ELEC 4700 - Assignment 1 Resubmission

Spencer Tigere 101001717

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Overall:    55/100

Comments:

Additional Deductions:


Questions:
1   a) Vth                          5/8
       Vth should use the equation vth= sqrt(2*kb*T/mn) because there are 2 degrees of freedom.
       it also should not then later be divided by sqrt(2), except for assigning velocities to the
       x and y components.

    b) MFP                          0/8
       MFP value should be 34 nm but cant find calculation for it in code

    c)  i)  2D Trajectory Plot      13/15
            plot particles with different track colours for clarity

        ii) Temperature Plot        9/9

2   a) Histogram                    2/6
       in order to get an overall maxwell boltzmann distribution, the x and y velocities must just
       be normally distributed. So instead of Vth*cos(theta) you can do Vx = Vth*randn(numPart)/sqrt(2)
       and then the resultant Vth (Vx^2 + Vy^2) will have a MB distribution

    b) 2D Trajectory Plot           0/7
       need to show plot with scattering and no boxes. code doesnt include it.

    c) Temperature Plot             6/6

    d) MFP and mean time            0/6

3   a) 2D Trajectory Plot           7/9
       Some particle leaking into boxes

    b) Electron Density Map         13/13
       improve clarity by using a histogram (hist3)

    c) Temperature Map              0/13
       take a look at the function discretize for finding which location bin particles fall into.
       to then be able to calculate the average temperature at arbitrary locations
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Introduction

The purpose of this assignment was to simulate the behavior of semiconductor electrons using the Monte-Carlo modelling technique. The electrons were given thermal velocity and the effects of scattering were observed. Below are reports on the electron movement and other relevant characteristics.

