ELEC 4700 Assignment-3 Monte-Carlo/Finite Difference Method

Assignment 3 - Joanna Abalos 100962263

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close all
clear
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% In this assignment, 30 000 particles are modelled to calculate
% temperatures, make models and observations using a combination of Monte-
% Carlo modeling and Finite Difference Method. 7 particles are plotted to
% observe their trajectories.

assignment3_1

%Increasing the applied voltage to 1.5V shows the particle's curved
%trajectories as a result of the static electric field.

%The relationship between electron drift current density and average
%carrier velocity is the following:
%driftcurrent =q*eConc*mu*E/area where mu = velocity/#particles/E
%Over time, the current over the entire semiconductor becomes/approaches a
%constant value.

assignment3_2
assignment3_3

%The particles are most dense at one side of the bottle-neck opening. This
%is due to the applied voltage and resulting electric field forcing the
%electrons right-ward, and bouncing off the boxes. The next step to make
%the simulation more accurate is to make the electrons react to each other.
%This would include bouncing off and repelling each other.
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Part 1:
The electric field is 5.000000e+05 V/m.
The force on each electron is 8.010883e-14 N.
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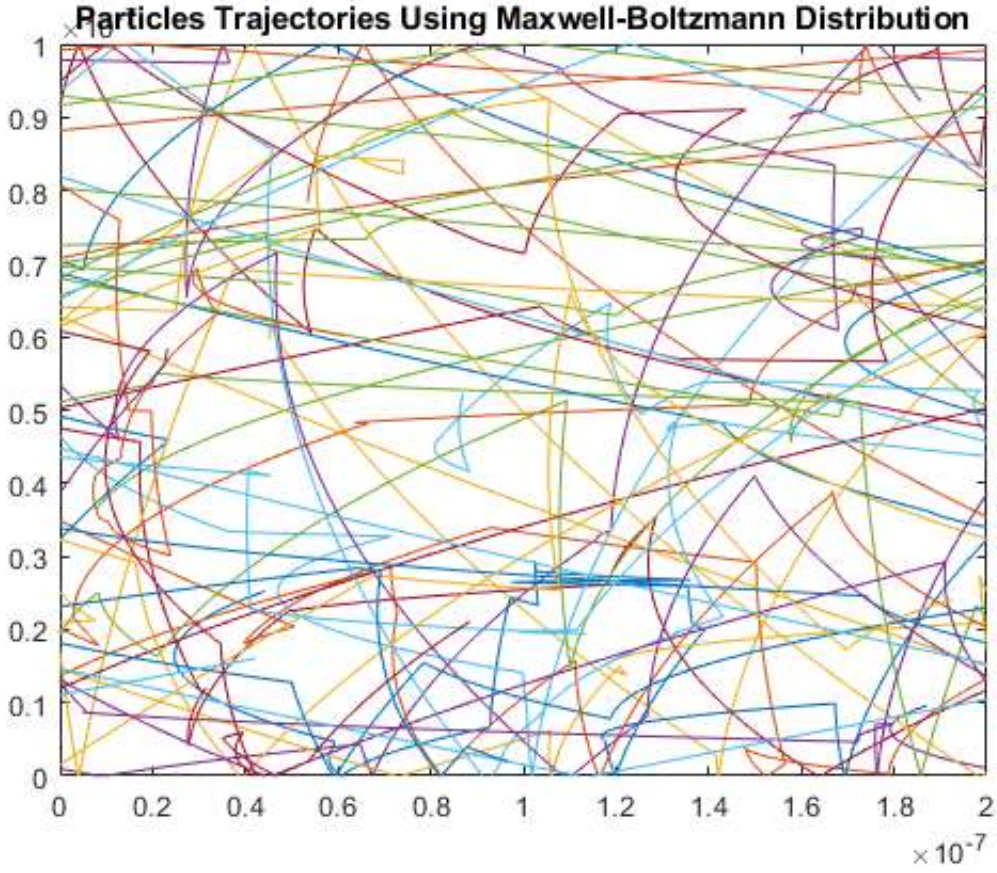
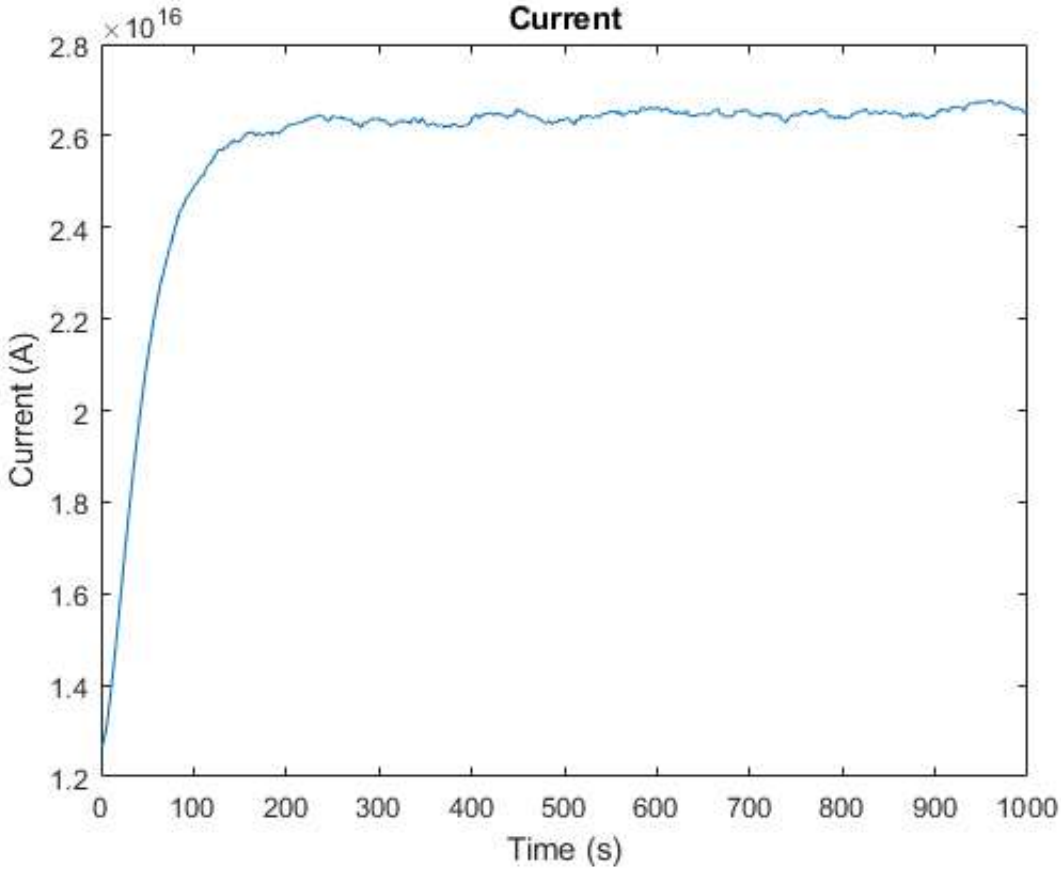
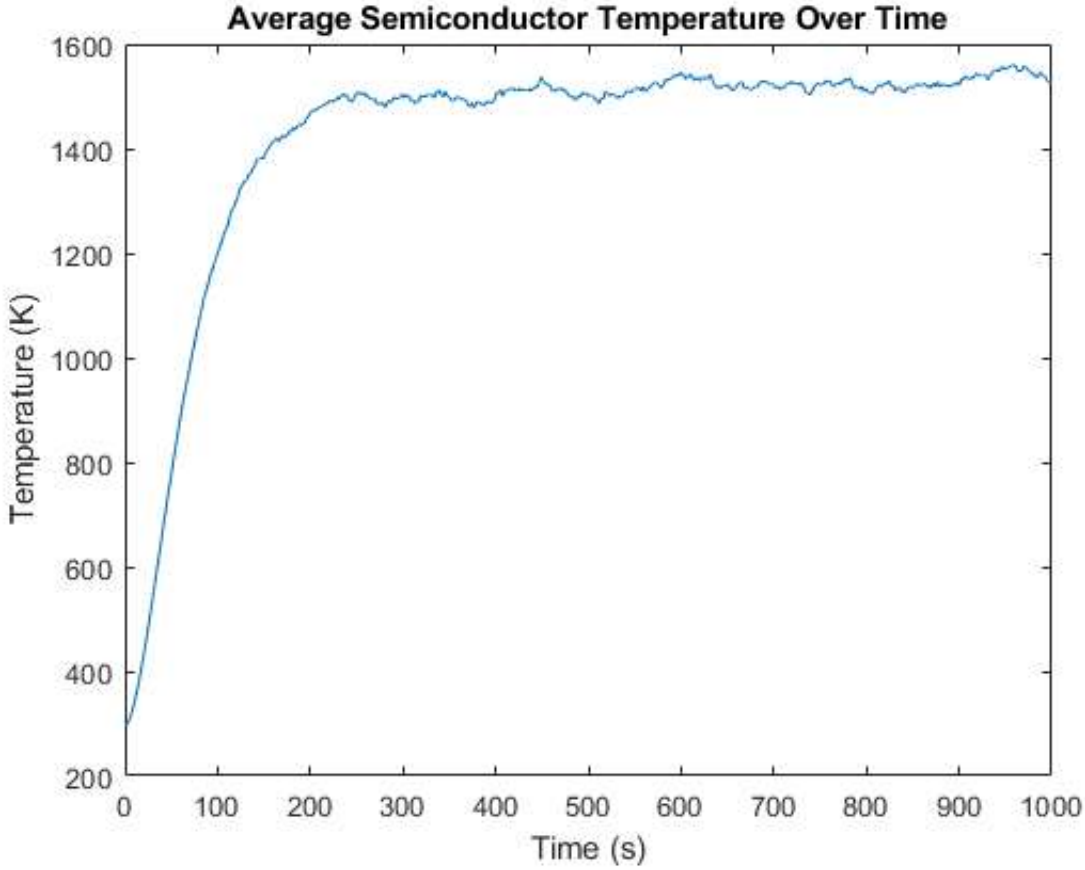
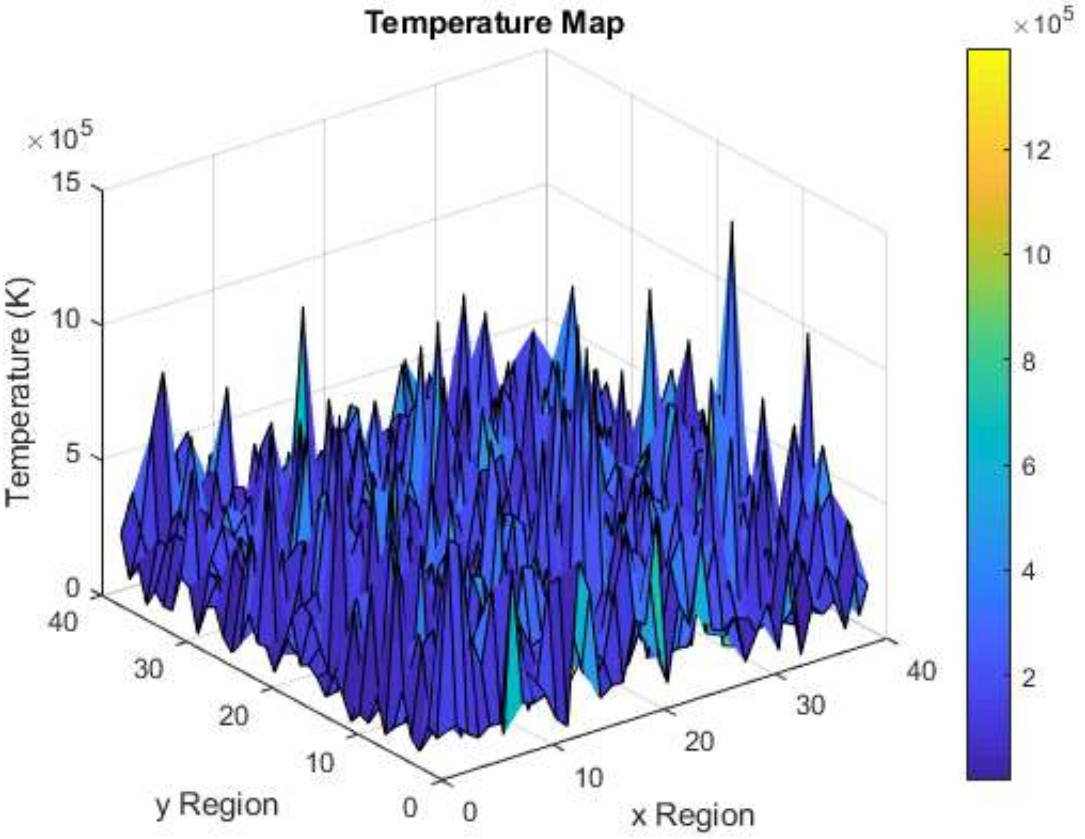
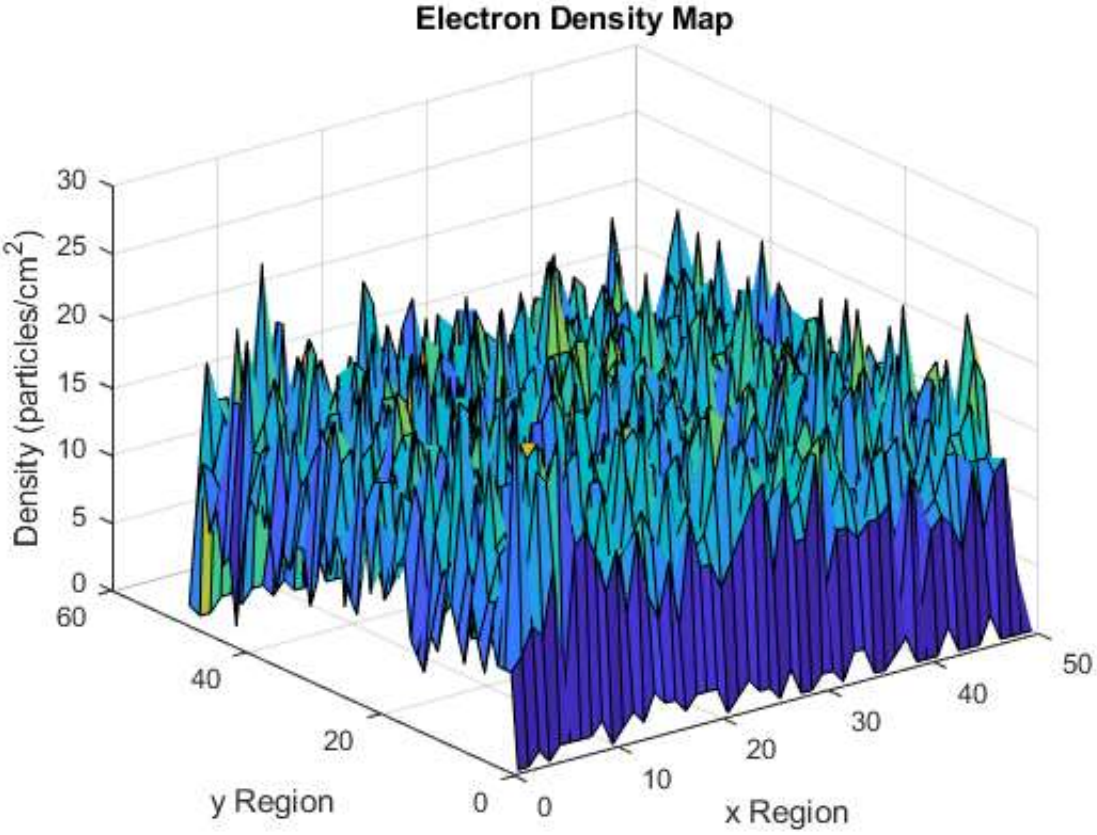
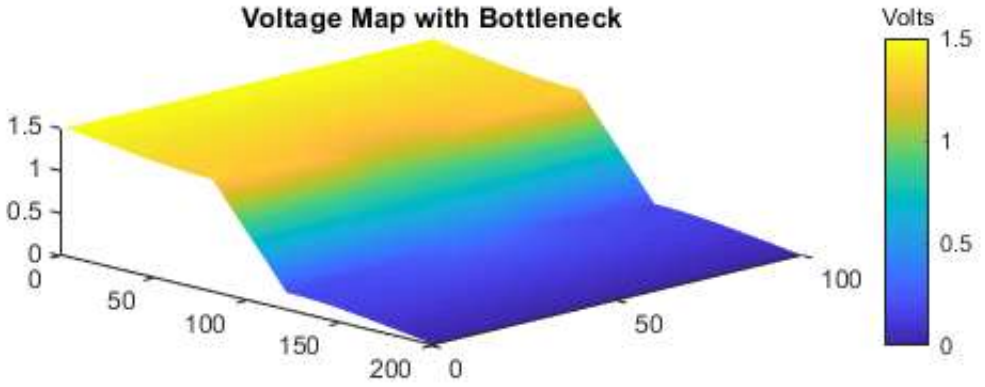

