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# Part 1 A3

Extension of Assignment 1 Miranda Heredia 100996160

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clear
close all

%Constants given
length = 200e-9;
height = 100e-9;
% iterations = 50; not used
Noelectron = 300;
K = 1.38064e-23;
T = 300;           %temp in Kelvin
mo = 9.1093856e-31;
m = 0.26*mo;
vth = sqrt(2*K*T/m);
Time_step = .002e-12;
q_0 = 1.60217653e-19;           % electron charge

% Voltage applied in x-direction of electric field
Voltage = 0.1;

Vel_x = zeros(Noelectron,1);
Vel_y = zeros(Noelectron,1);

Pos_x = zeros(Noelectron,1);
Pos_y = zeros(Noelectron,1);

Pos_x(:,1) = length*rand(Noelectron,1);
Pos_y(:,1) = height*rand(Noelectron,1);

e_x = Voltage/(length);      %value of electric field across x (PART A)

fprintf('Part a) The value of the electric field on the electrons is
%i\n',e_x);

force = e_x*q_0;           %creates a vector containing forces of all
                           %electrons
                           %(PART B)
fprintf('Part b) The value of force on each electron is %i\n',force);

a_elec = force/m;          %creates a vector containing all acceleration
                           %of electrons
                           %will be used to modify the plot. stay
                           %tuned
                           %for more (PART C)
fprintf('Part c) The value of acceleration on each electron is %i
\n',a_elec);
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for n=1:Noelectron
    Vel_x(n,1)= randn(1,1)*vth;
    Vel_y(n,1) = randn(1,1)*vth;
end
AvgV = sqrt(Vel_x.^2 + Vel_y.^2);

%initialize temperature vector
timesteps = 100;
T_avg_V = zeros(timesteps,1);

%PScattering
colorarray = rand(Noelectron,1);
p_scatter = 1 - exp(-Time_step/0.2e-12);
time = 1:timesteps;
for n= 1:timesteps

    % velocity gets updated at each time step
    Vel_x = Vel_x + a_elec*(timesteps*4e-17);

    Pos_x_old = Pos_x;
    Pos_y_old = Pos_y;

    random = rand(Noelectron,1);

    %all electrons with higher probabilities
    new = random < p_scatter;

    %all electrons with lower probabilities
    new2 = random >= p_scatter;

    rand_v_x = zeros(Noelectron,1);
    rand_v_y = zeros(Noelectron,1);

    for i = 1:1:Noelectron
        r1 = randi([1 Noelectron], 1,1);
        r2 = randi([1 Noelectron], 1,1);
        rand_v_x(i,1) = Vel_x(r1,1);
        rand_v_y(i,1) = Vel_y(r2,1);
    end
    %all electrons with lower probabilities will stay the same
    Vel_x = Vel_x.*new2;
    Vel_y = Vel_y.*new2;

    rand_v_x=rand_v_x.*new;
    rand_v_y=rand_v_y.*new;

    Vel_x = Vel_x+rand_v_x;
    Vel_y = Vel_y+rand_v_y;

    Pos_x = Pos_x + Vel_x*Time_step;
    Pos_y = Pos_y +Vel_y*Time_step;

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%checking for boundary positions
idLong = Pos_x>=length;
Pos_x(idLong) = Pos_x(idLong) - length;
Pos_x_old(idLong) = 0;

idShort = Pos_x<=0;
Pos_x(idShort) = Pos_x(idShort) + length;
Pos_x_old(idShort) = length;

%Check for y boundary and correct

Vel_y(Pos_y>=height) = -1*Vel_y(Pos_y>=height);
Vel_y(Pos_y<=0) = -1*Vel_y(Pos_y<=0);

Pos_y(Pos_y>height) = height - (Pos_y(Pos_y>height)-height);

%average thermal velocity
v_avg = mean(sqrt(((Vel_x.^2)+(Vel_y.^2)))); 
T_avg_V(n) = (1/sqrt(2))*(m*(v_avg))/K;

mfp = (0.2e-15)*(v_avg);

meantime = (Noelectron./sum(v_avg))*mfp;

% 2D Trajectory as in Figure 1 in Manual
figure(1)
scatter(Pos_x,Pos_y,3,colorarray);
axis([0 200e-9 0 100e-9])
title(['The mean free path is ', num2str(mfp)]);
hold on

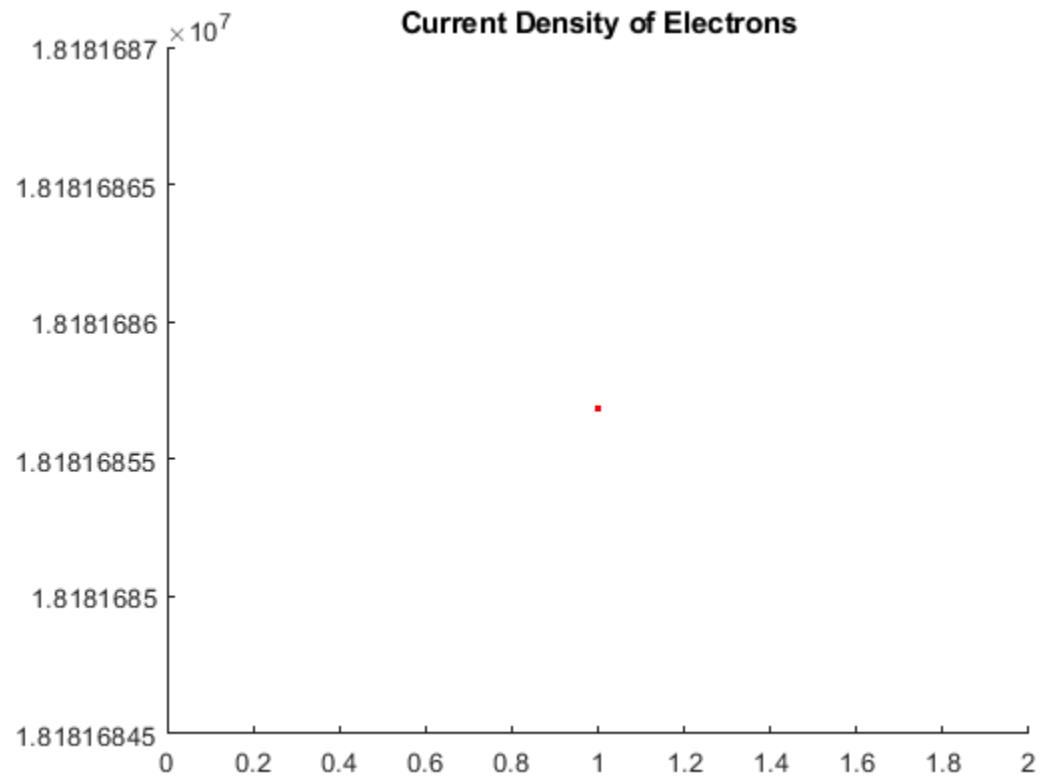
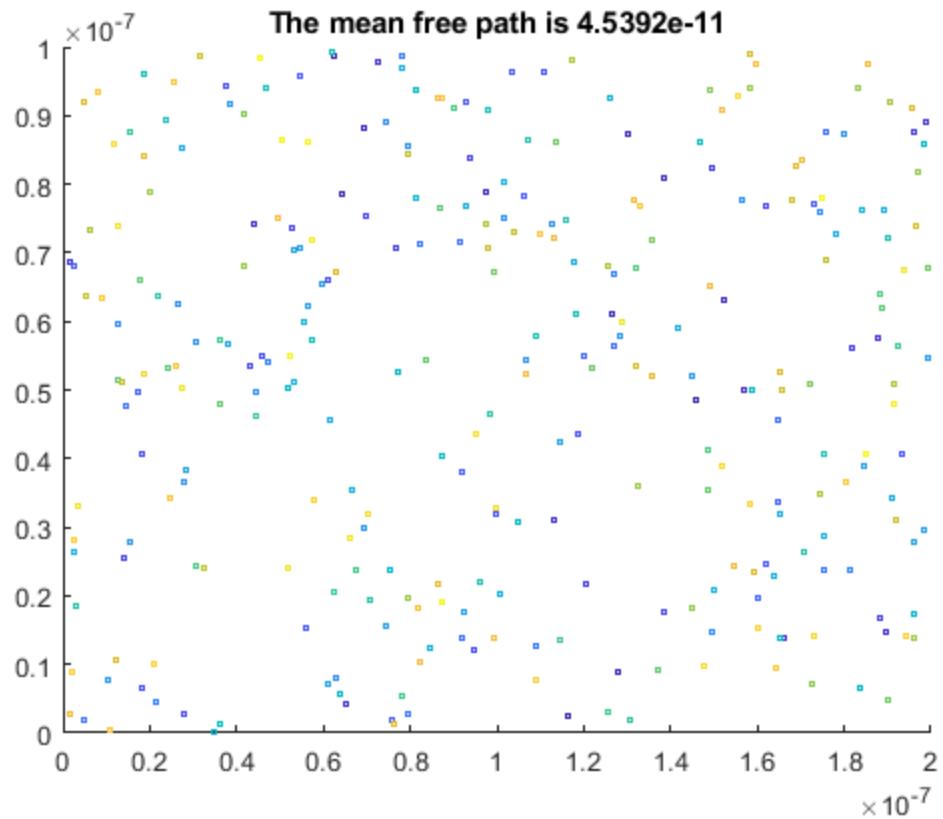
% Part D Drift Current of electron