Part 1 Electron Modelling

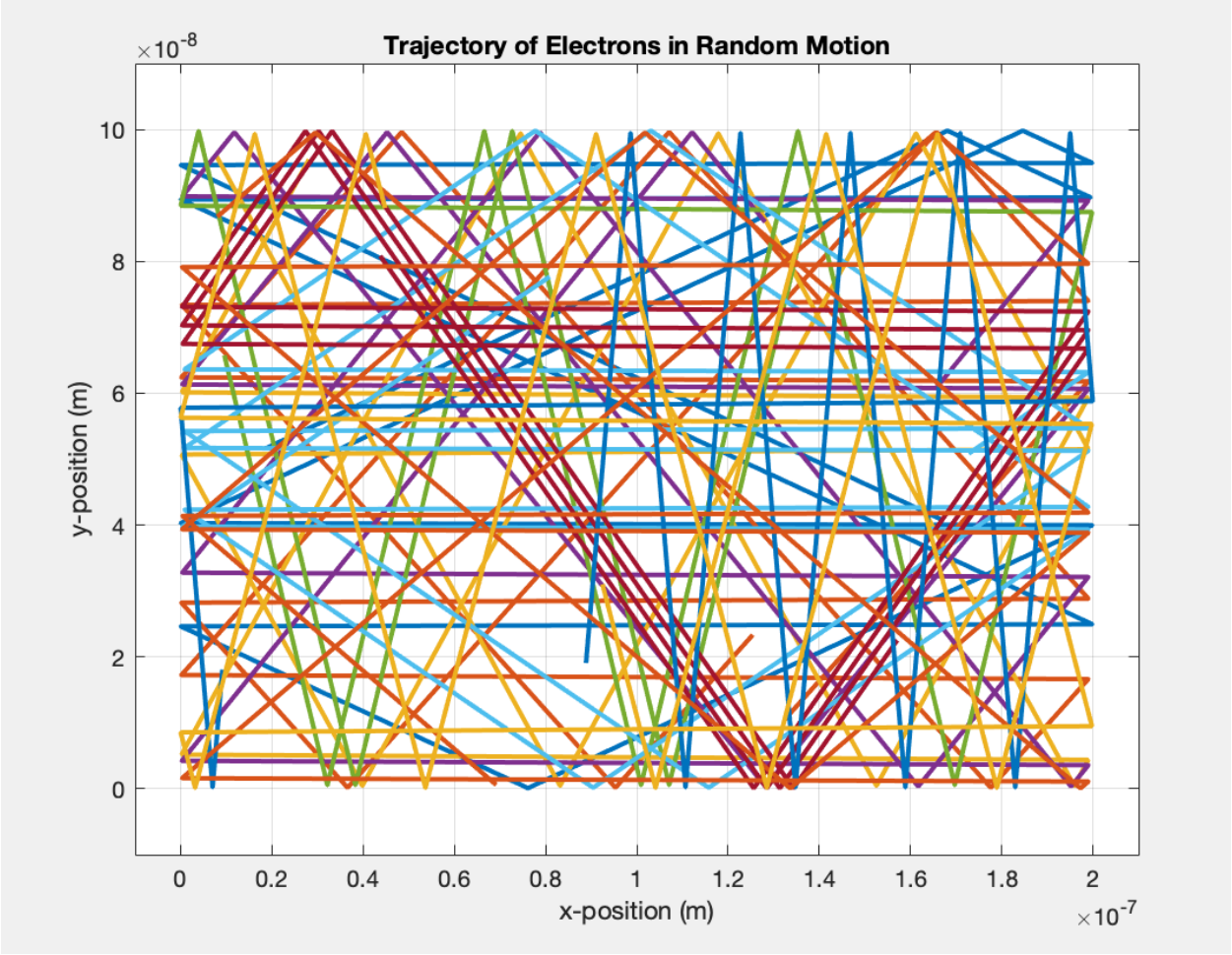

Figure 1. Trajectory of Electrons in Random Motion

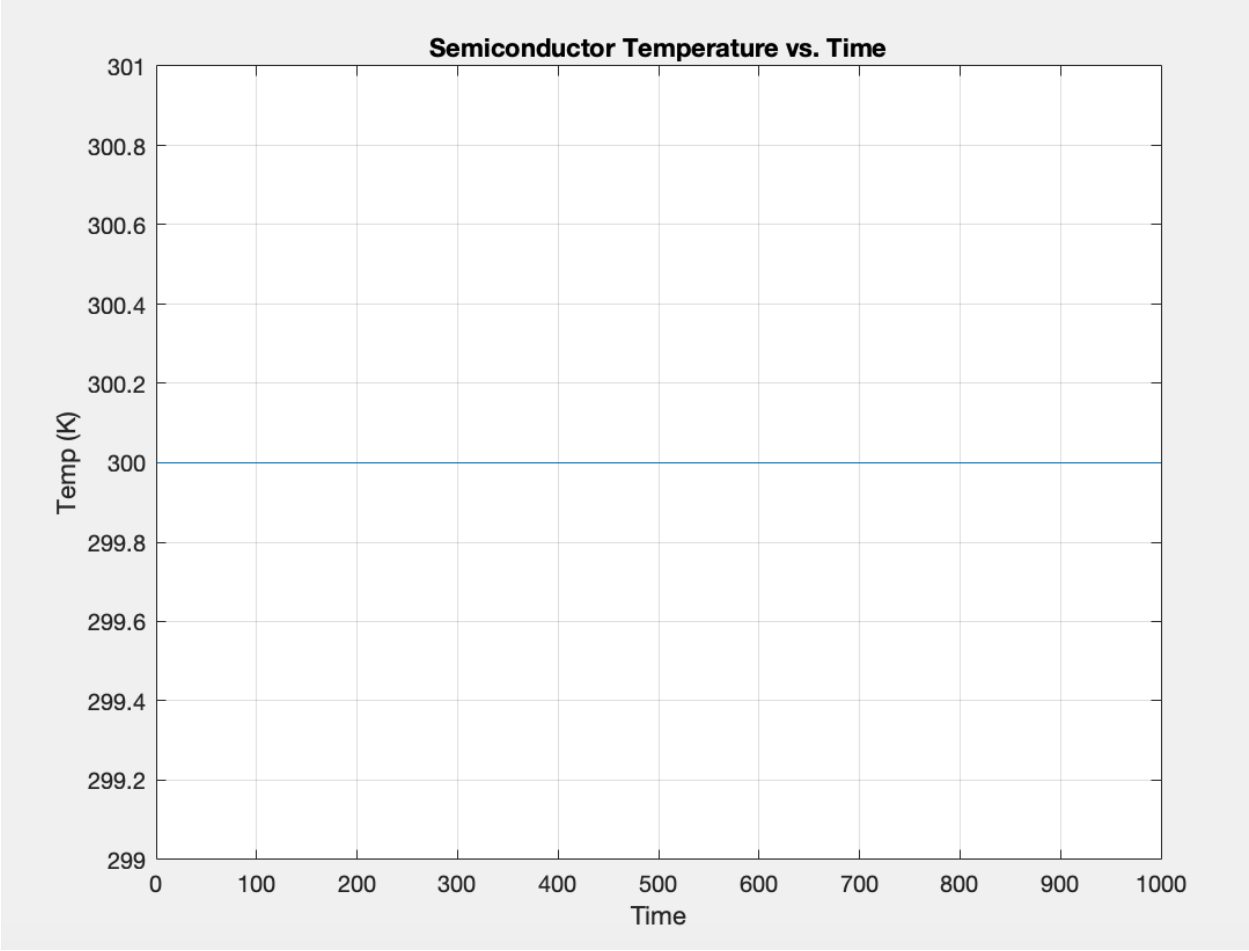

Figure 2. Semiconductor Temperature vs. Time

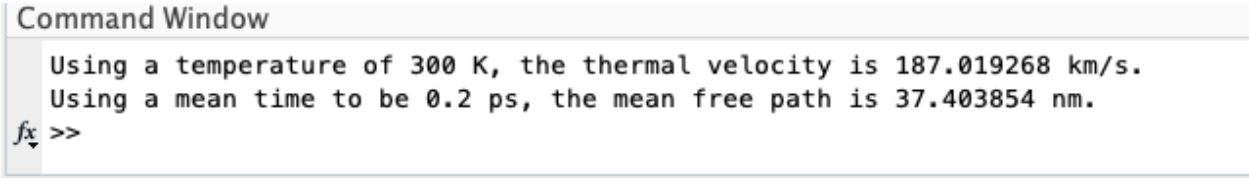

Figure 3. Thermal velocity & MFP

Part 2 Collisions with Mean Free Path (MFP)

