Elec 4700

The Physics and Modeling of Advanced Devices and Technologies

Monte – Carlo/Finite Difference Method

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**Introduction**

Combining the Monte-Carlo technique that was done in the first assignment and the finite difference method that was done in the next assignment. First the Monte-Carlo simulation was completed after a voltage was applied and the electron field was examined. Next, the finite difference method to calculate the electric field applied on the Monte-Carlo method and finally, applying the electric field to the first simulation.

**Monte-Carlo Simulation**

The electric field was first calculated, by dividing the voltage applied (0.1V) by the distance(200x10^-9). The electric field is measured to be 500,000 V/m.

Next the force is calculated by multiplying the charge by the electric field. The force is calculated to be 8 x 10^-14.

Finally, the current was calculated by using equation 1 below.

(1)

Where,

I: Current

n: the number of particles

A: Area of the conductor

v: Drift velocity

Q is the charge of the particle (constant)

The plots are generated below, the number of particles chosen was 5000 for the experiment in order to observe the results clearly. Figure 1 below shows the sample trajectory of 5000 particles.

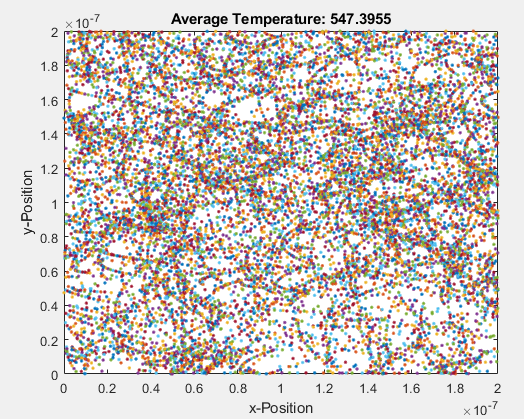


Figure 1: Particles Trajectory Path

The average temperature of the particles after 1000 iterations can be seen in figure 2 below.

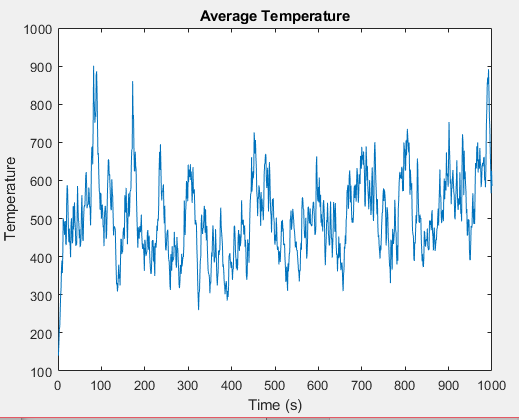


Figure 2: Average Temperature over time

Next the electron density map and the temperature map were then plotted using surf in matlab. The electron density map and the temperature map can be seen in figure 3 and 4 respectively below.

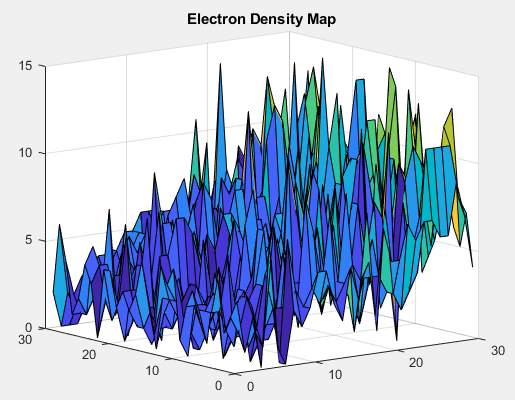
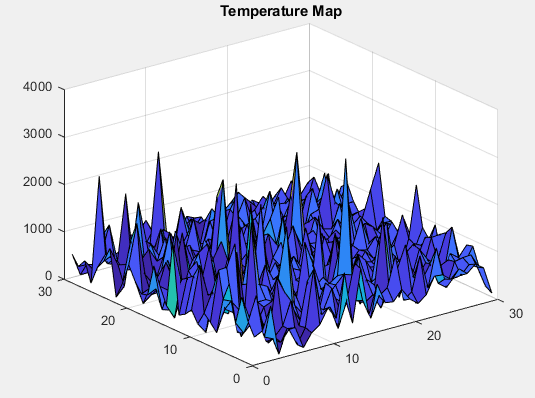
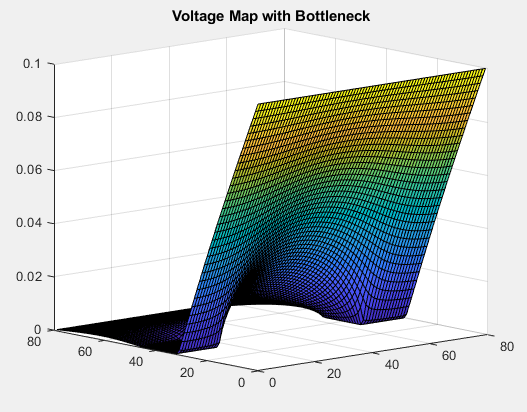


Figure 4: Temperature Map

Figure 3: Electron Density Map

**Finite Difference Method**

The following part involves calculating a voltage and electric field using the finite difference method. Figure \_\_ is the G-matrix that was created from the finite difference method. Next, figure \_ below is the voltage map with the bottle-necks present, finally figure \_\_ below is the electric field resulted from the quiver function.

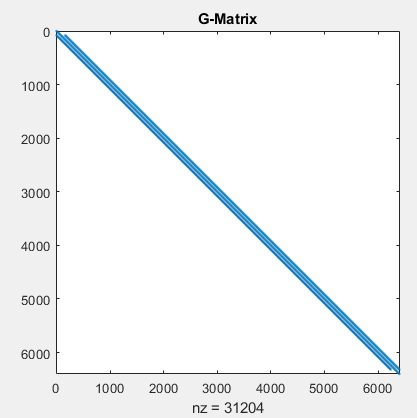


Figure \_: Finite Difference G- Matrix Figure \_: Voltage Map with Bottleneck

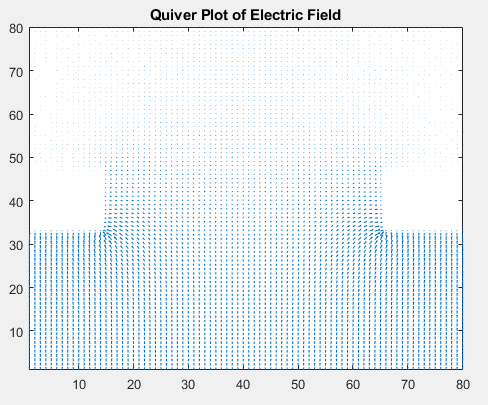


Figure \_: Quiver Plot of Electric Field

**Monte-Carlo Simulation and Finite Difference Method**

**Conclusion**