Carleton University

Elec4700 Assignment 3

Monte-Carlo/Finite Difference Method

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Part 1:

a)

```
E_field =

   5.0000e+05


E_force =

   8.0109e-14


E_Acceleration =

   3.3823e+17

>>
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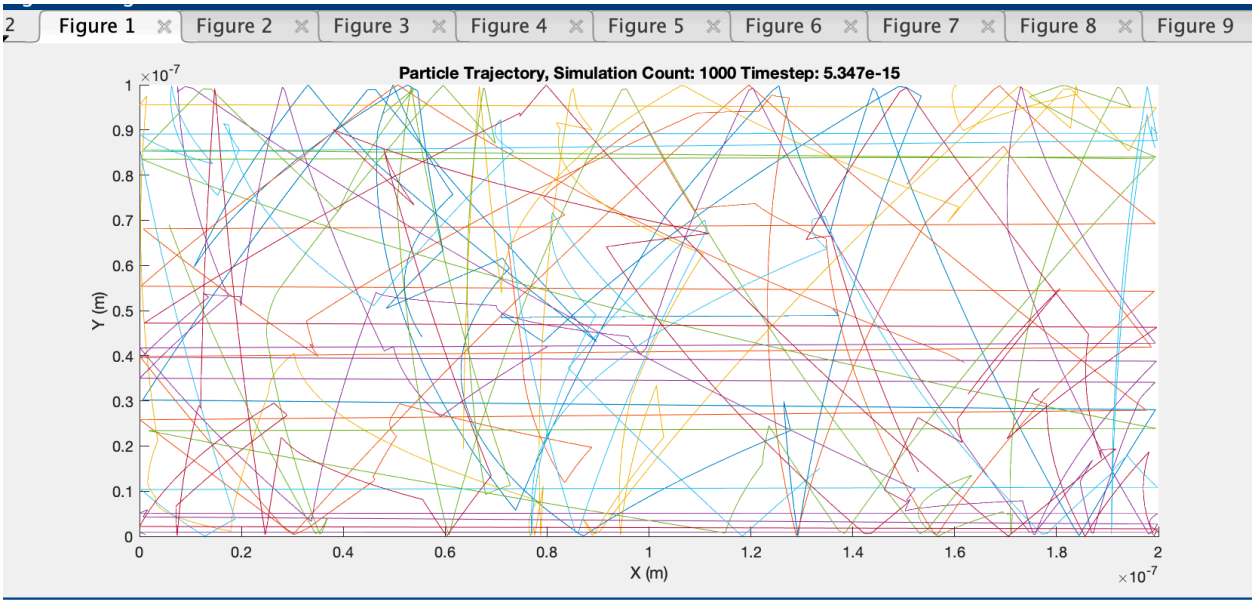
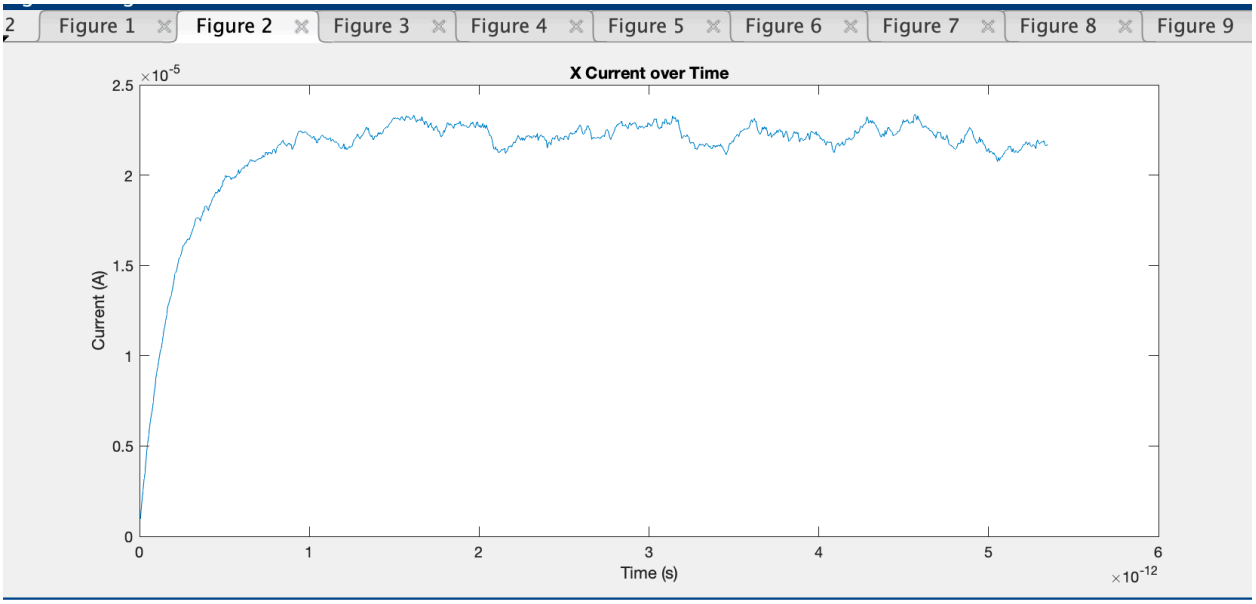




d) The relationship between electron drift current density and average carrier velocity is shown by the equation current density J = -qnV, n is the electron concentration and V is the average carrier velocity.

