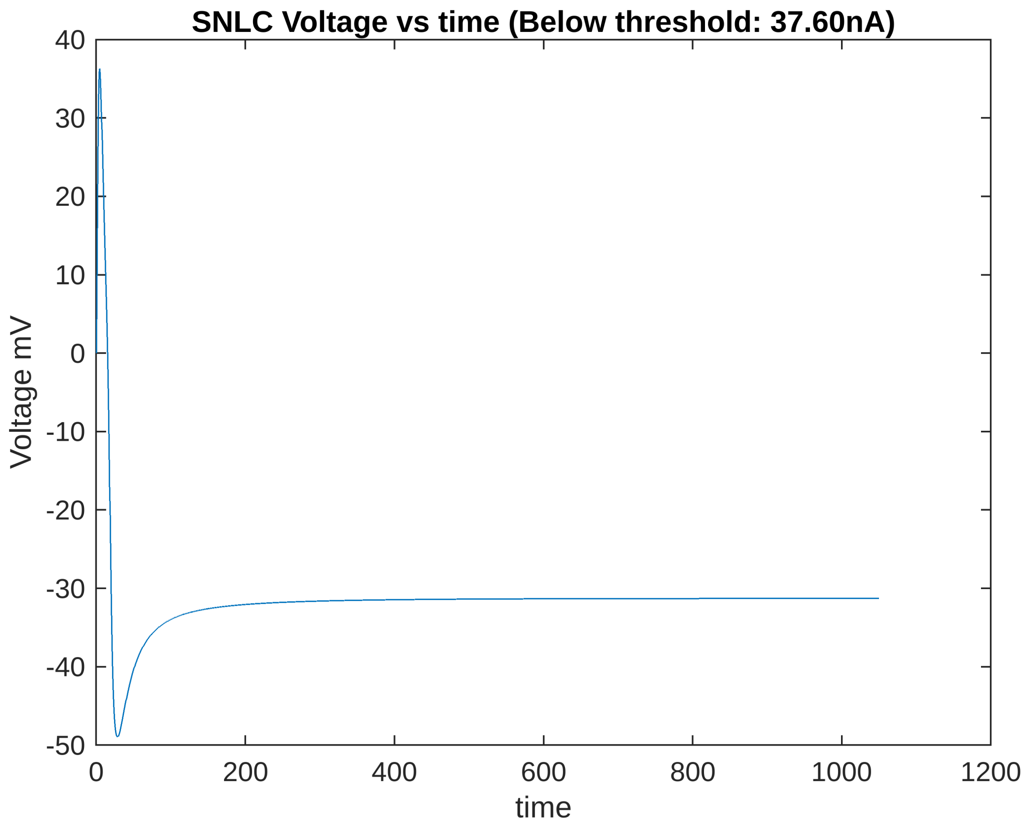

```
figure()
plot(n_SNLC,Vm_SNLC)
xlabel('n')
ylabel('V')
title('SNLC graph (Just Above threshold)')
```



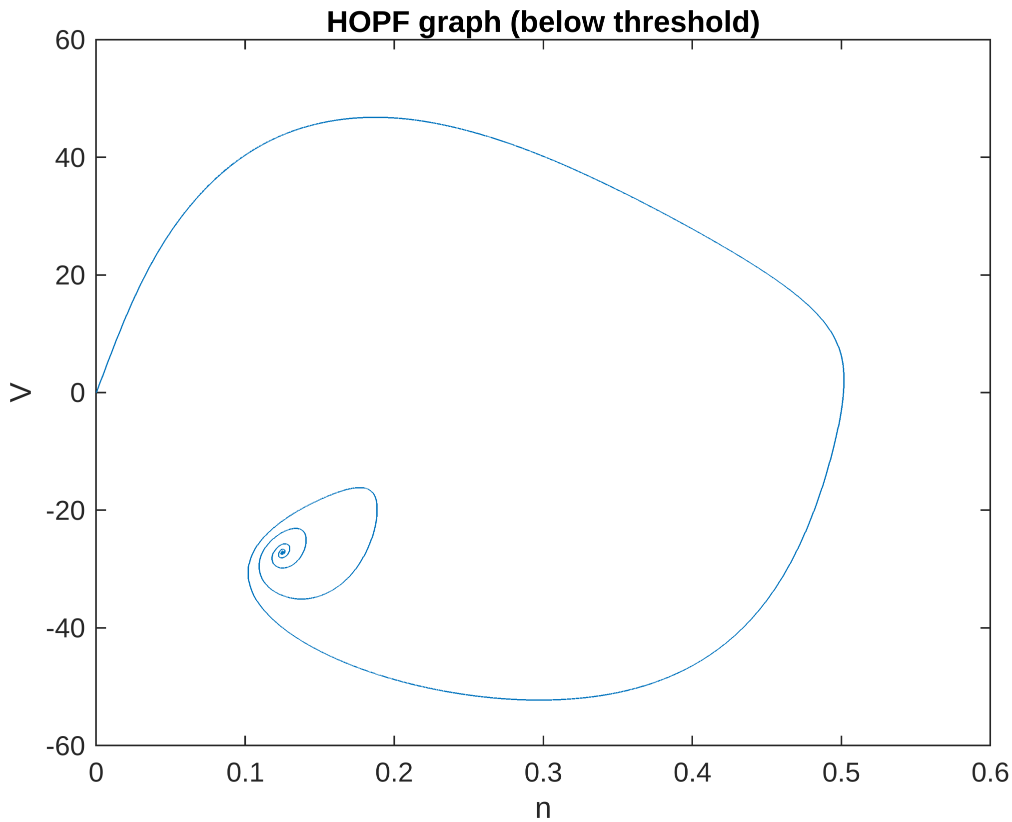

```
%__Threshold is 88.31 and 37.78 for Hopf and SNLC respectively.


%%Below Threshold Behavior(1: HOPF, 2:SNIC)
[t, y] = ode45(@(t,y)Morris_Lecar_1(t,y,88.25),tspan, y0);
[t2, y2] = ode45(@(t,y)Morris_Lecar_2(t,y,37.60),tspan, y0);

%Output Variables
Vm_hopf = y(:,1);
n_hopf = y(:,2);
Vm_SNLC = y2(:,1);
n_SNLC = y2(:,2);

figure()
plot(t,Vm_hopf)
xlabel('time')
ylabel('Voltage mV')