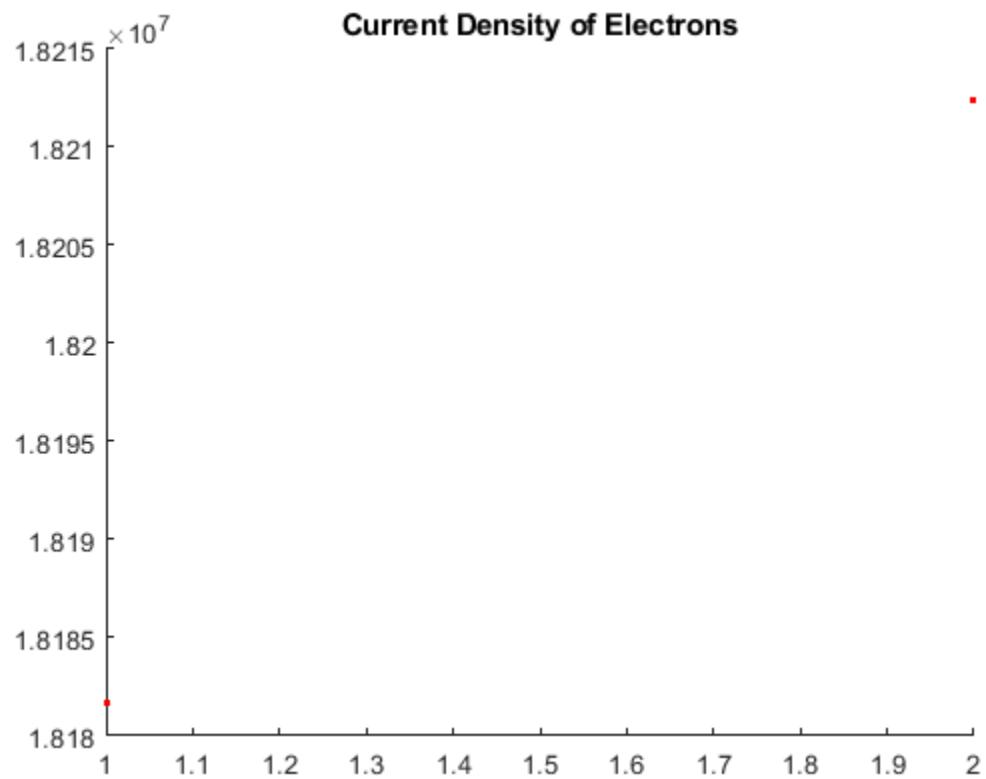
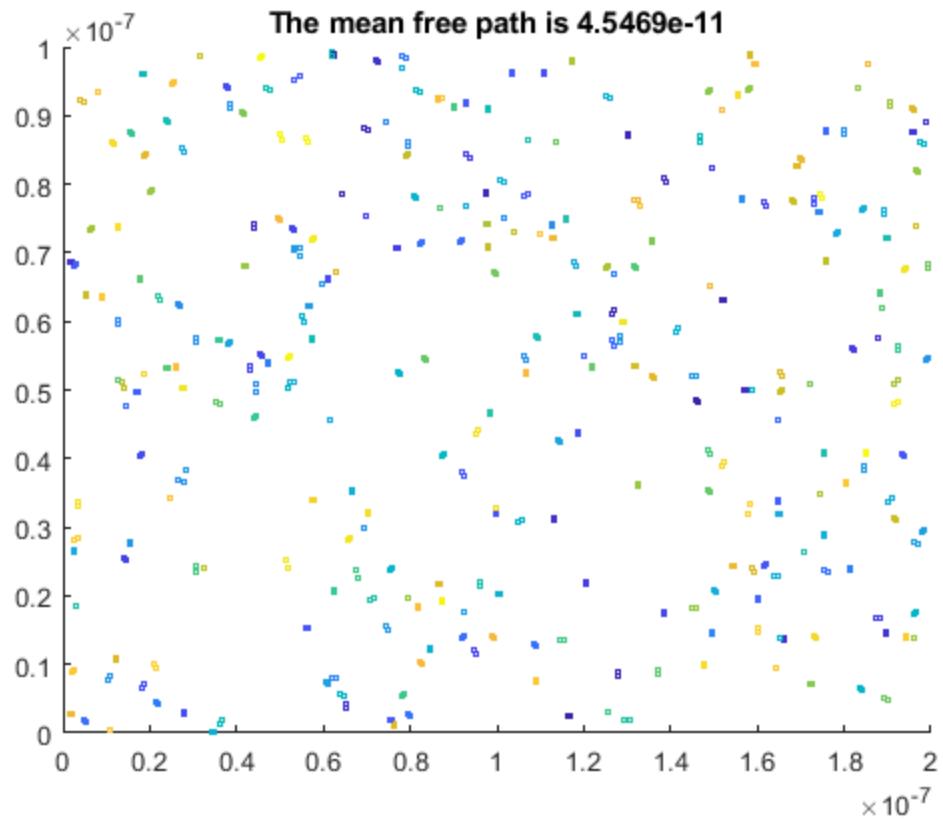
e_conc = 10^15;
Id = v_avg*e_conc*e_x*q_0;

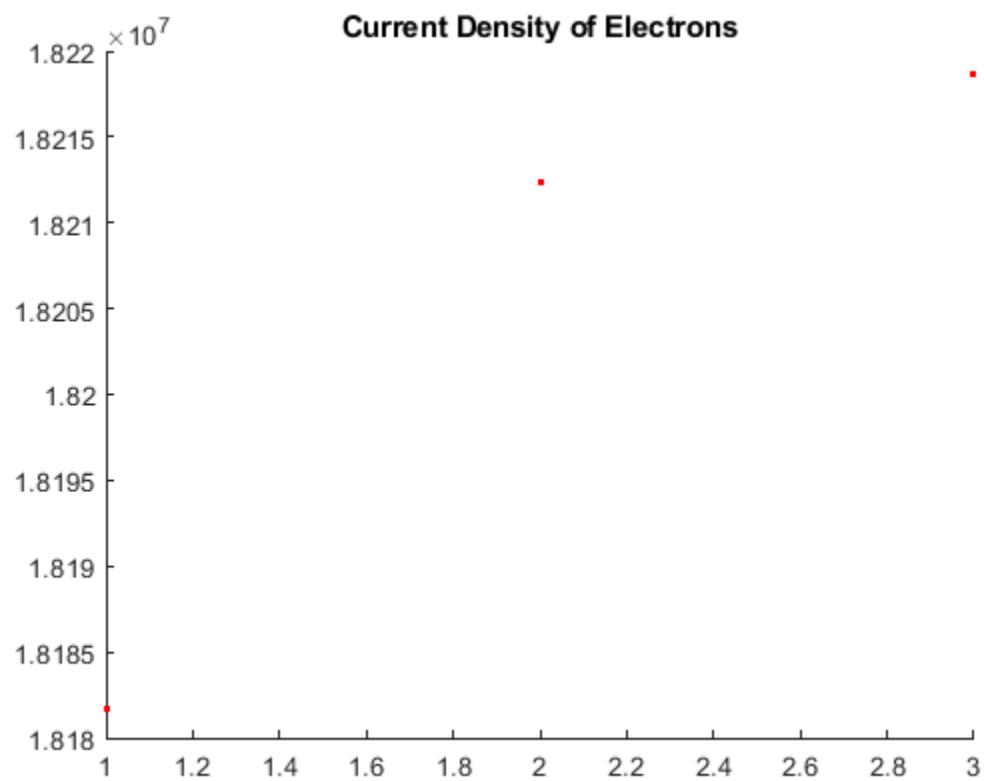
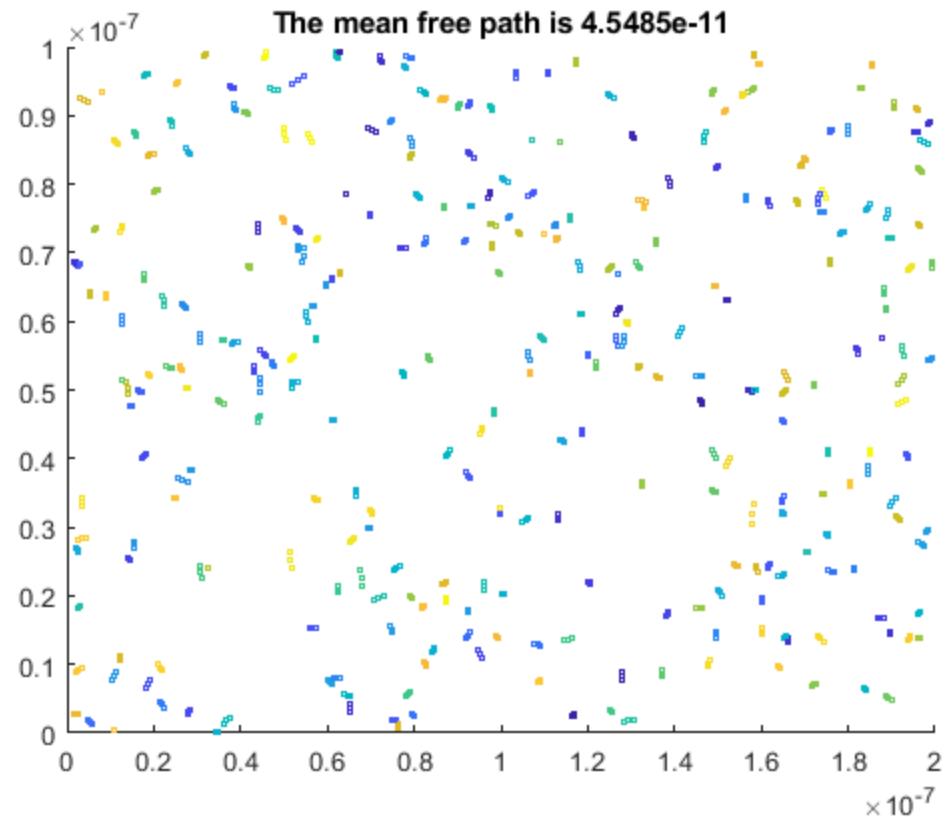
%Plot for current density of electrons

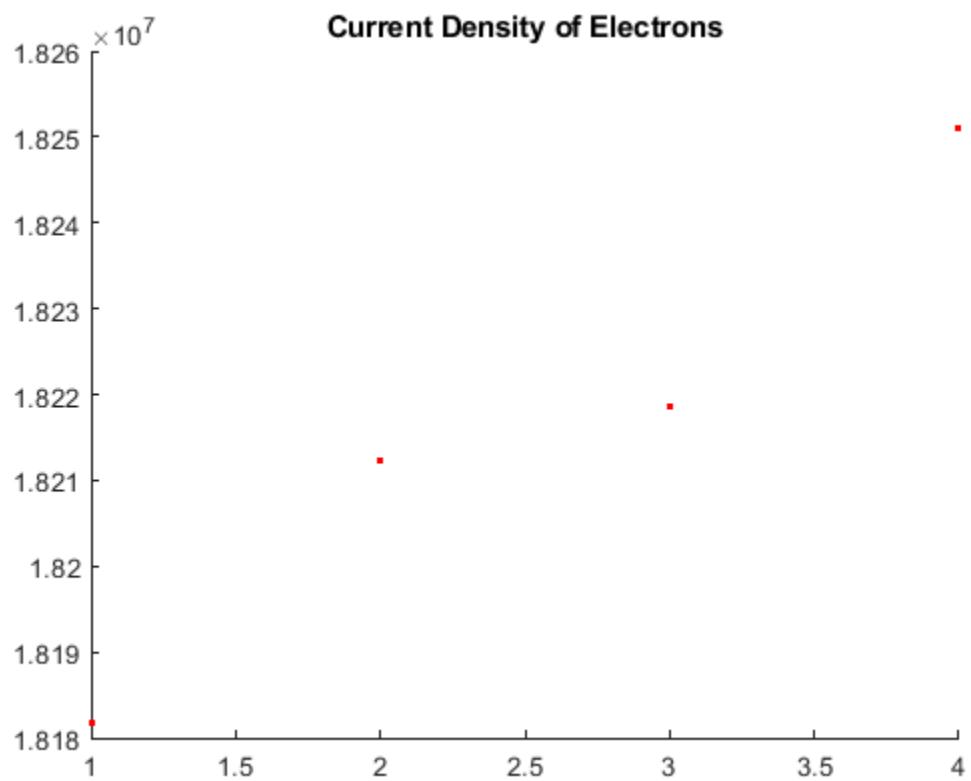
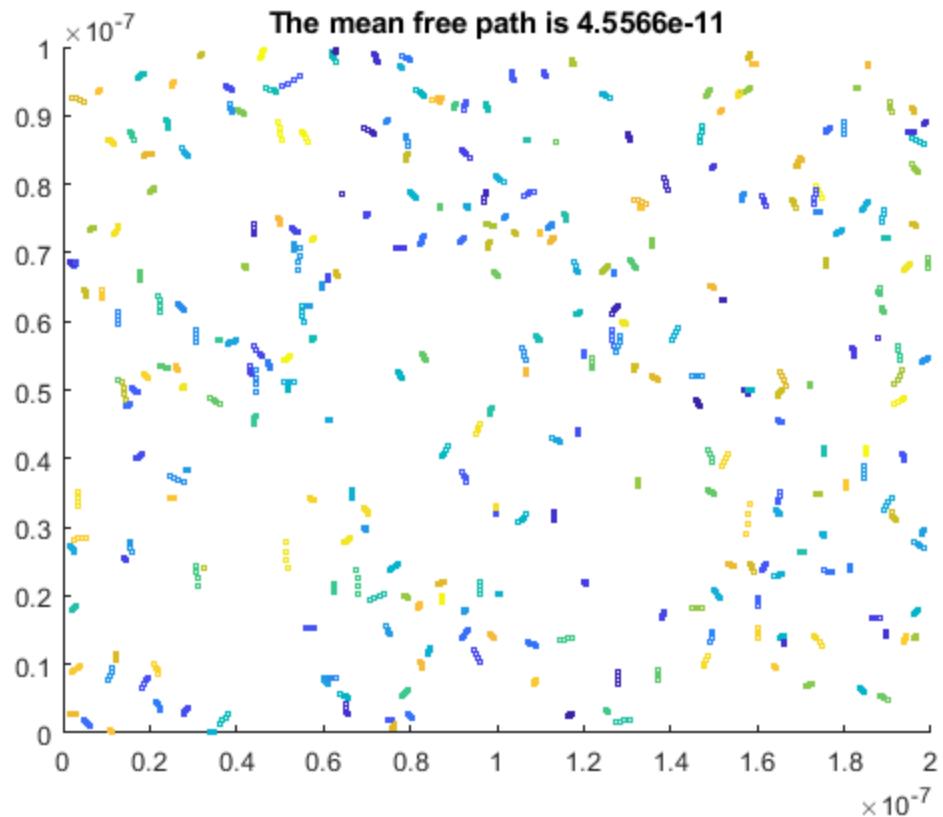
figure (2)
scatter(n,Id,'r.')
title('Current Density of Electrons');