Particles Trajectories Using Maxwell-Boltzmann Distribution
×10^-7

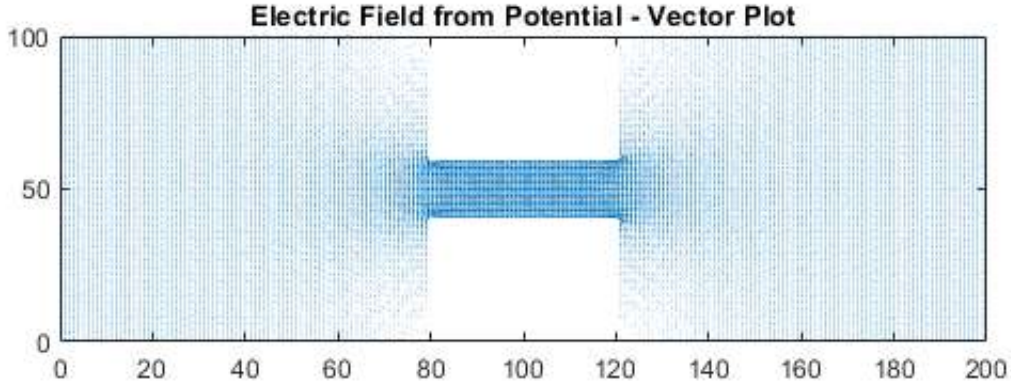

Current
×10^16
Current (A)
Time (s)