title('HOPF Voltage vs time (below threshold: 88.25nA)')
hold off
```



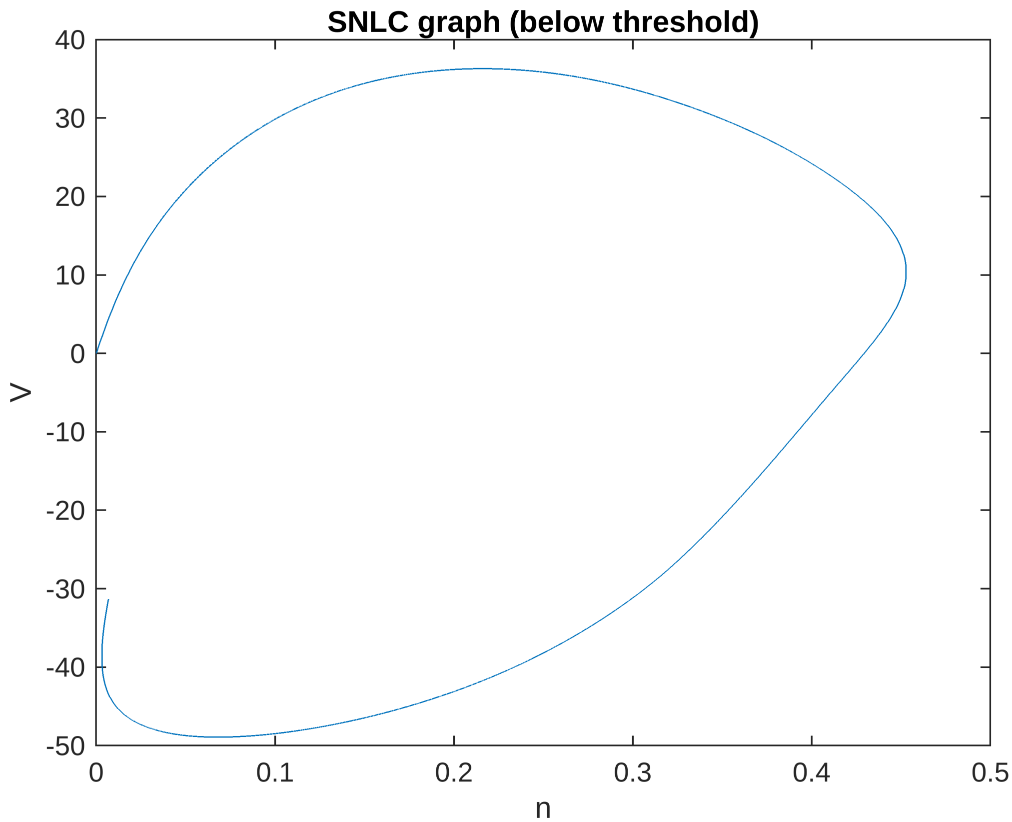

```
figure()
plot(t,Vm_SNLC)
xlabel('time')
ylabel('Voltage mV')
title('SNLC Voltage vs time (Below threshold: 37.60nA)')
hold off
```



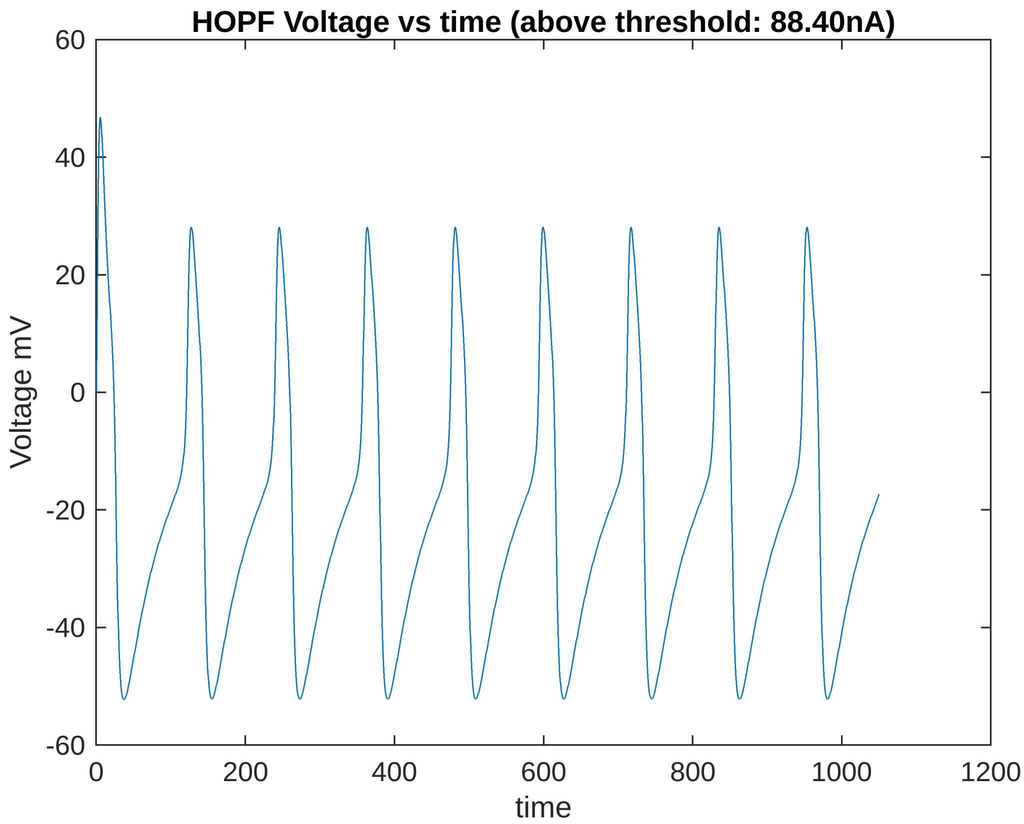

```
figure()
plot(n_hopf,Vm_hopf)
xlabel('n')
ylabel('V')
title('HOPF graph (below threshold)')
```



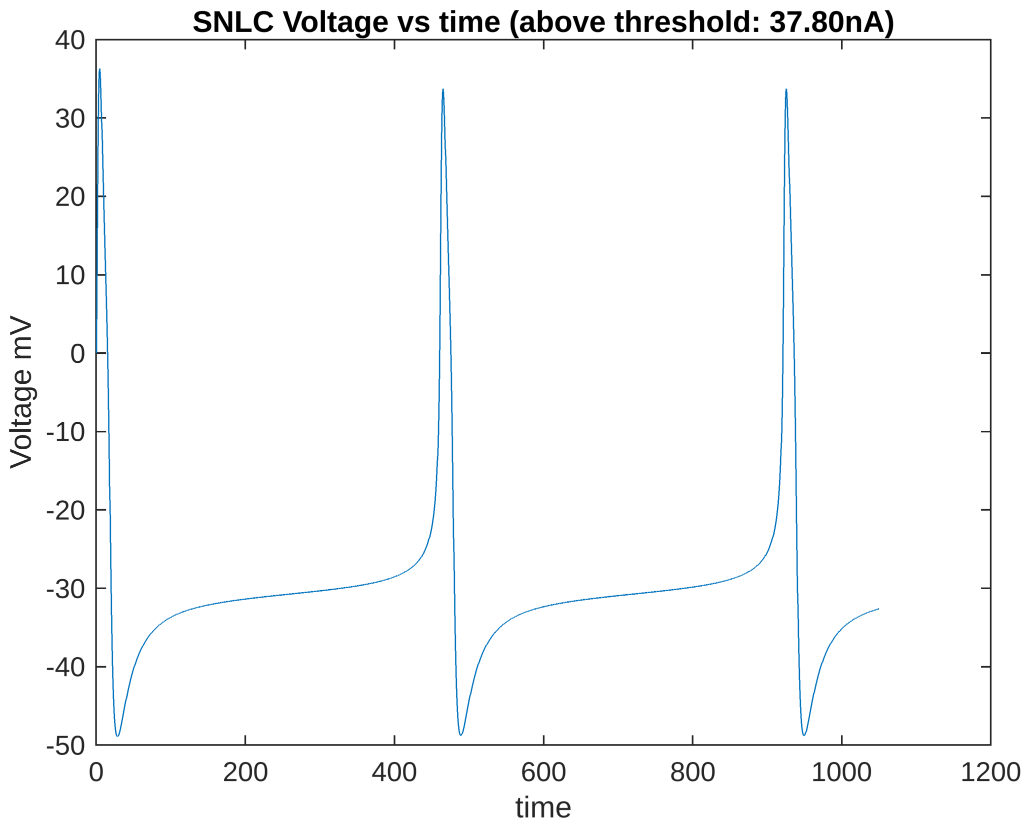

```
figure()
plot(n_SNLC,Vm_SNLC)
xlabel('n')
ylabel('V')
title('SNLC graph (below threshold)')
```



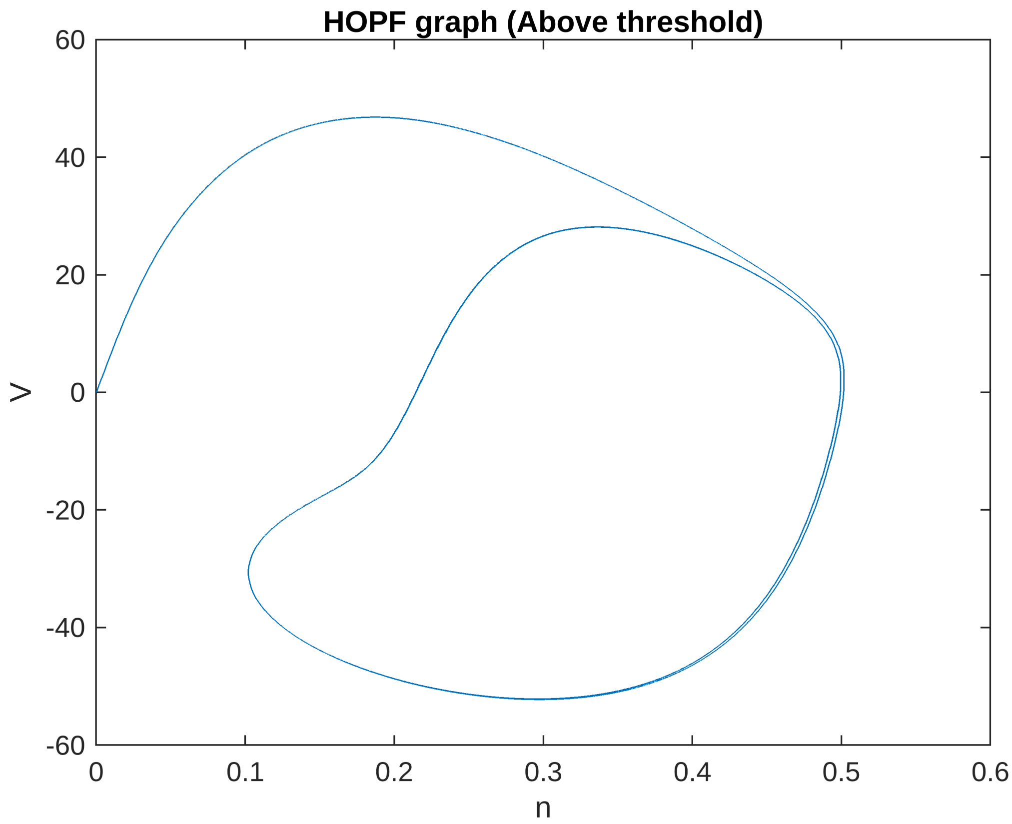

```