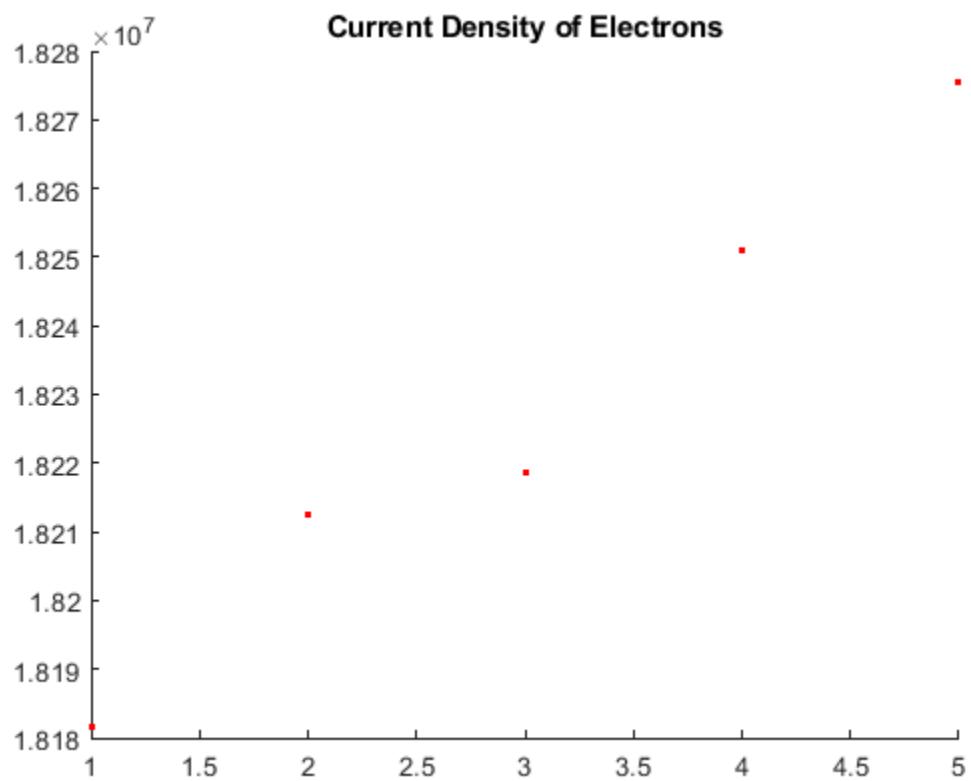
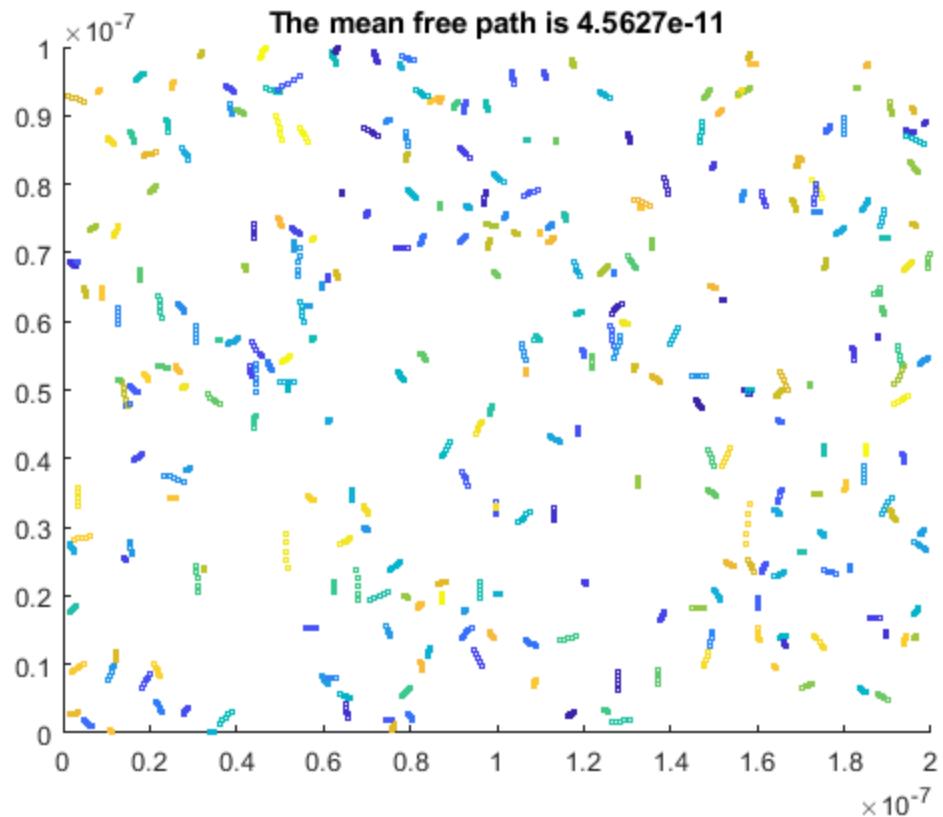
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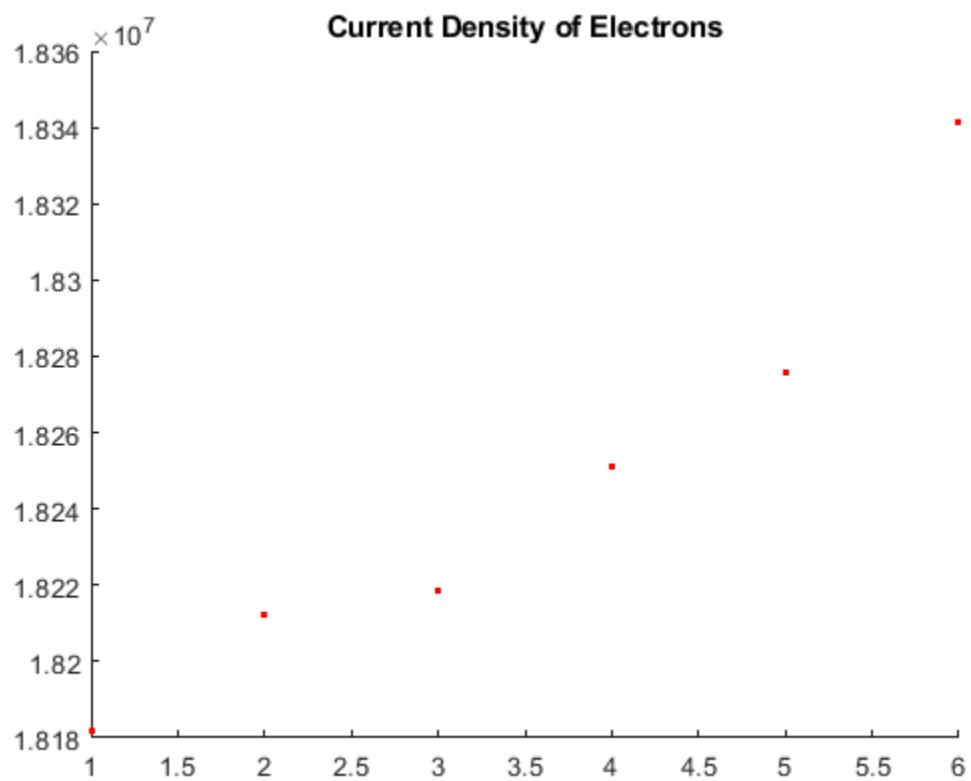
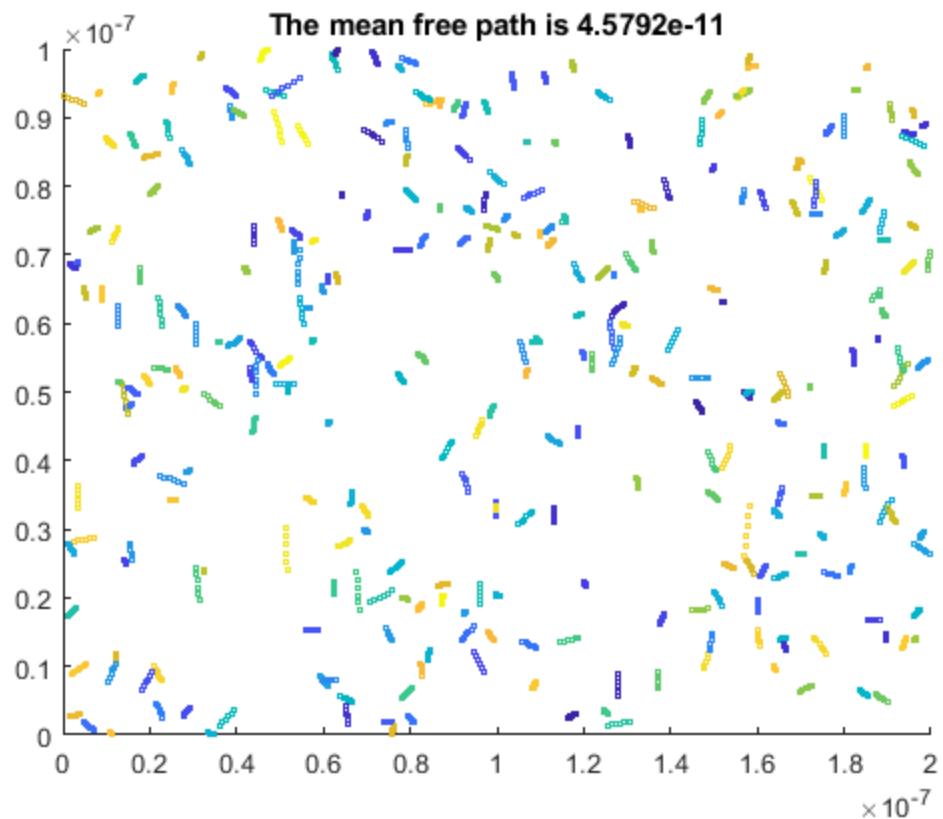