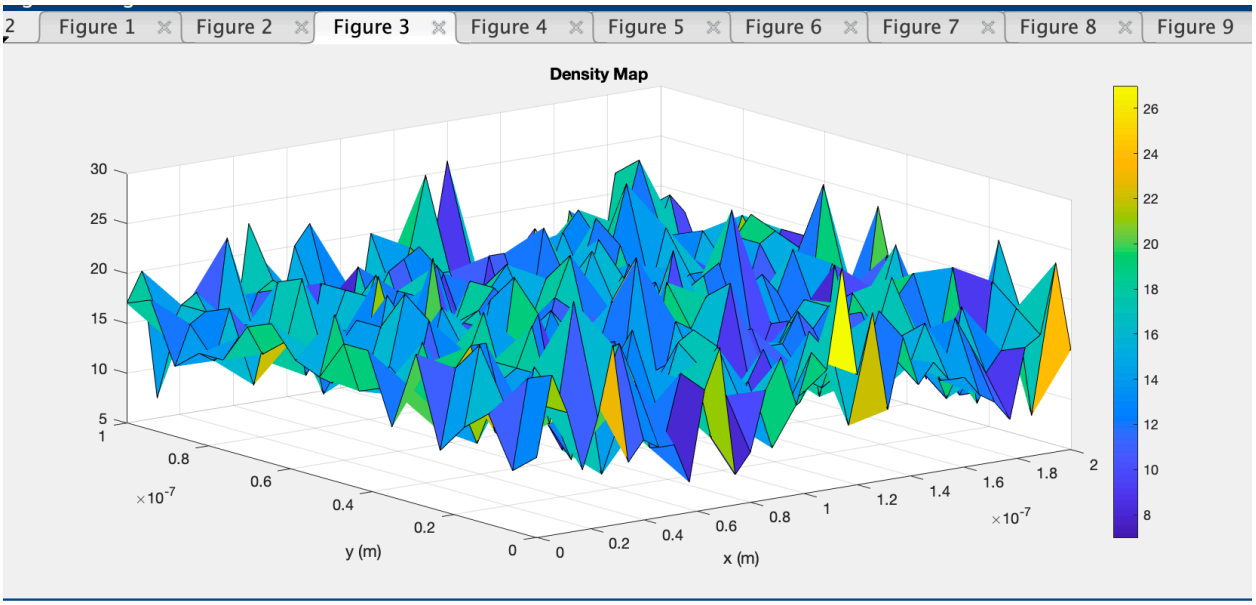


Figure 1
Figure 2
Figure 3
Figure 4
Figure 5
Figure 6
Figure 7
Figure 8
Figure 9
Density Map
30
25
20
15
10
5
1
0.8
0.6
0.4
0.2
0
×10^-7
y (m)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^-7
x (m)
26
24
22
20
18
16
14
12
10
8

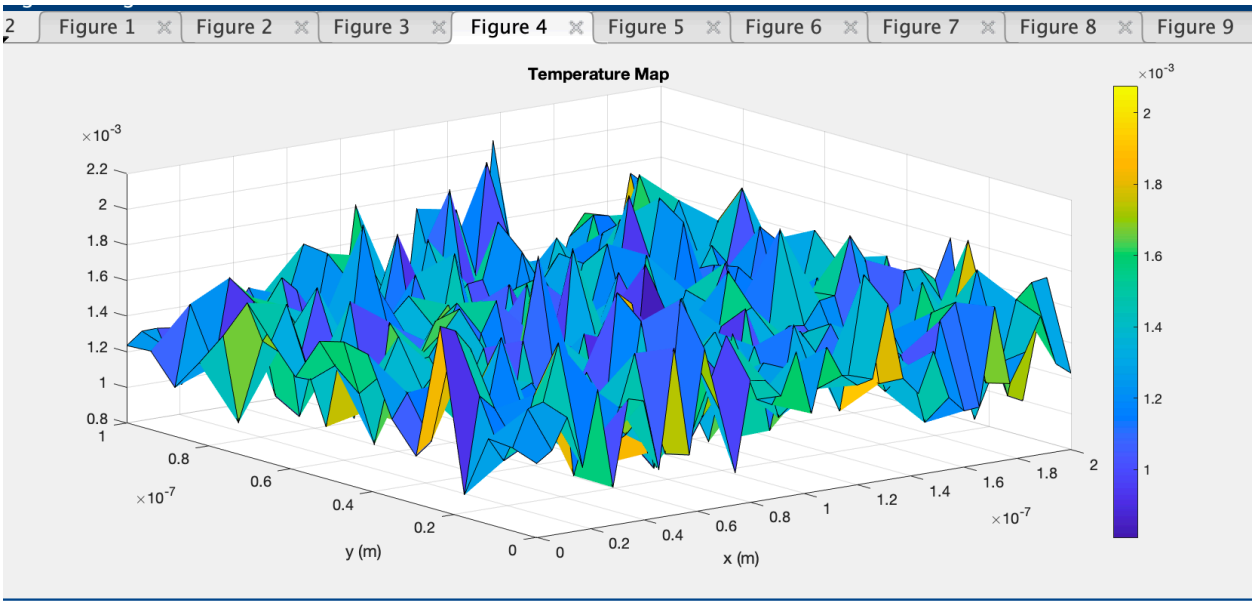