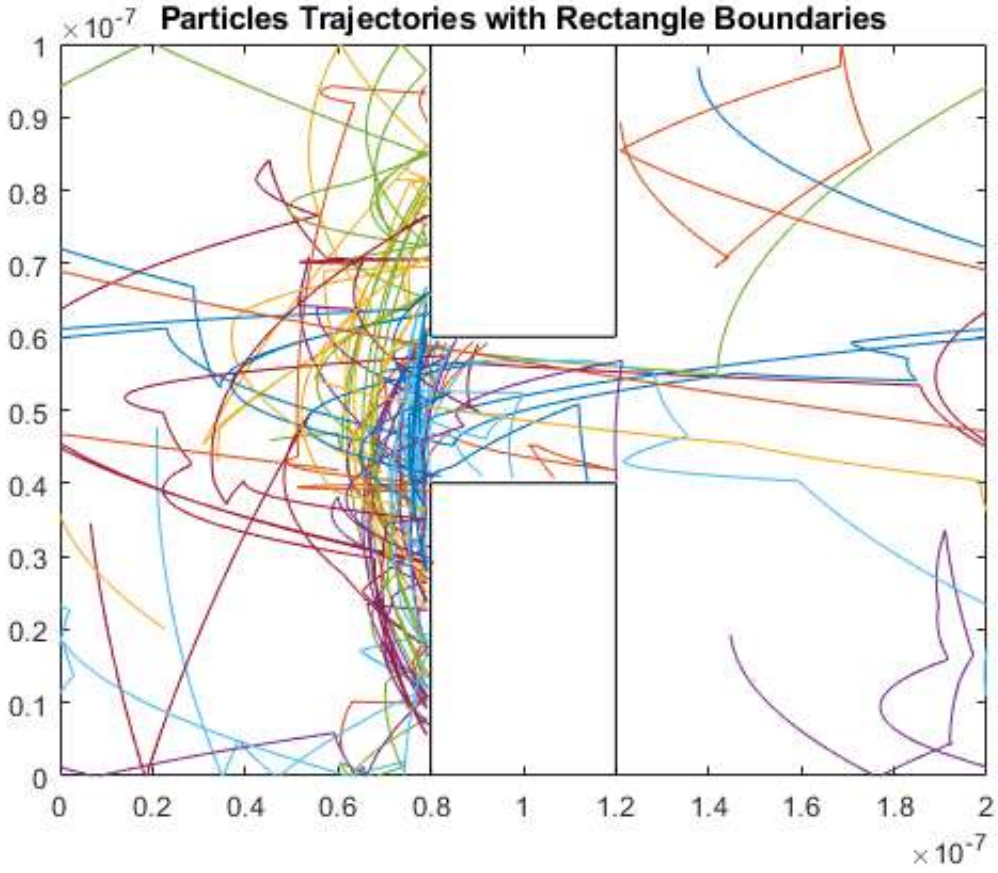

Average Semiconductor Temperature Over Time
Temperature (K)
Time (s)
1600
1400
1200
1000
800
600
400
200
0
100
200
300
400
500
600
700
800
900
1000