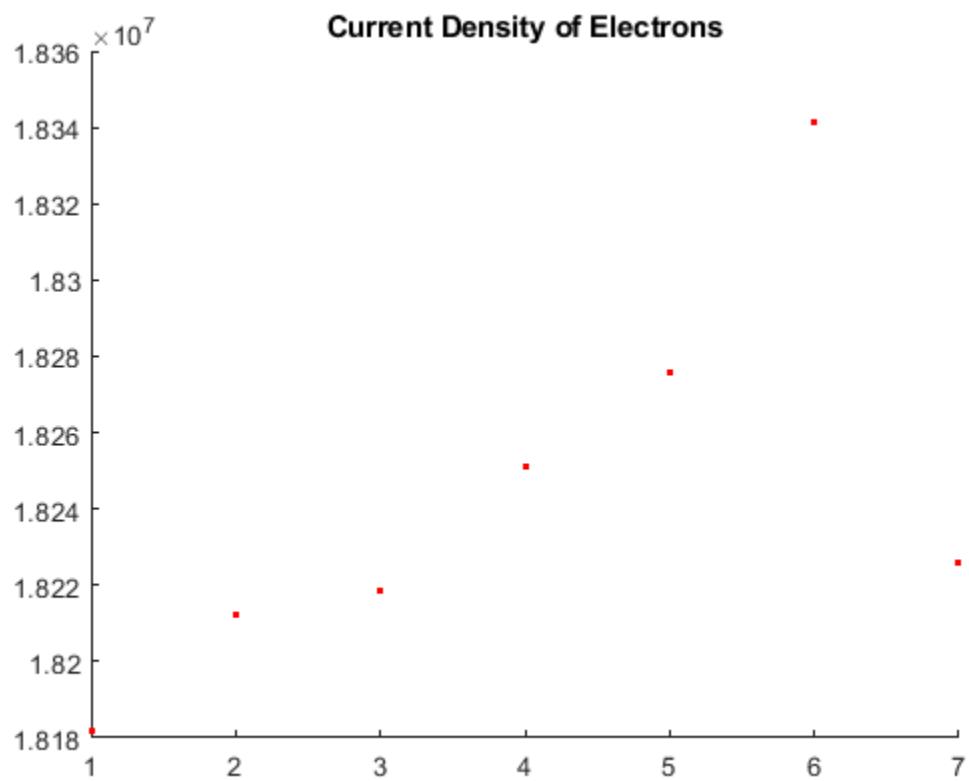
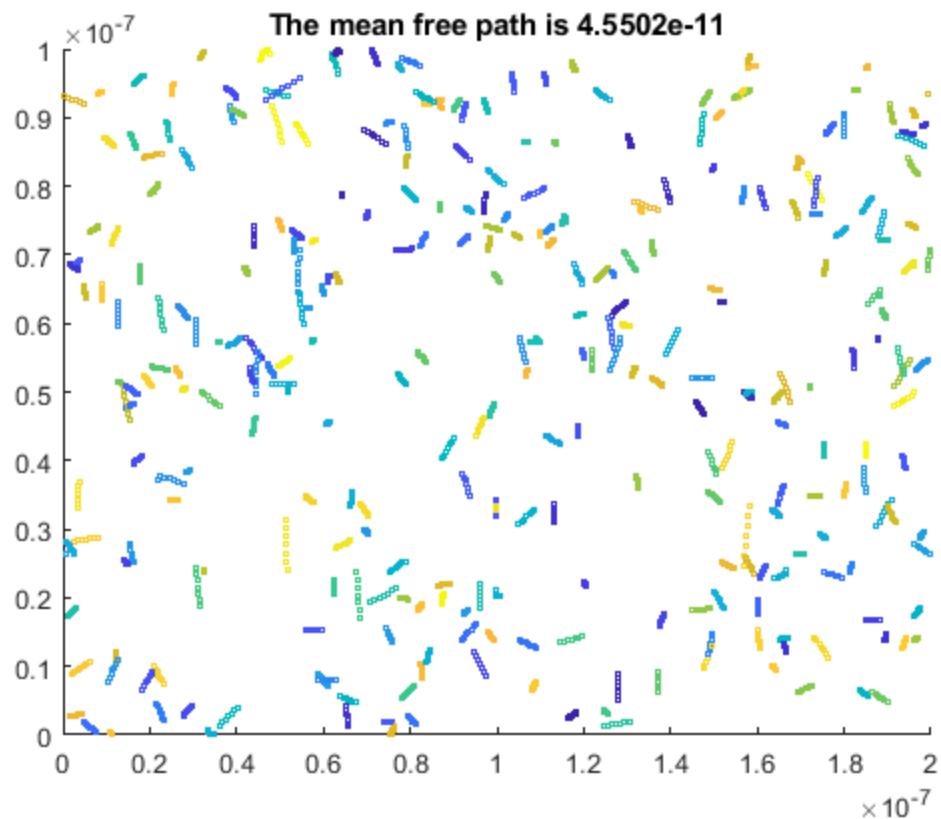


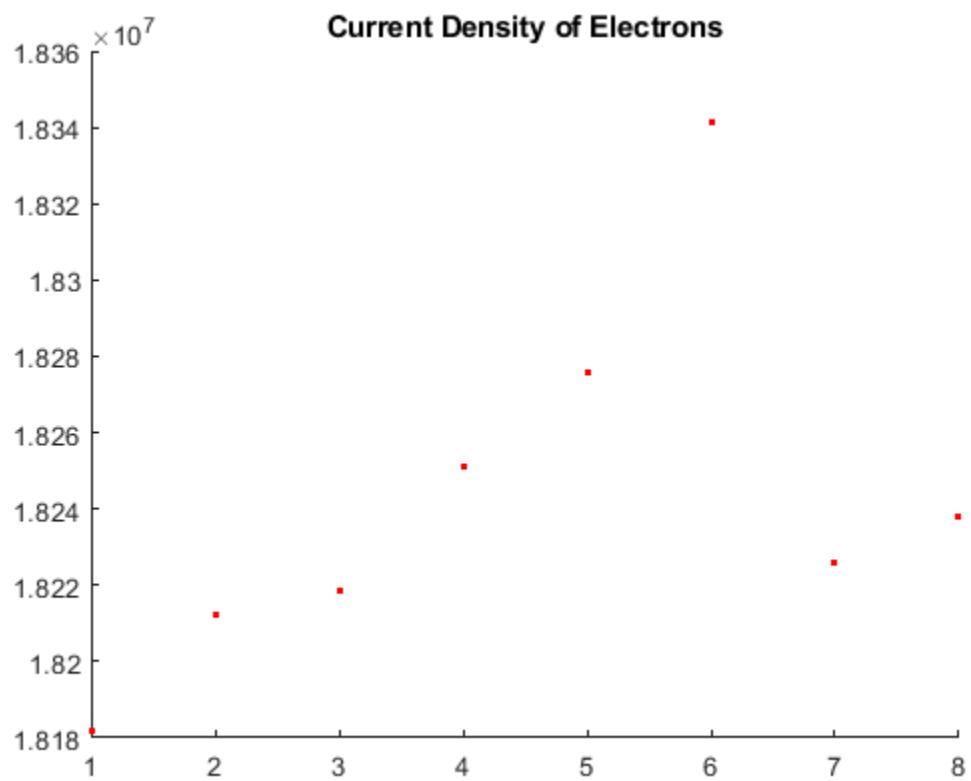
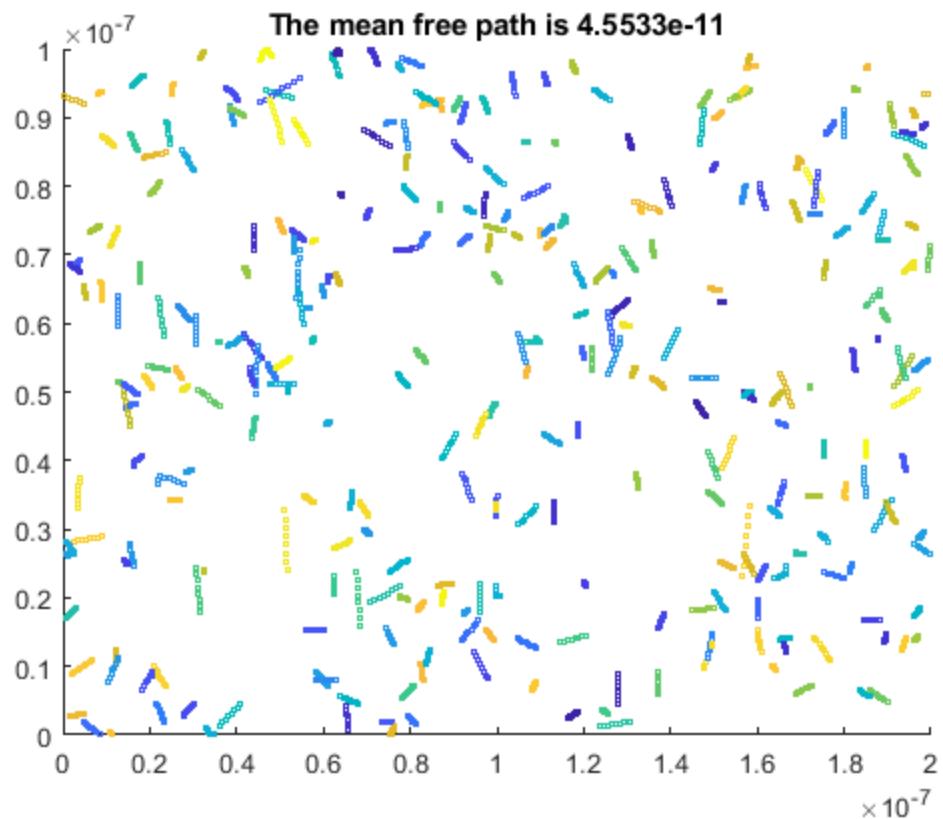