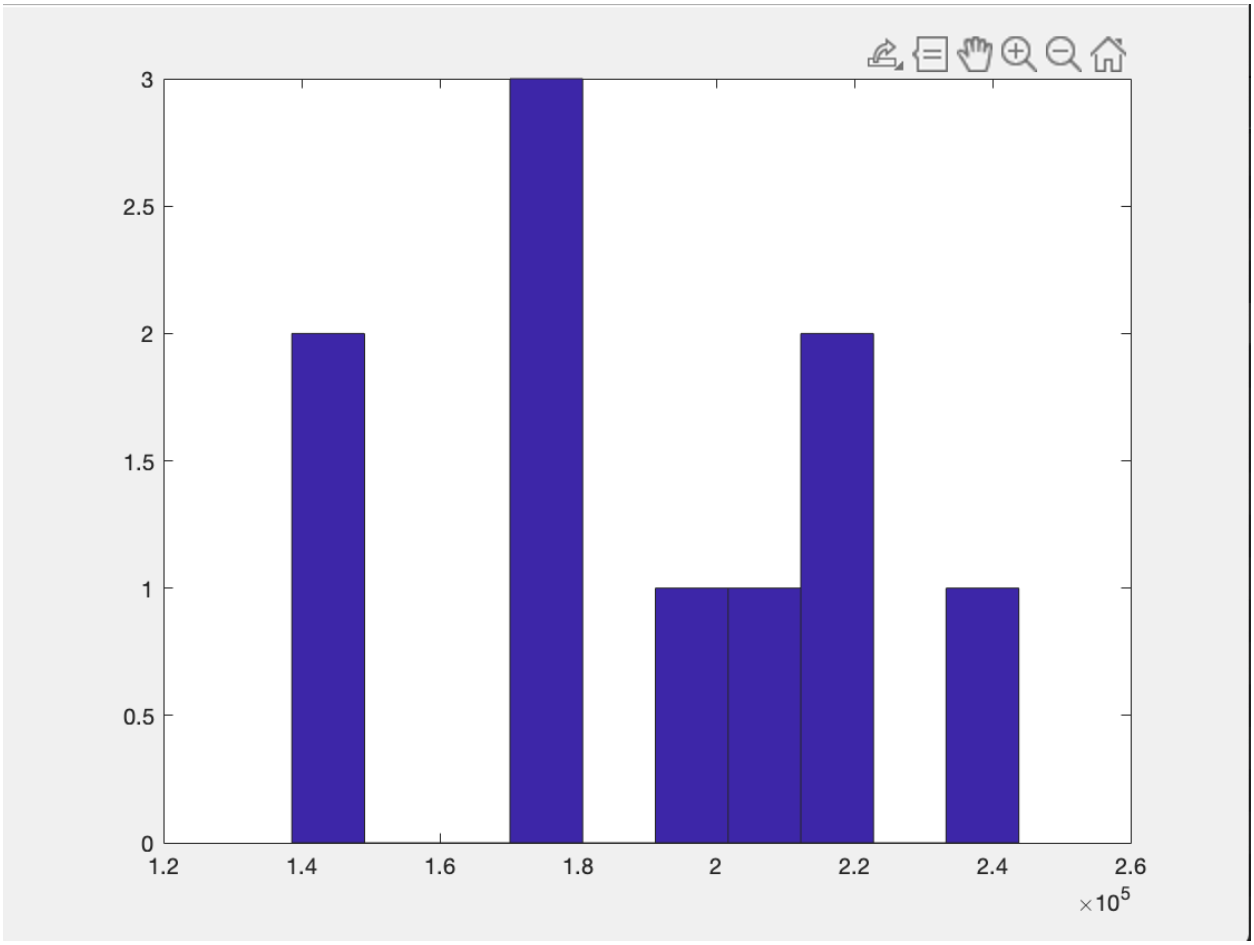

Figure 4. Particle Velocity Histogram

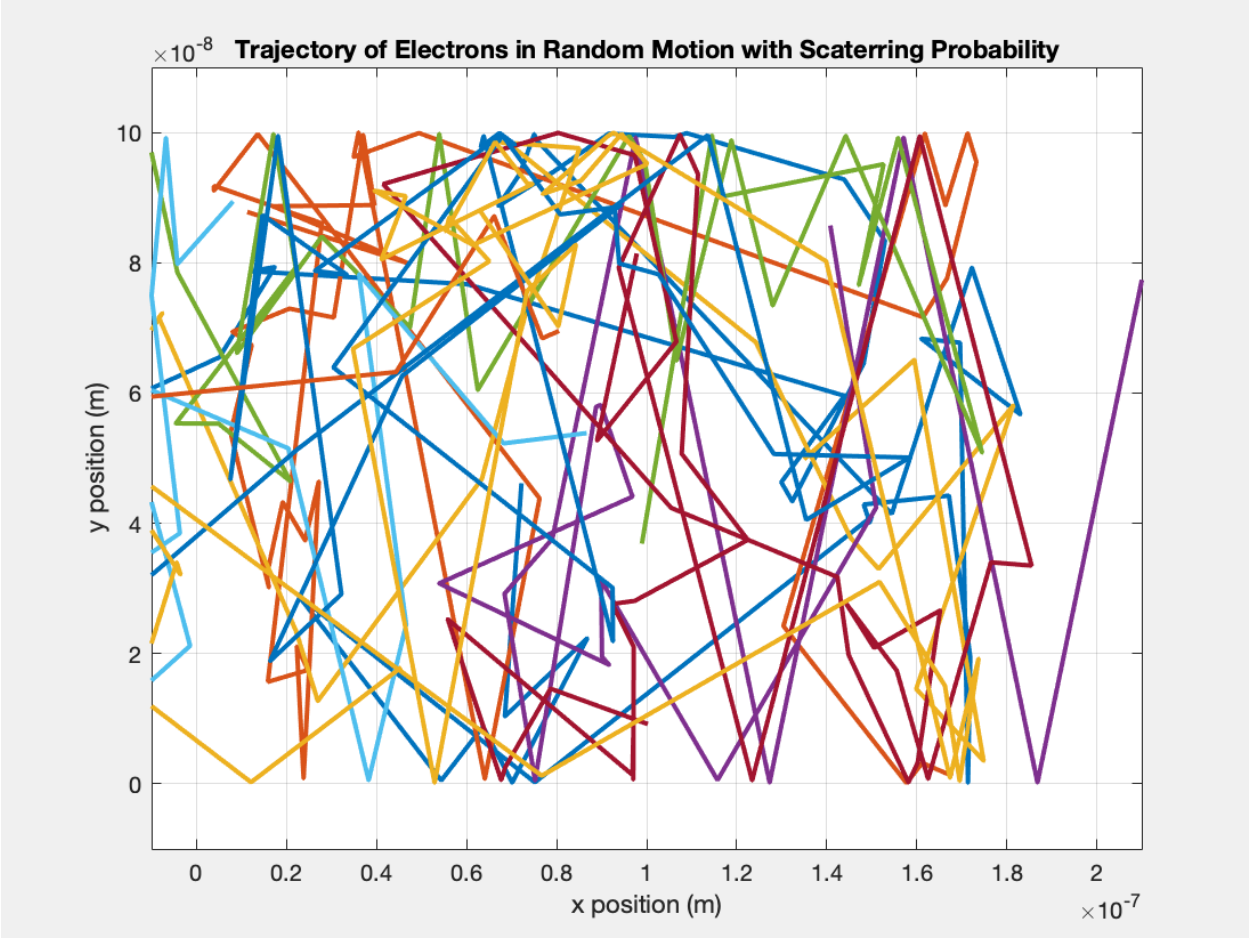

Figure 5. Trajectory of Electrons in Random Motion with Scattering Probability