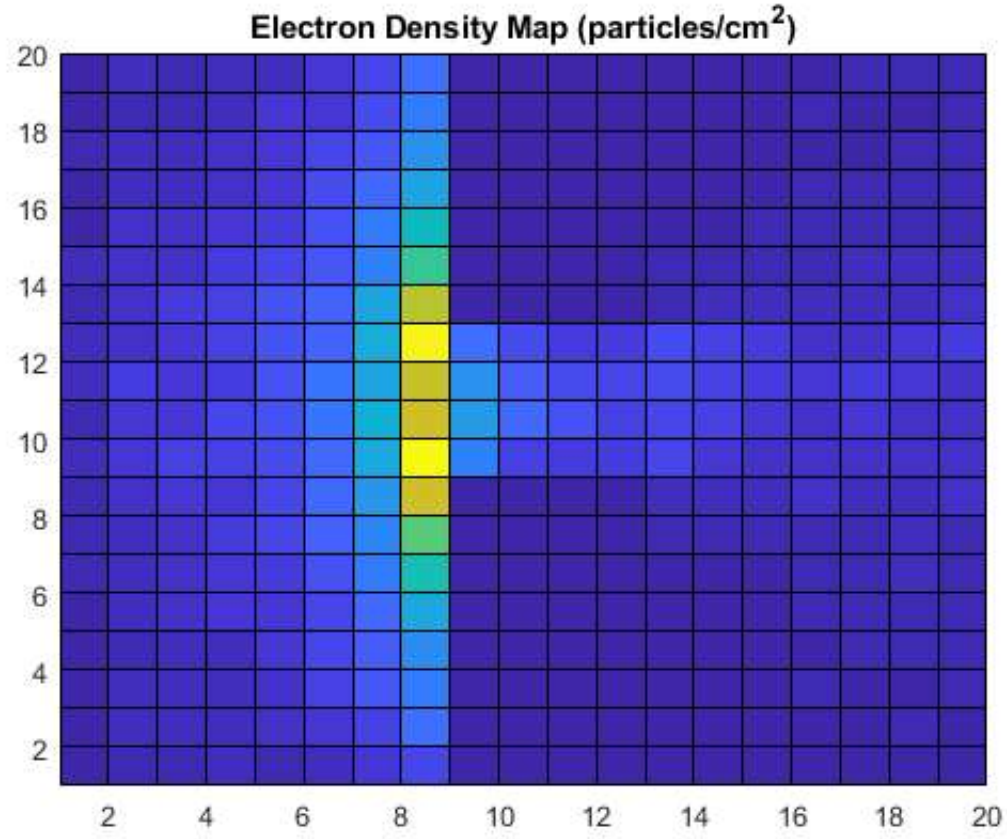

Temperature Map
×10^5
Temperature (K)
15
10
5
0
y Region
x Region
40
30
20
10
0
×10^5
12
10
8
6
4
2

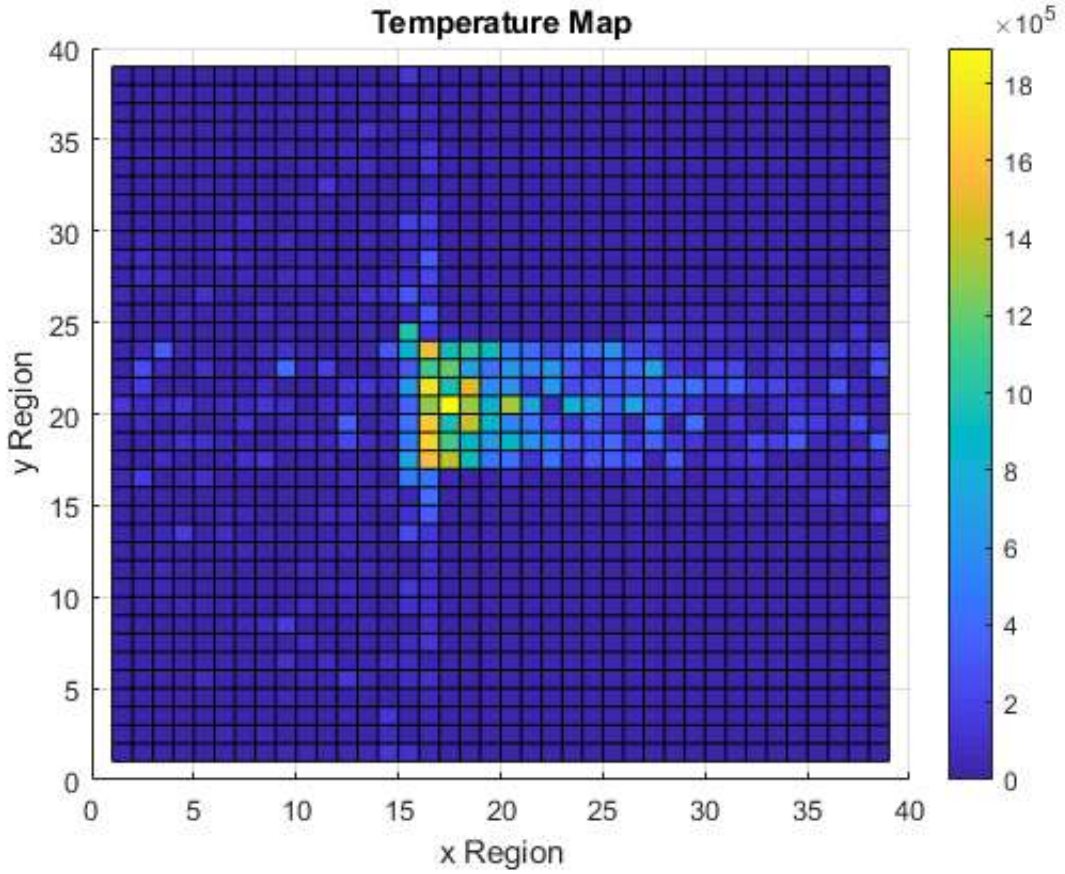

Electron Density Map
Density (particles/cm^2)
30
25
20
15
10
5
0
60
40
20
0
y Region
0
10
20
30
40
50
x Region