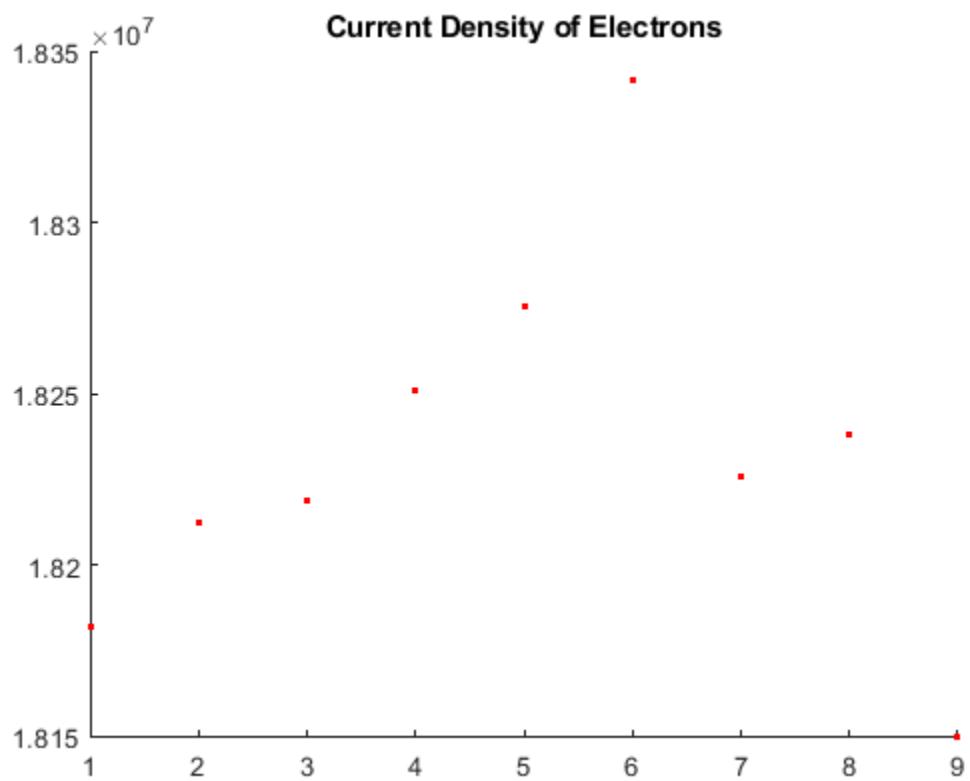
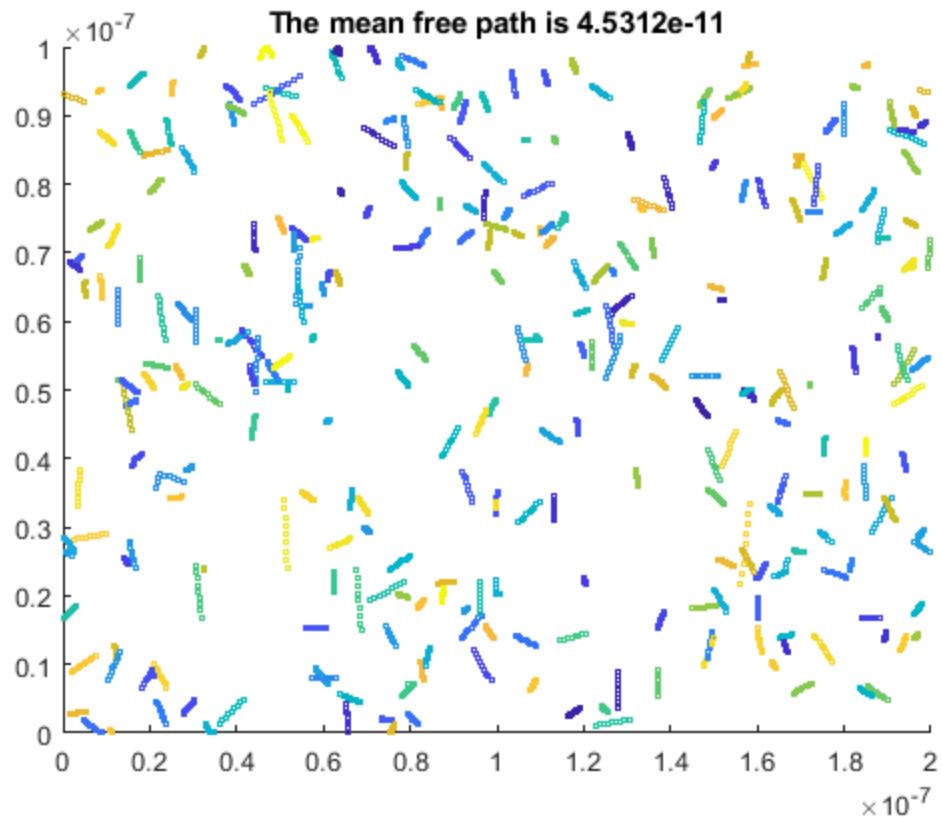


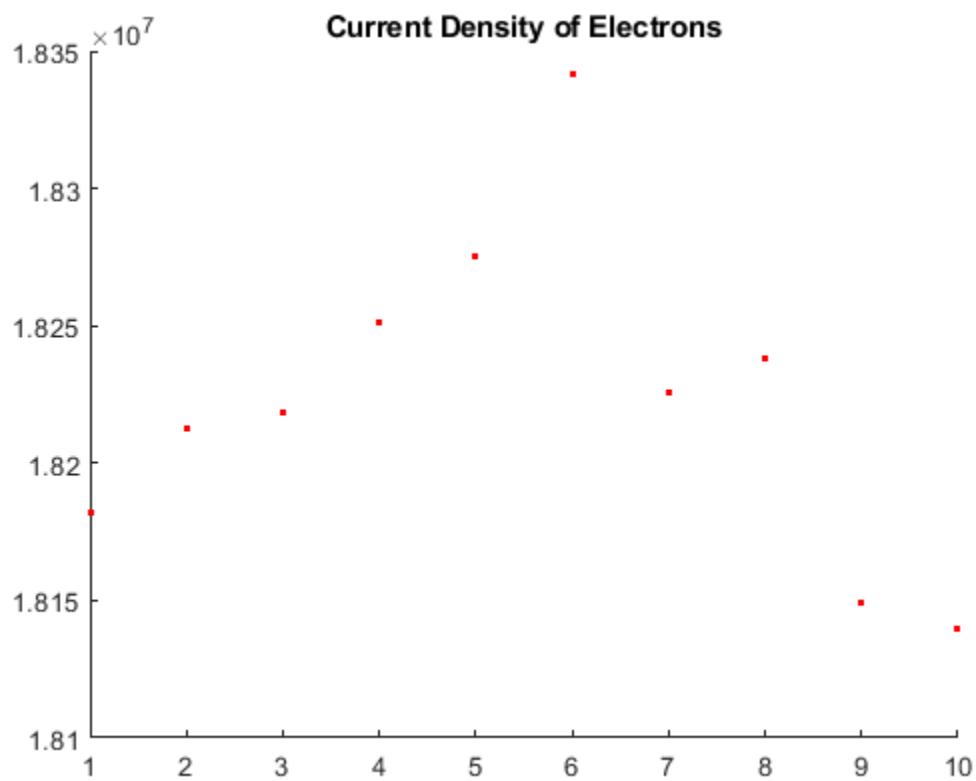
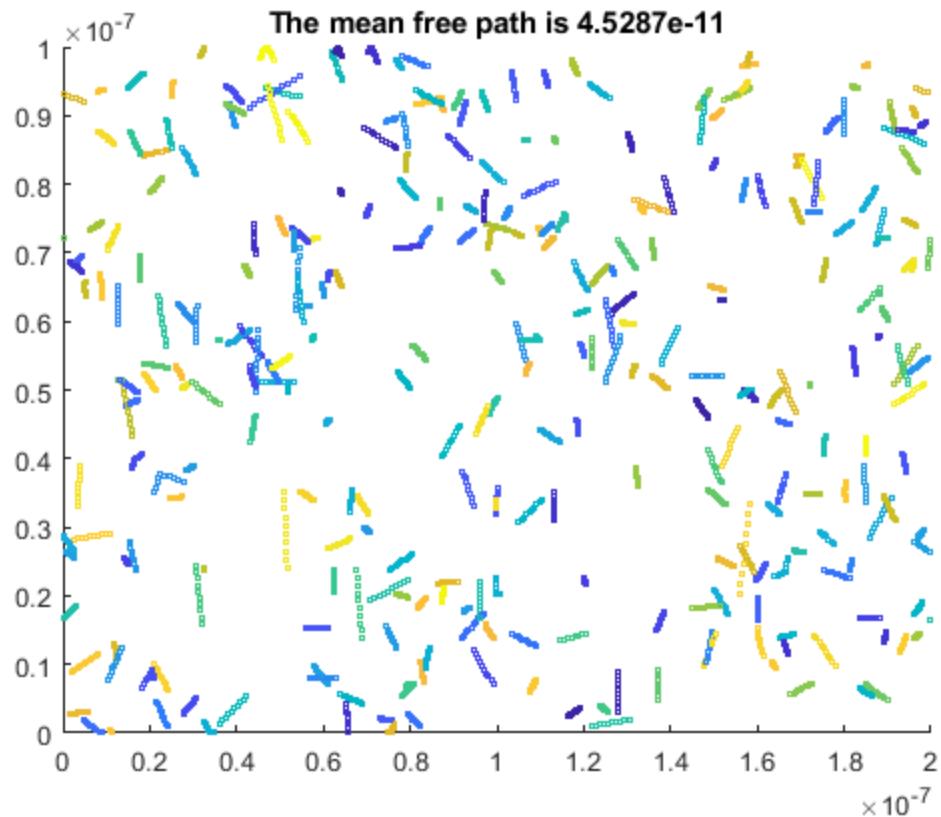