%%Above Threshold Behavior(1: HOPF, 2:SNIC)
[t, y] = ode45(@(t,y)Morris_Lecar_1(t,y,88.40),tspan, y0);
[t2, y2] = ode45(@(t,y)Morris_Lecar_2(t,y,37.80),tspan, y0);

%Output Variables
Vm_hopf = y(:,1);
n_hopf = y(:,2);
Vm_SNLC = y2(:,1);
n_SNLC = y2(:,2);

figure()
plot(t,Vm_hopf)
xlabel('time')
ylabel('Voltage mV')
title('HOPF Voltage vs time (above threshold: 88.40nA)')
hold off
```



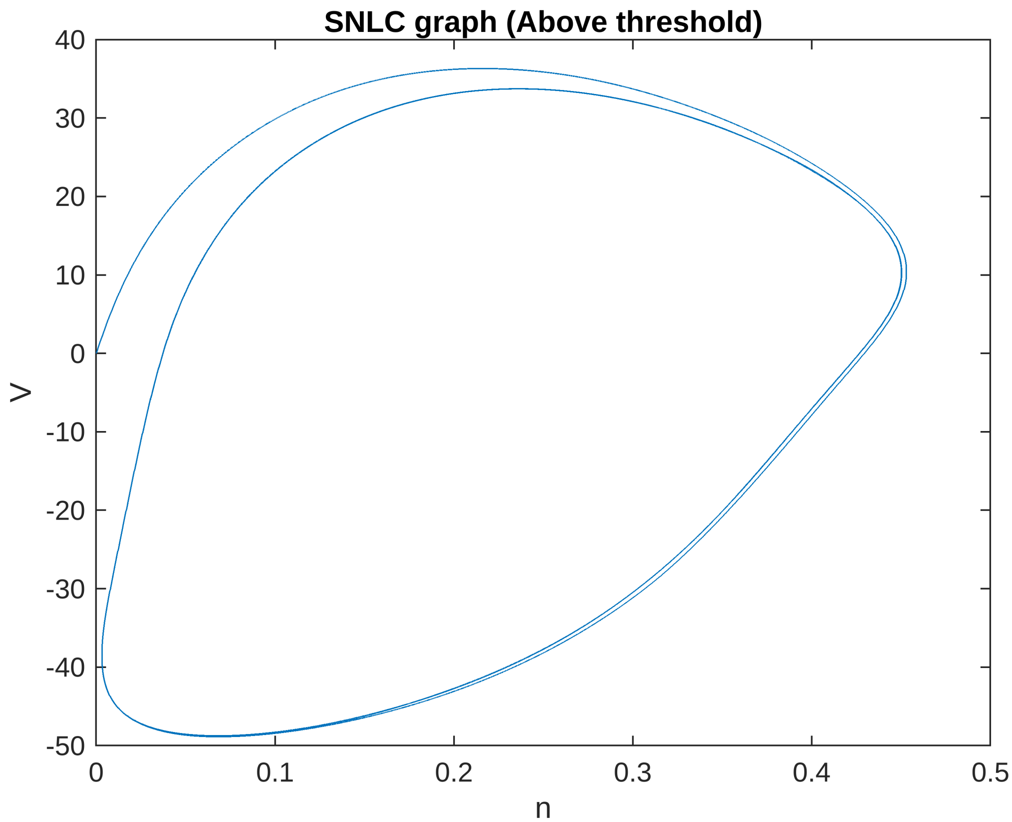

```
figure()
plot(t,Vm_SNLC)
xlabel('time')
ylabel('Voltage mV')
title('SNLC Voltage vs time (above threshold: 37.80nA)')
hold off
```




```
figure()
plot(n_hopf,Vm_hopf)