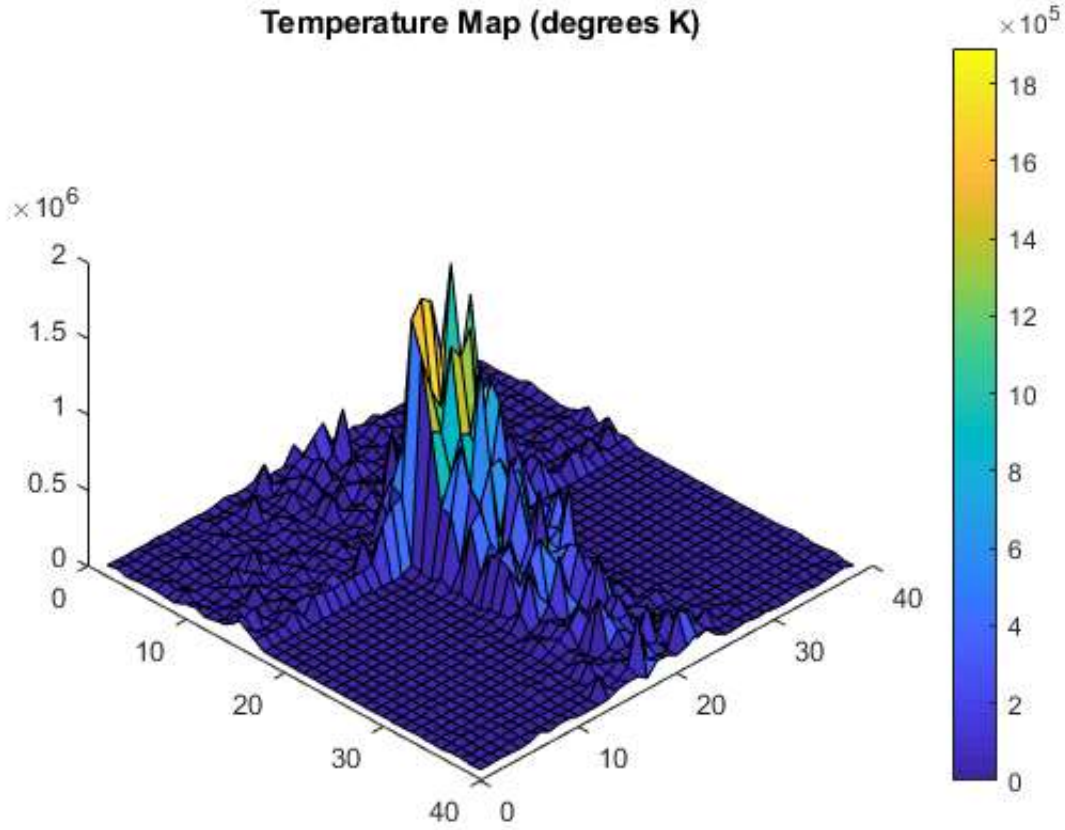

Voltage Map with Bottleneck
Volts
1.5
1
0.5
0
0
50
100
150
200
0
50
100
1.5
1
0.5
0