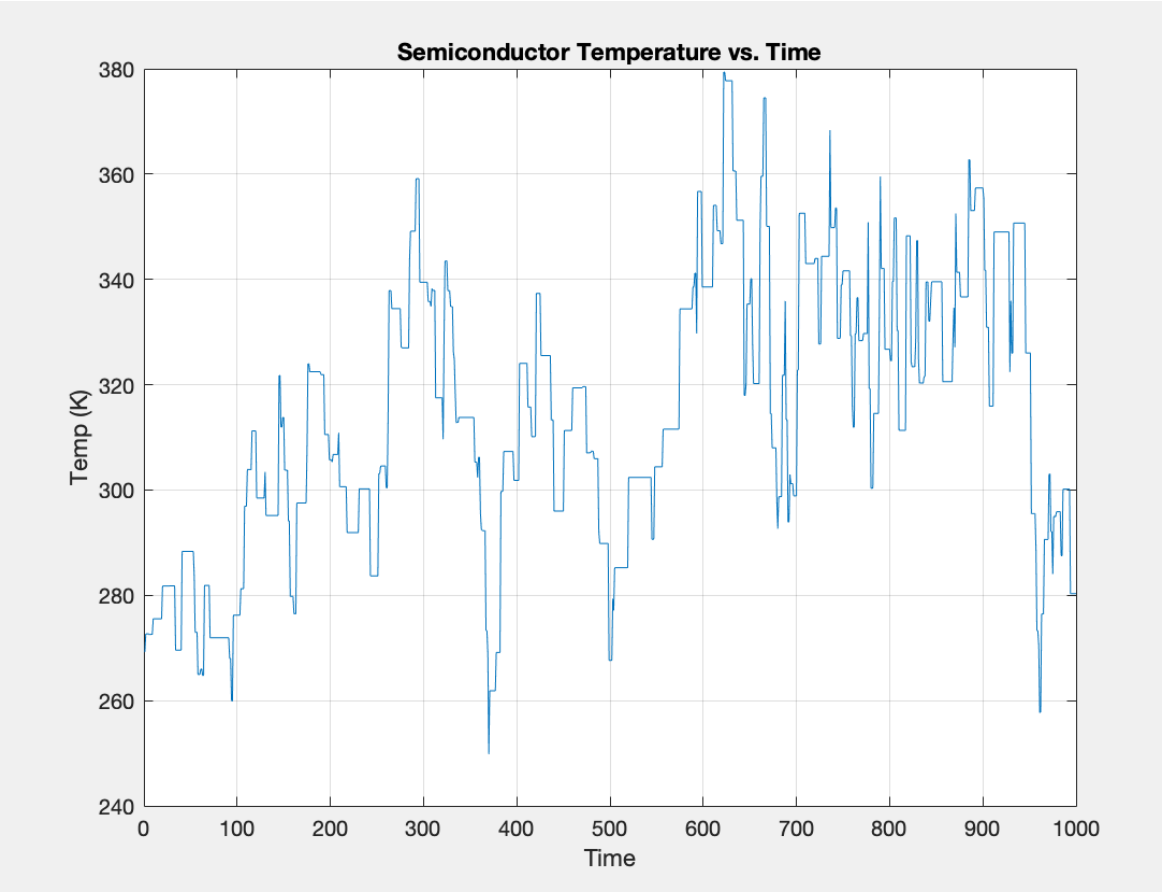

Figure 6. Semiconductor Temperature vs. Time

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Using a temperature of 300 K, the thermal velocity is 187.019268 km/s.
Using a mean time to be 0.2 ps, the mean free path is 37.403854 nm.
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Figure 7. MFP & Mean Time