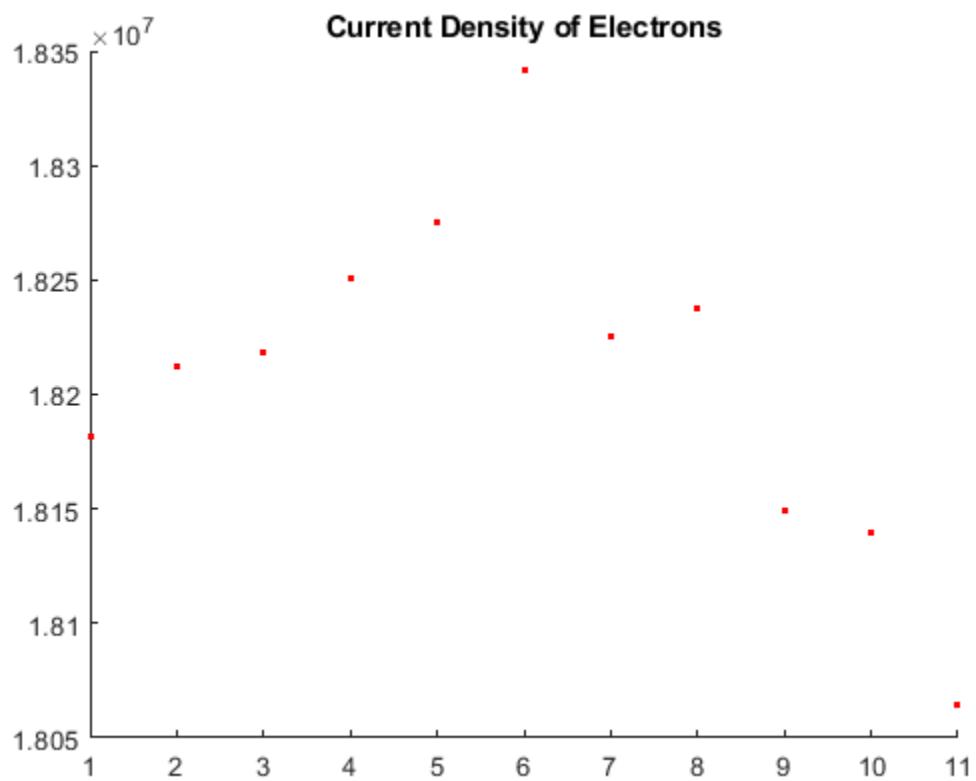
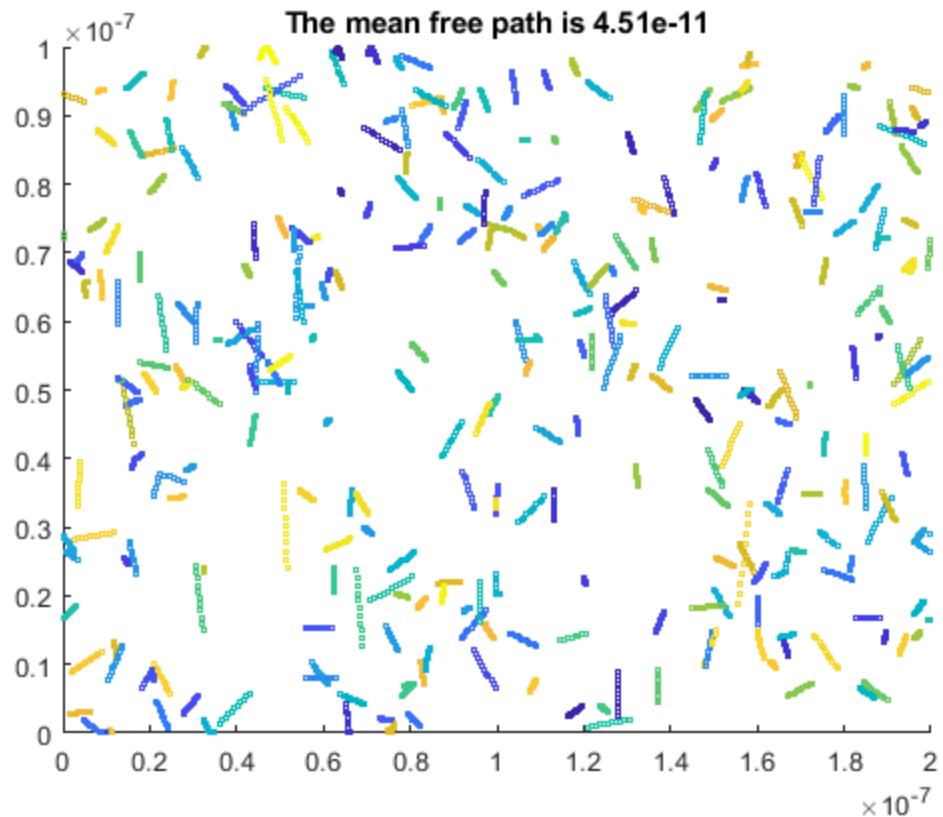


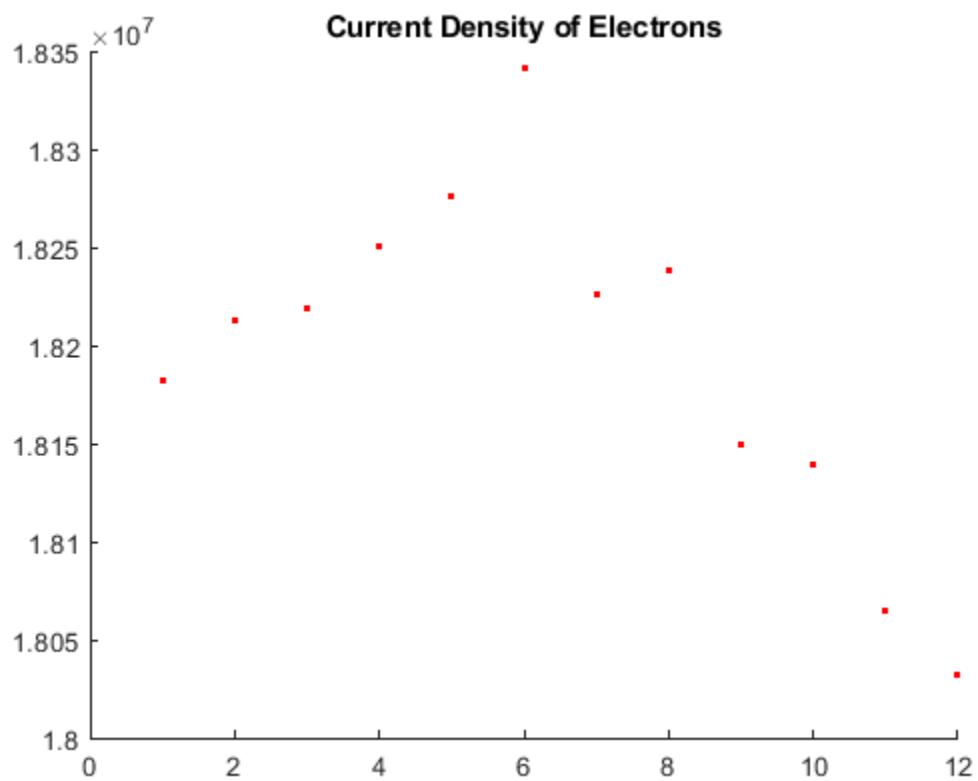
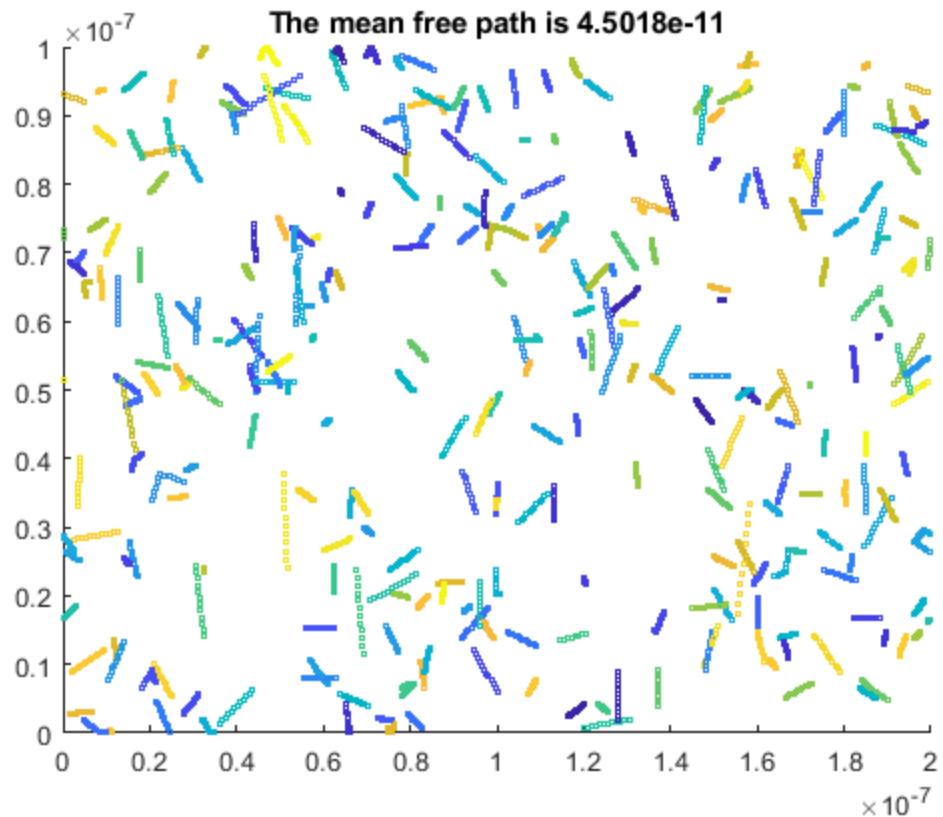


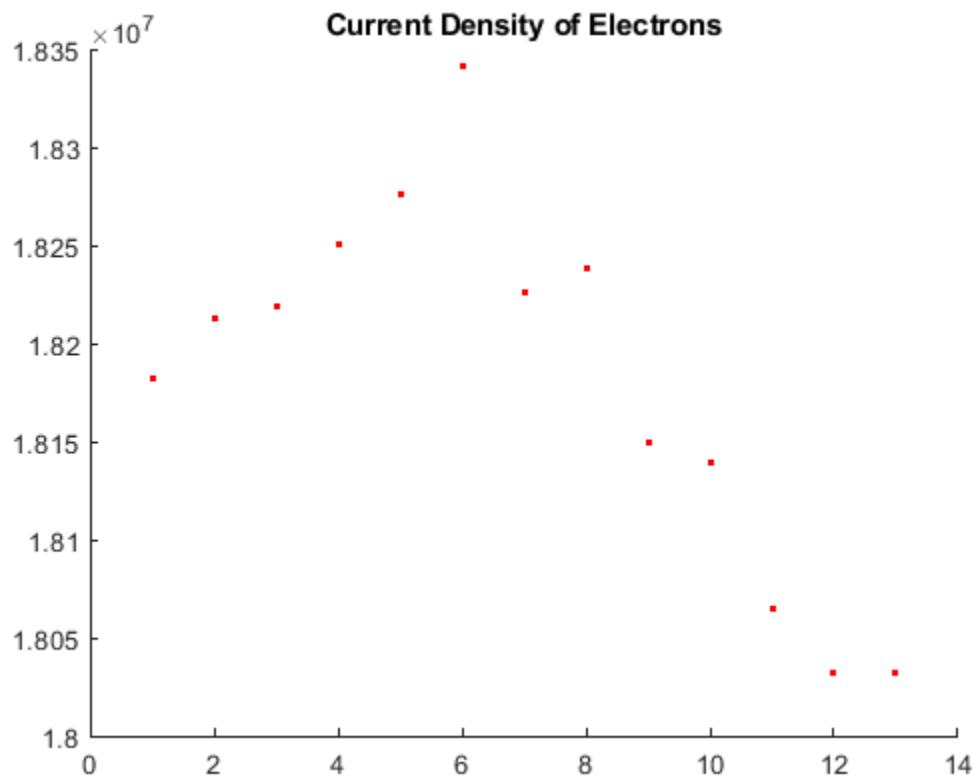
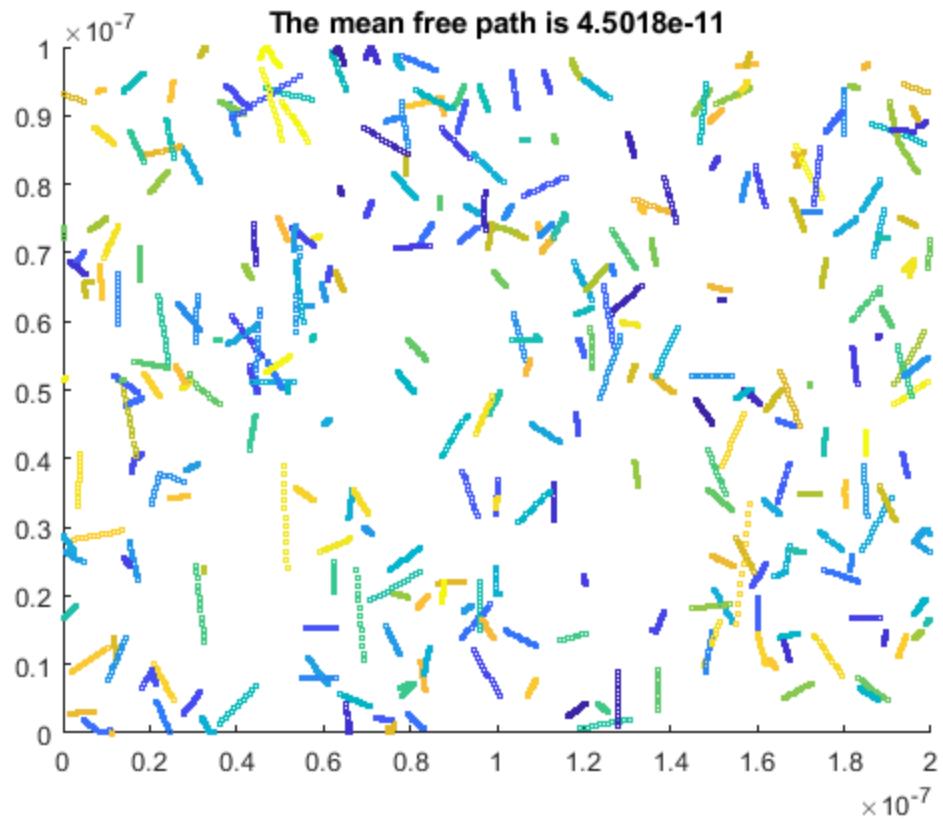