xlabel('n')
ylabel('V')
title('HOPF graph (Above threshold)')
```




```
figure()
plot(n_SNLC,Vm_SNLC)
xlabel('n')
ylabel('V')
title('SNLC graph (Above threshold)')
```



Explanation

```
% Among threshold for initial V0 and n0, the applied current is
approximately 88.31nA for HOPF
% and 37.78nA for SNLC. The graph for HOPF shows the continuing to fade
% away while SNLC is not that obvious. Therefore, the HOPF graph of V vs N
% shows a circling trend while fading to some degree. On the other hand of
% SNLC, it showed not a good round circle clockwise and it stops at a point.
This
% shows that the dynamic system does show sufficient but not enough
oscillilative behavior
% that it converges to a point while doing a lot of spirals.

% Below threshold has HOPF V vs time graph shows a high diminishing Voltage
% to a constant value. SNLC graph V vs time also shows diminishing and
% approaches to a constant value as well. When looking at the V vs n graph
% for HOPF it does not go around a circle. Rather, it looks more like a
% spiral quickly converging to a specific point. Same goes to SNLC, which
% shows that they don't exhibit enough oscillatory behavior to sustain
% voltage.

%Above threshold is not the case, as we can see from the voltage vs time
%graphs from both cases, they had action potentials. From the V vs n
```

```
%graphs, they had large circles that circulate among each other clockwise.
This shows
%that the dynamics of the active and inactive channels have oscillative
%relationships of membrane potentials.

%Overall, from the simulation of the Morris Lecar Model, it shows
%sufficient evidence of the oscillative nature of the variables to the
%gating of membrane potential. It is also very prone to applied currents.
```