Part 3 Enhancements

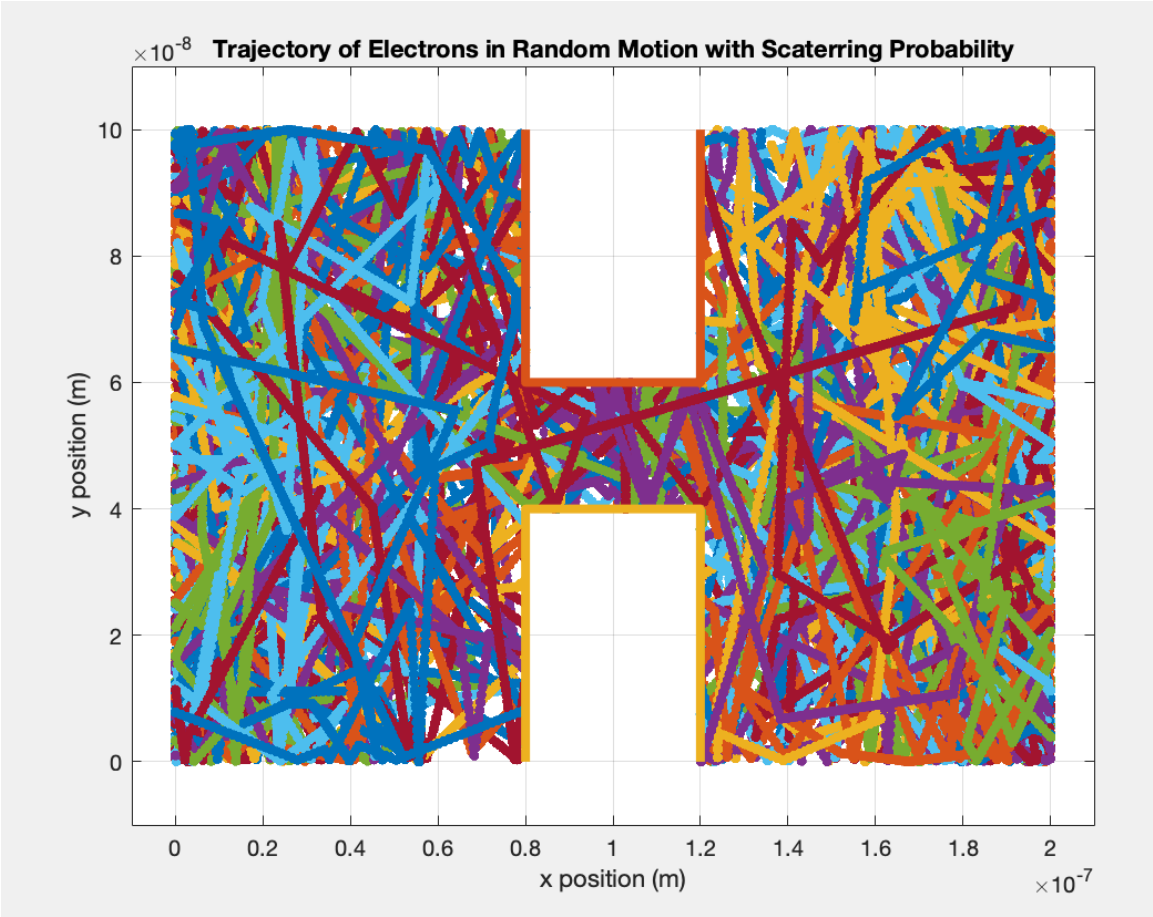

Figure 8. Trajectory of Electrons in Random Motion with Scaterring Probability