Figure 1
Figure 2
Figure 3
Figure 4
Figure 5
Figure 6
Figure 7
Figure 8
Figure 9
Temperature Map
×10^-3
2.2
2
1.8
1.6
1.4
1.2
1
0.8
1
0.8
0.6
0.4
0.2
0
×10^-7
y (m)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^-7
x (m)
×10^-3
2
1.8
1.6
1.4
1.2
1

Part 2:

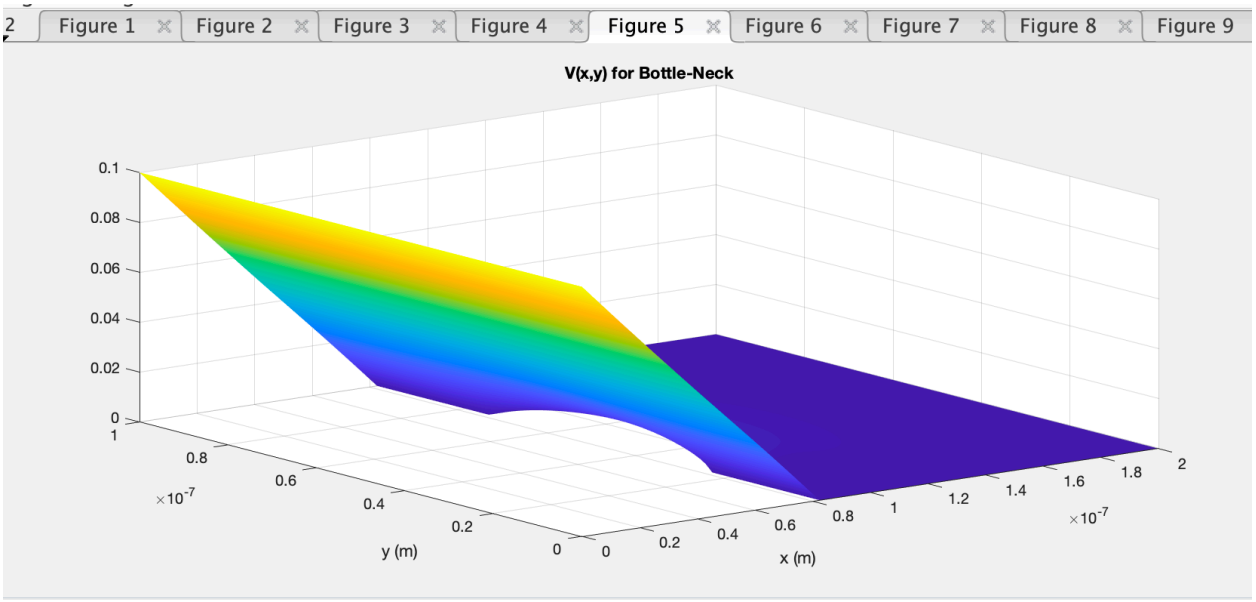