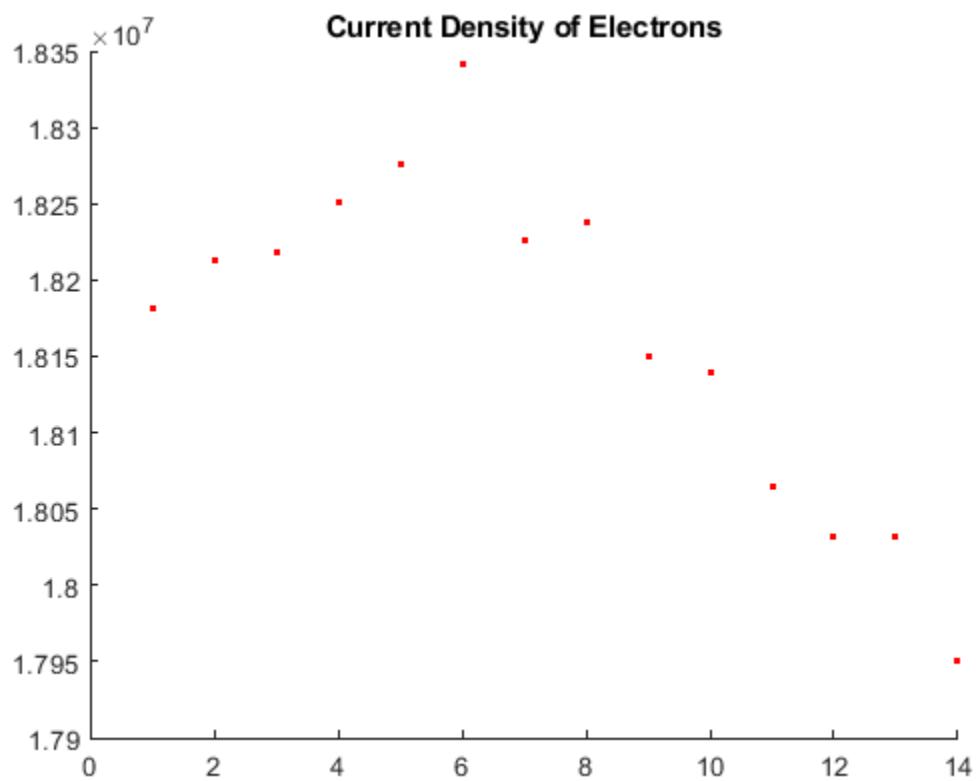
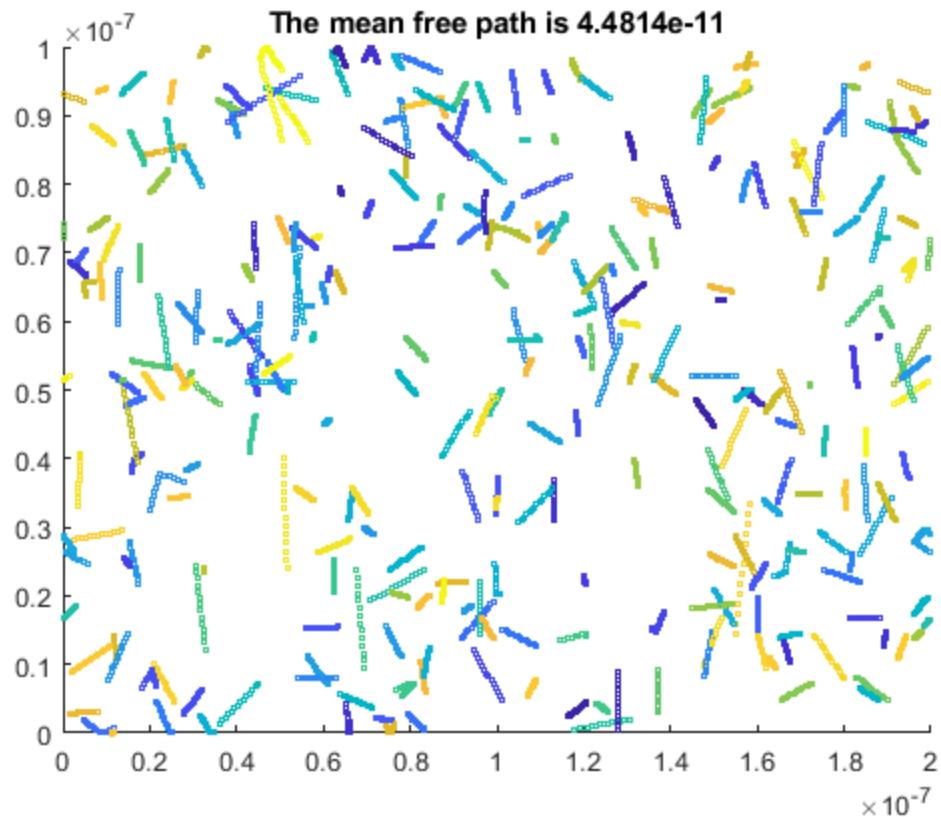


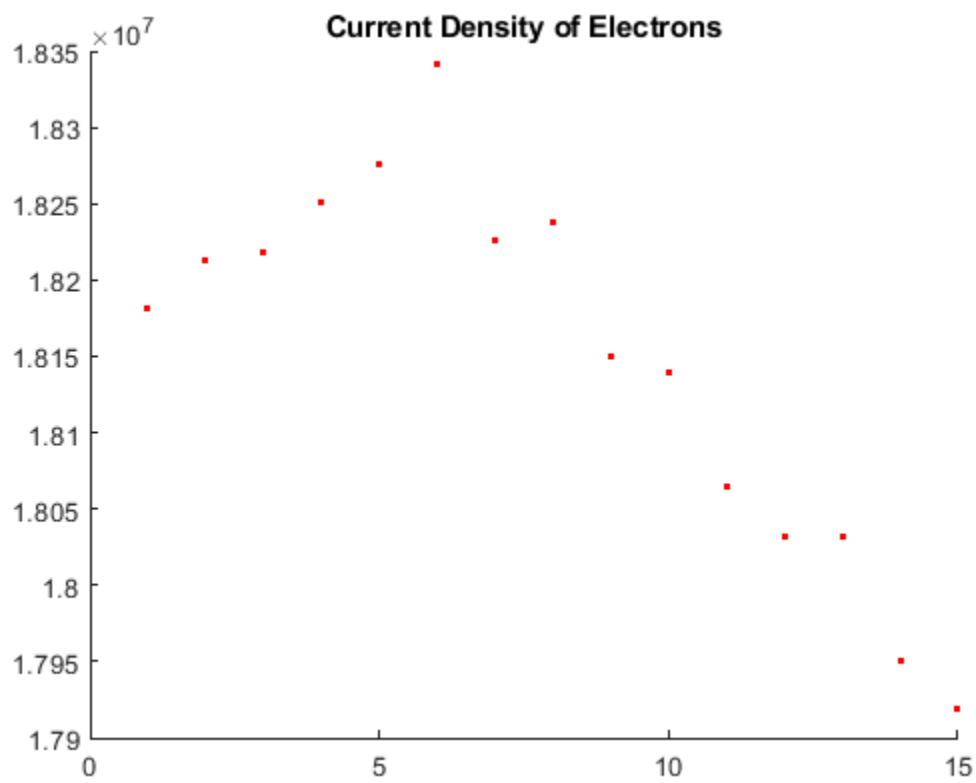
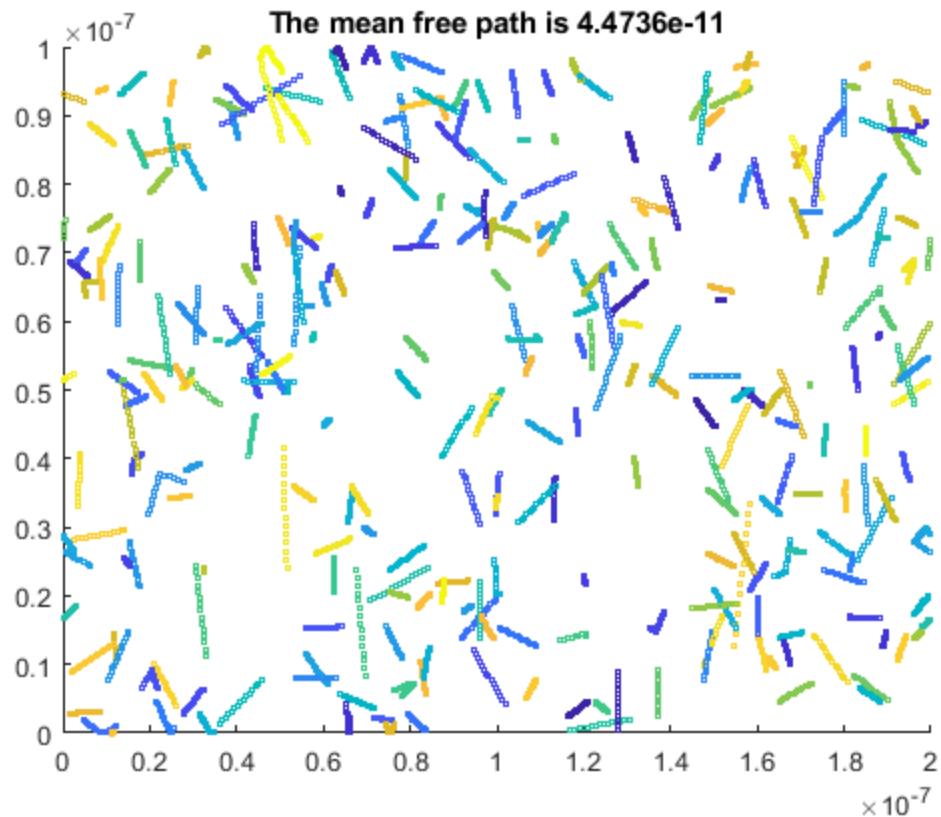