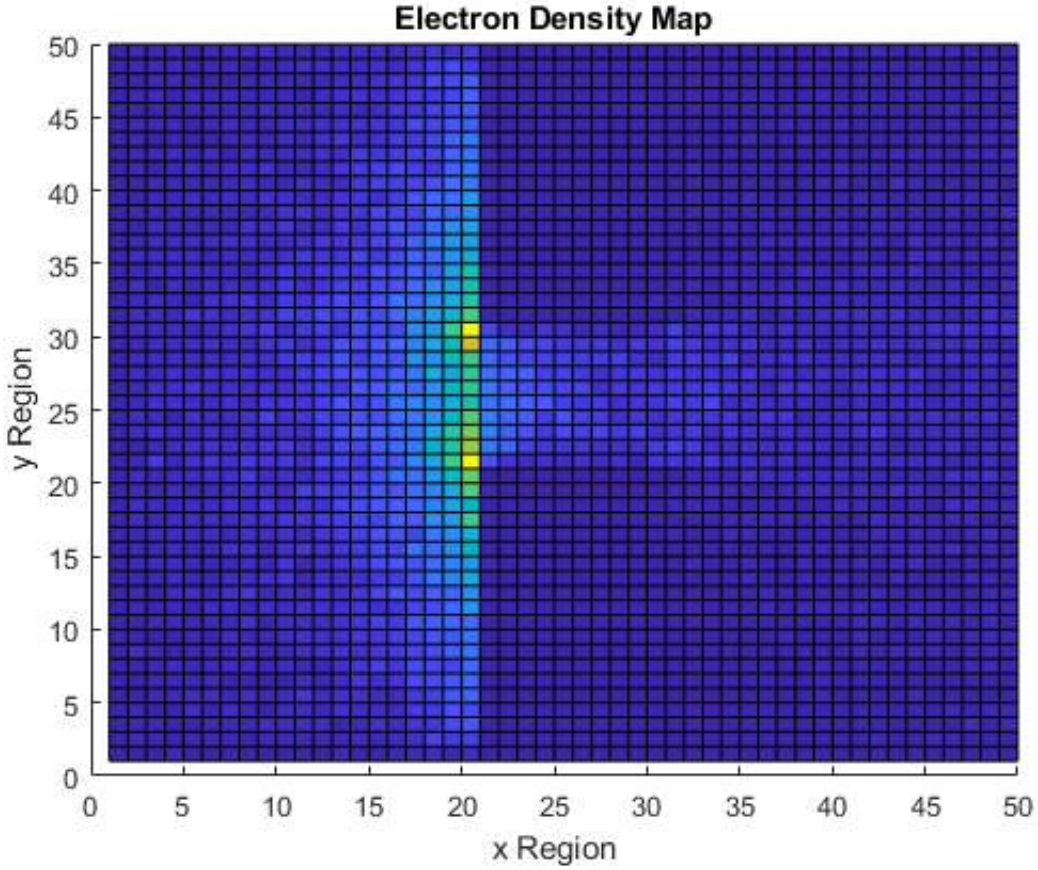

Electric Field from Potential - Vector Plot
100
50
0
0
20
40
60
80
100
120
140
160
180
200

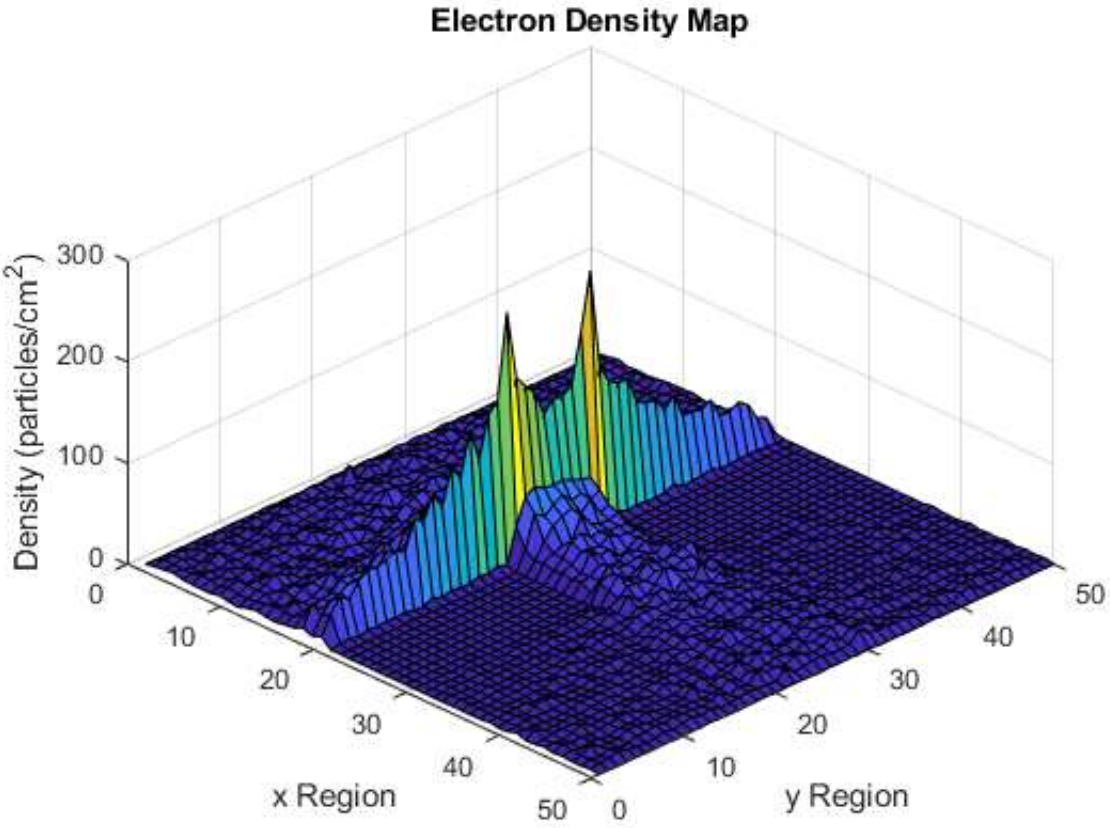

Particles Trajectories with Rectangle Boundaries
×10^-7
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^-7


Electron Density Map (particles/cm^2)
20
18
16
14
12
10
8
6
4
2
2
4
6
8
10
12
14
16
18
20


Temperature Map
y Region
x Region
×10^5


Temperature Map (degrees K)
×10^6
×10^5


Electron Density Map
y Region
x Region
0
5
10
15
20
25
30
35
40
45
50


Electron Density Map
Density (particles/cm^2)
x Region
y Region
0
100
200
300
10
20
30
40
50

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