Figure 1
Figure 2
Figure 3
Figure 4
Figure 5
Figure 6
Figure 7
Figure 8
Figure 9
V(x,y) for Bottle-Neck
0.1
0.08
0.06
0.04
0.02
0
1
0.8
0.6
0.4
0.2
0
×10^-7
y (m)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^-7
x (m)

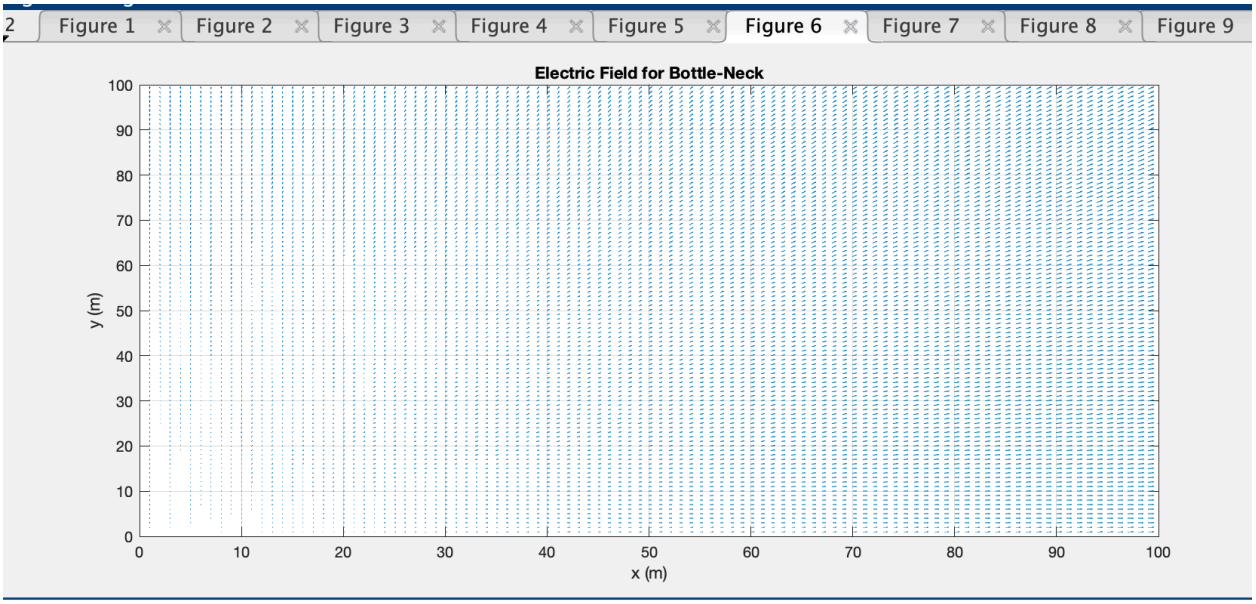


Figure 1