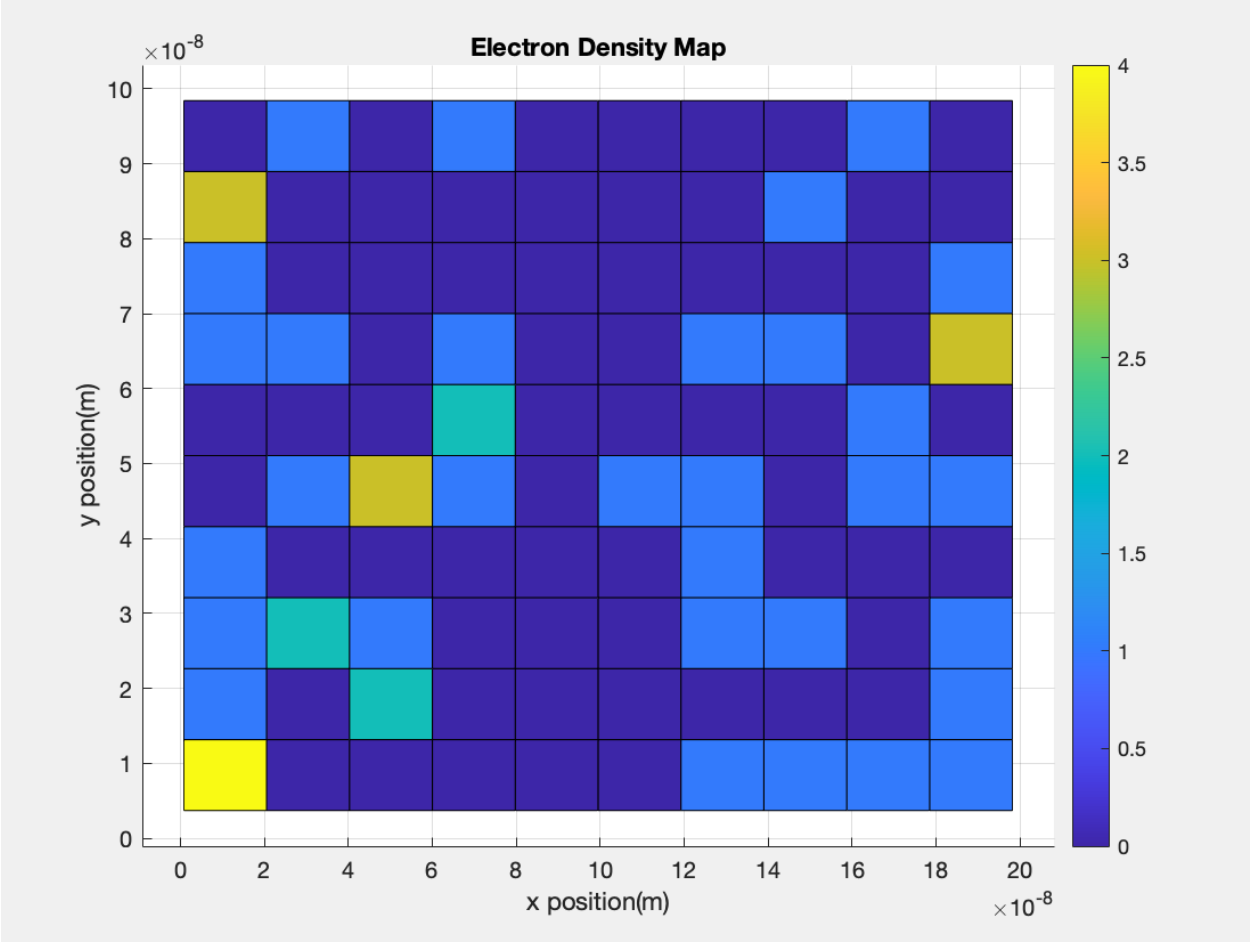

Figure 9. Electron Density Map

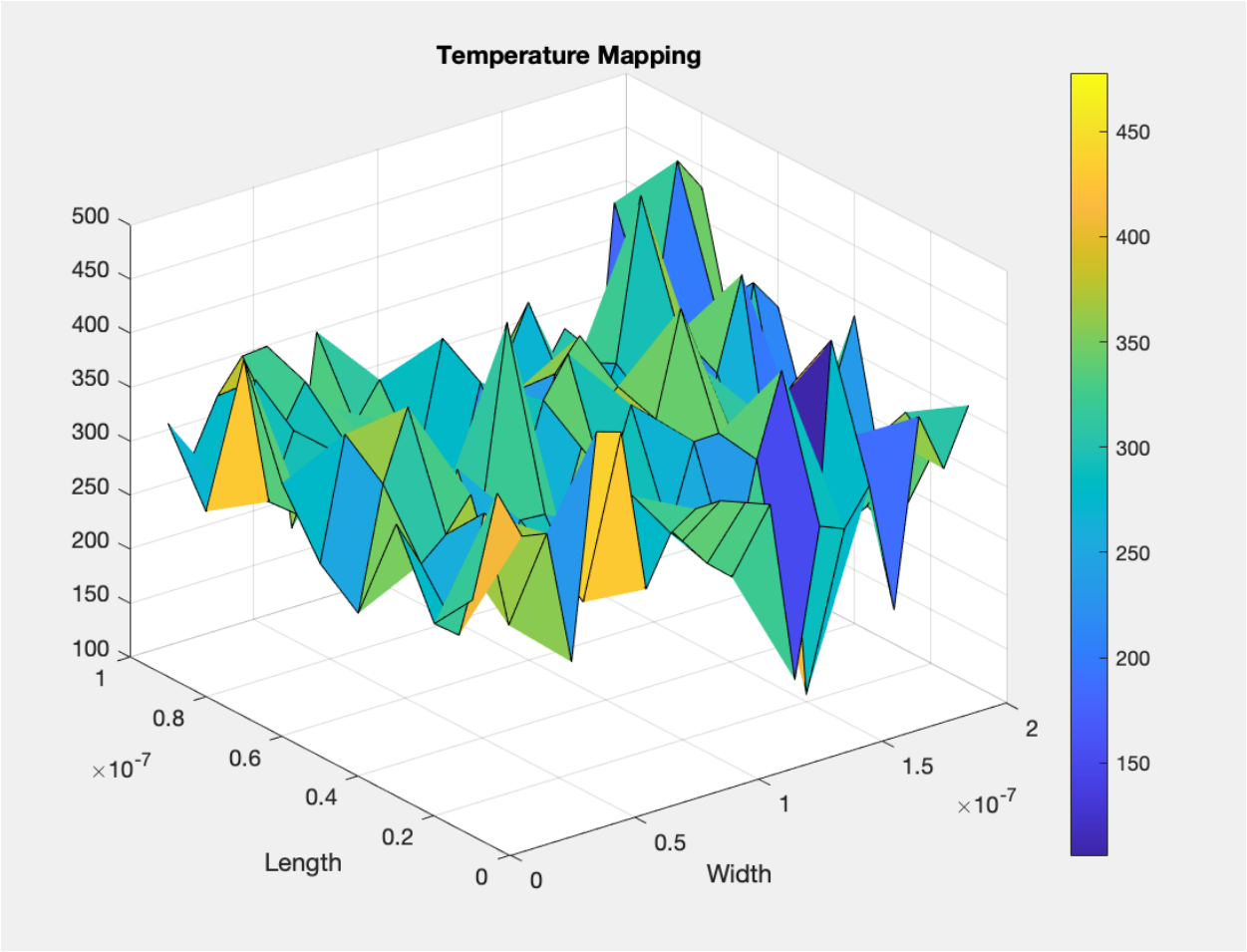

Figure 10. Temperature Mapping