Figure 2
Figure 3
Figure 4
Figure 5
Figure 6
Figure 7
Figure 8
Figure 9
Electric Field for Bottle-Neck
y (m)
x (m)
0
10
20
30
40
50
60
70
80
90
100

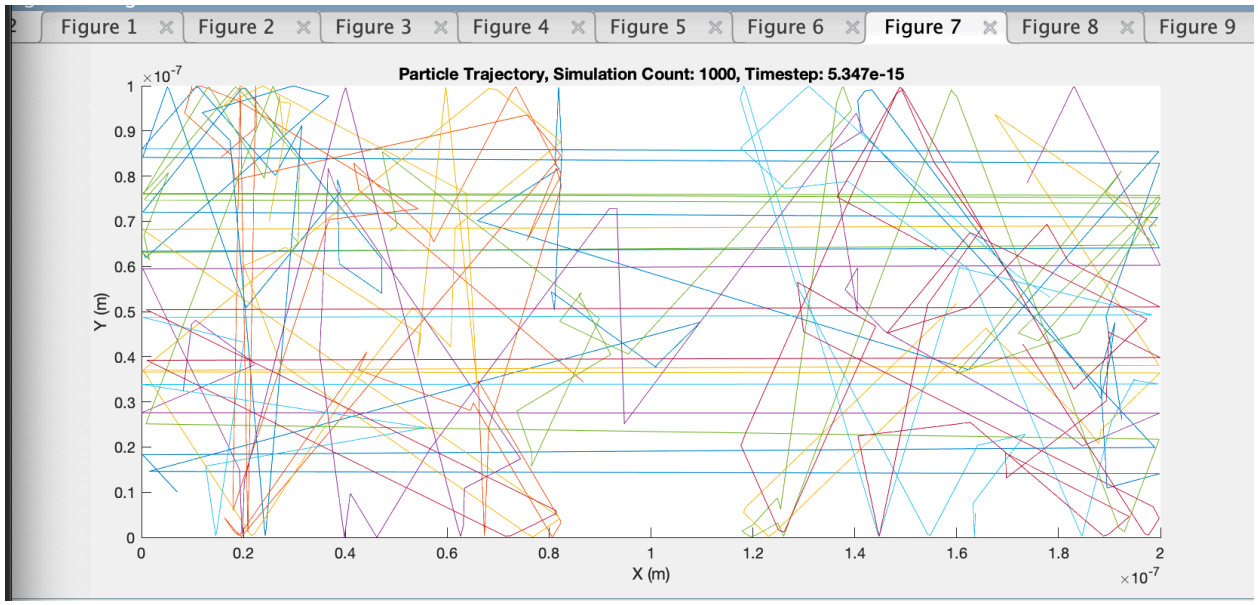


Figure 1
Figure 2
Figure 3
Figure 4
Figure 5
Figure 6
Figure 7
Figure 8
Figure 9
Particle Trajectory, Simulation Count: 1000, Timestep: 5.347e-15
×10^-7
Y (m)
X (m)
×10^-7

Part 3:

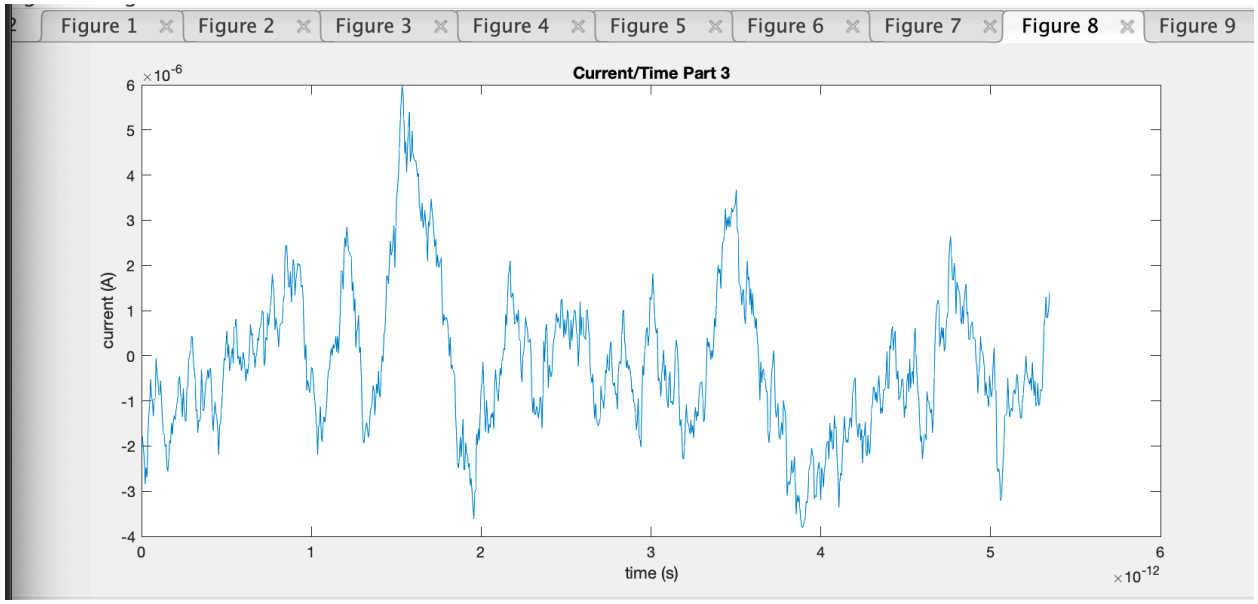
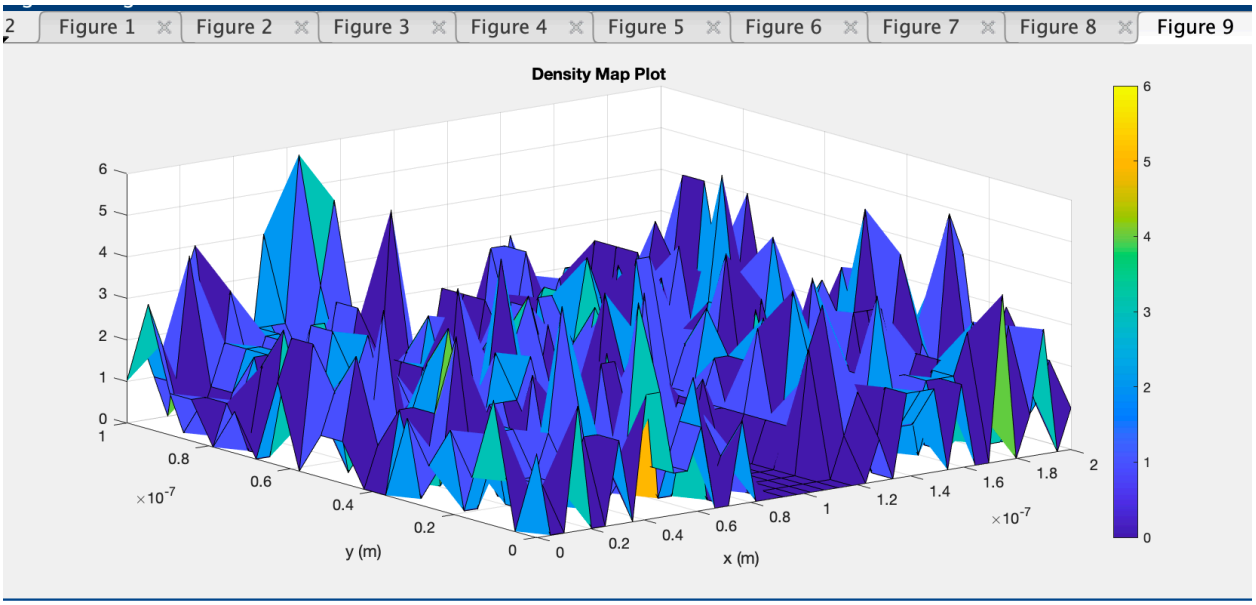


Figure 1
Figure 2
Figure 3
Figure 4
Figure 5
Figure 6
Figure 7
Figure 8
Figure 9
Current/Time Part 3
×10^-6
current (A)
time (s)
×10^-12



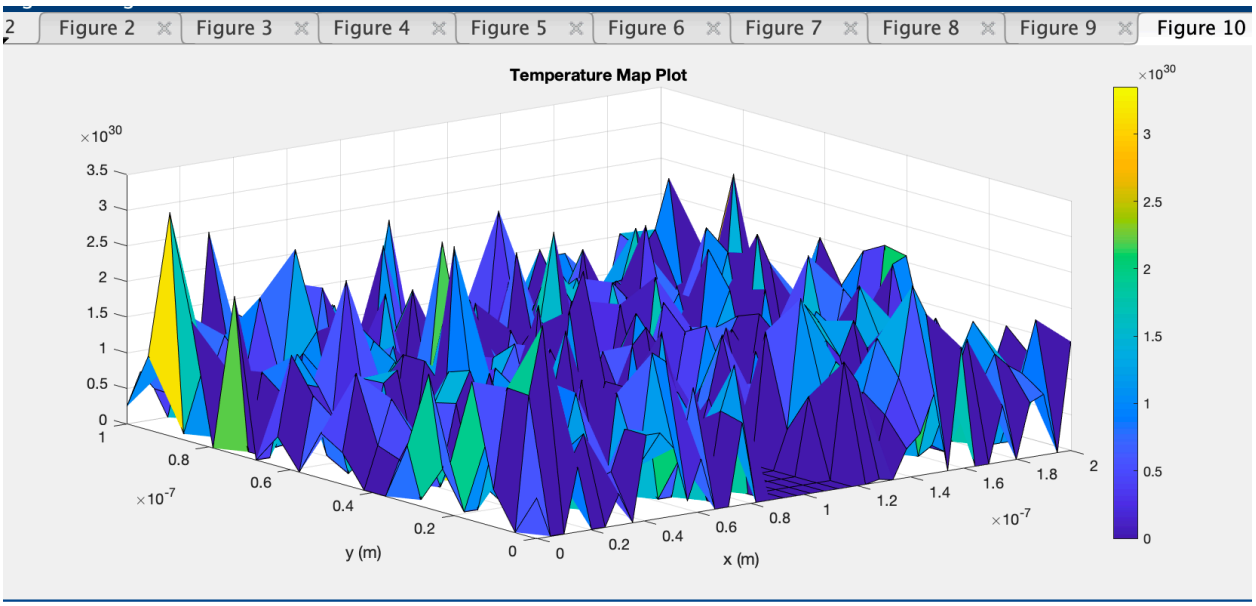
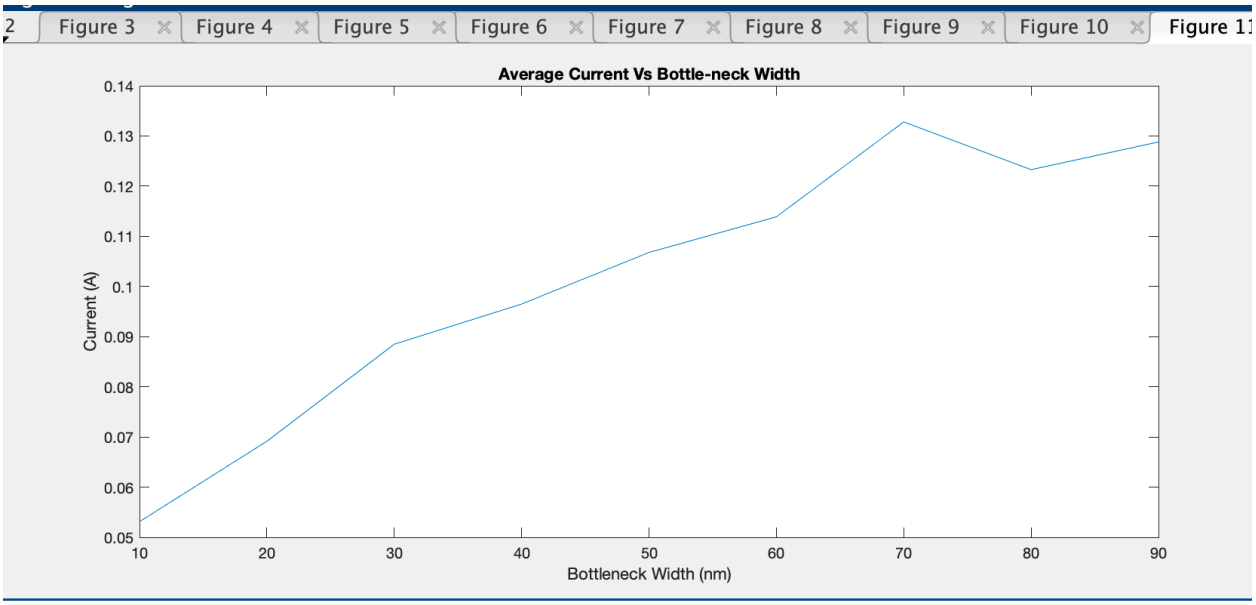


Figure 9 shows that the density is higher on the left side of the plot



c) The steps to make the simulation more accurate is by decreasing time step size, the mesh size and increasing the total number of electrons and the step size.