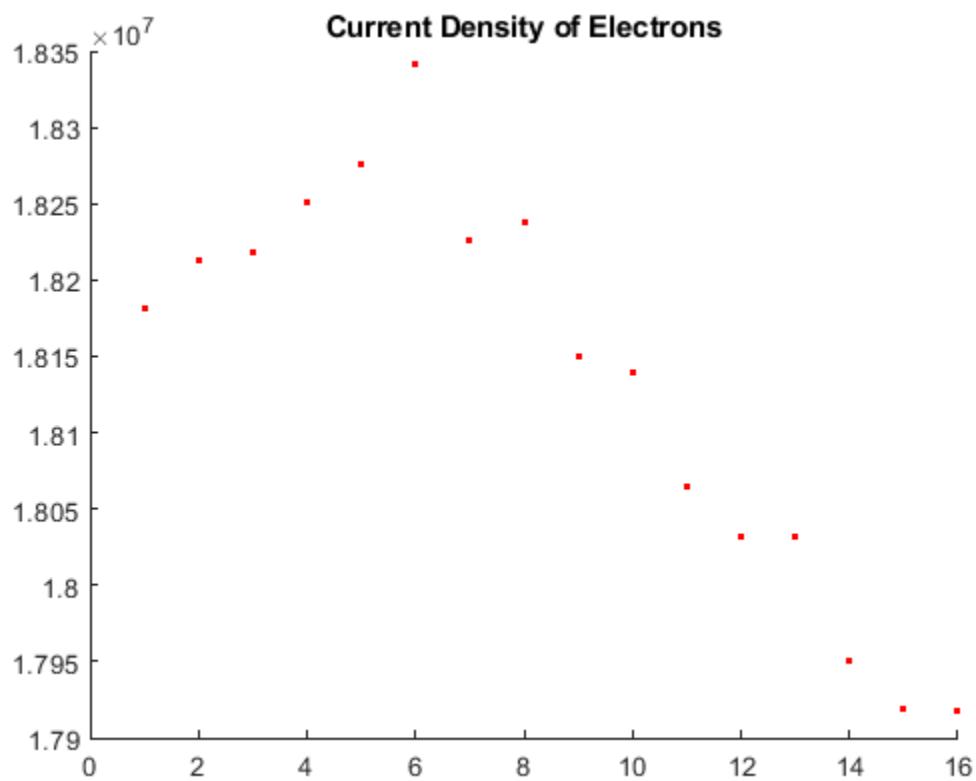
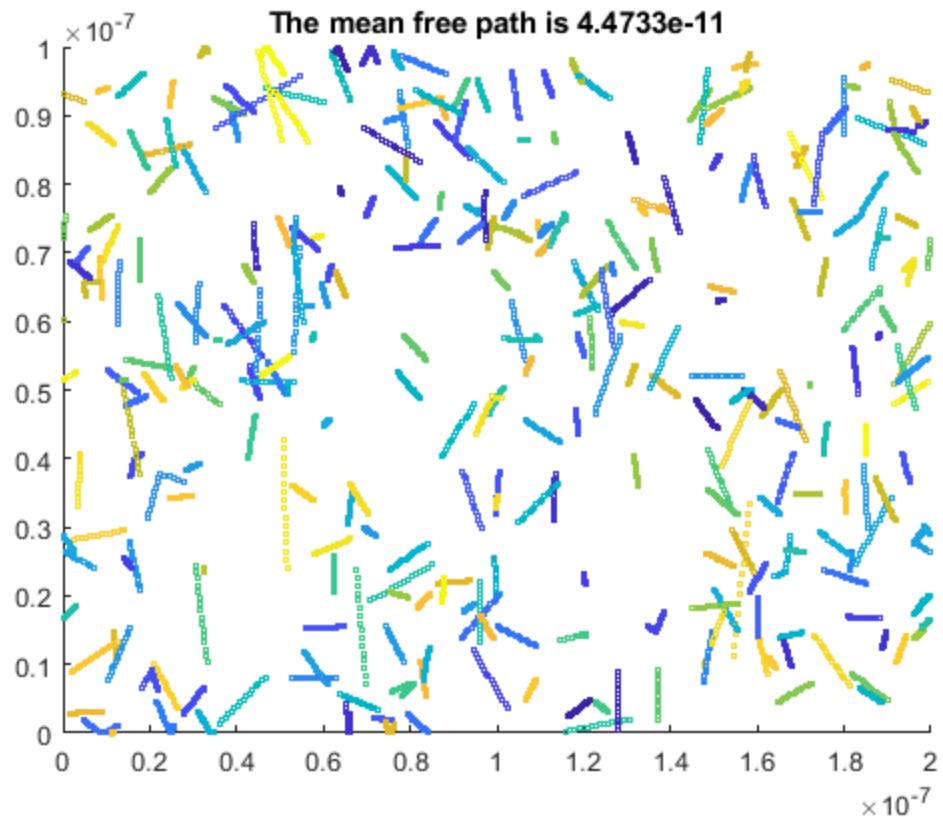


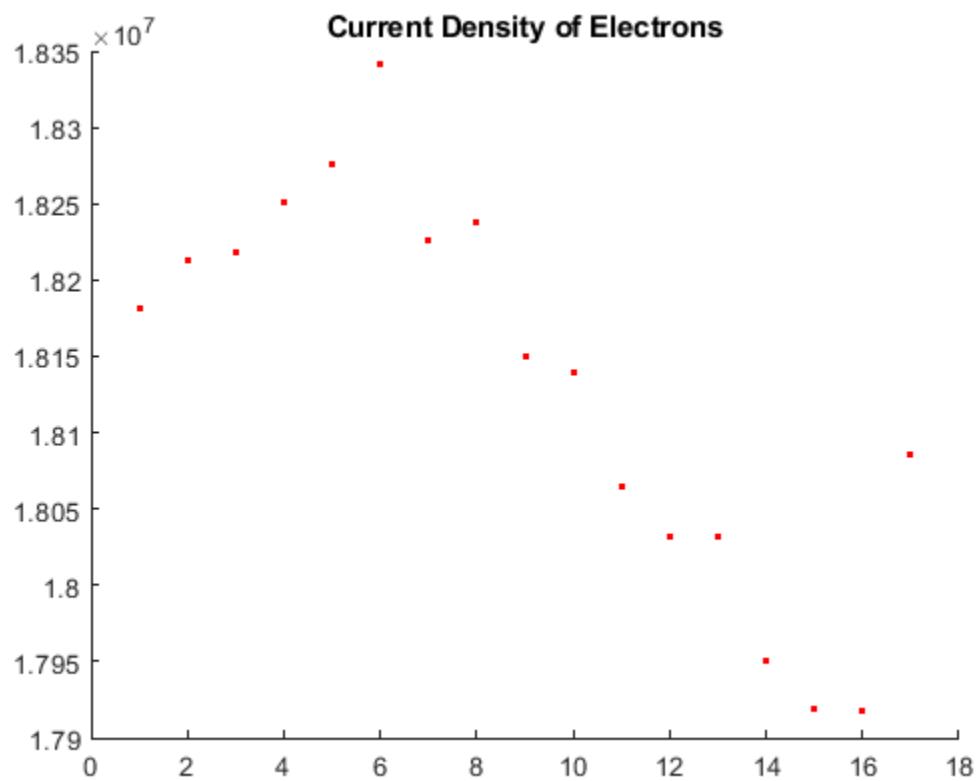
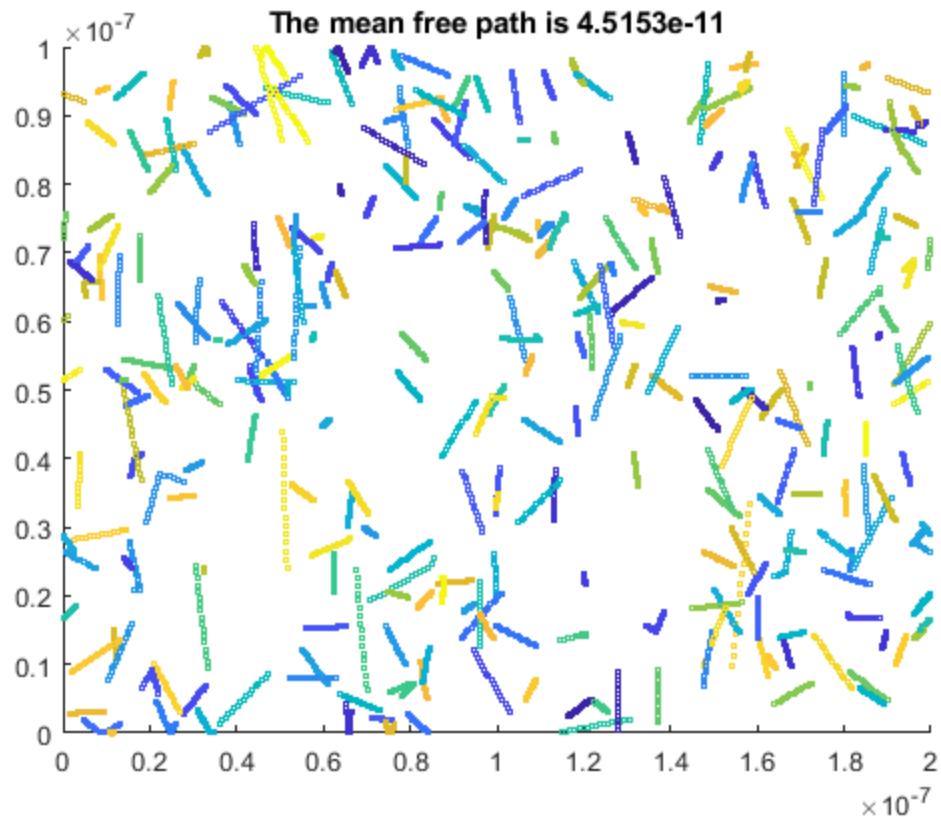


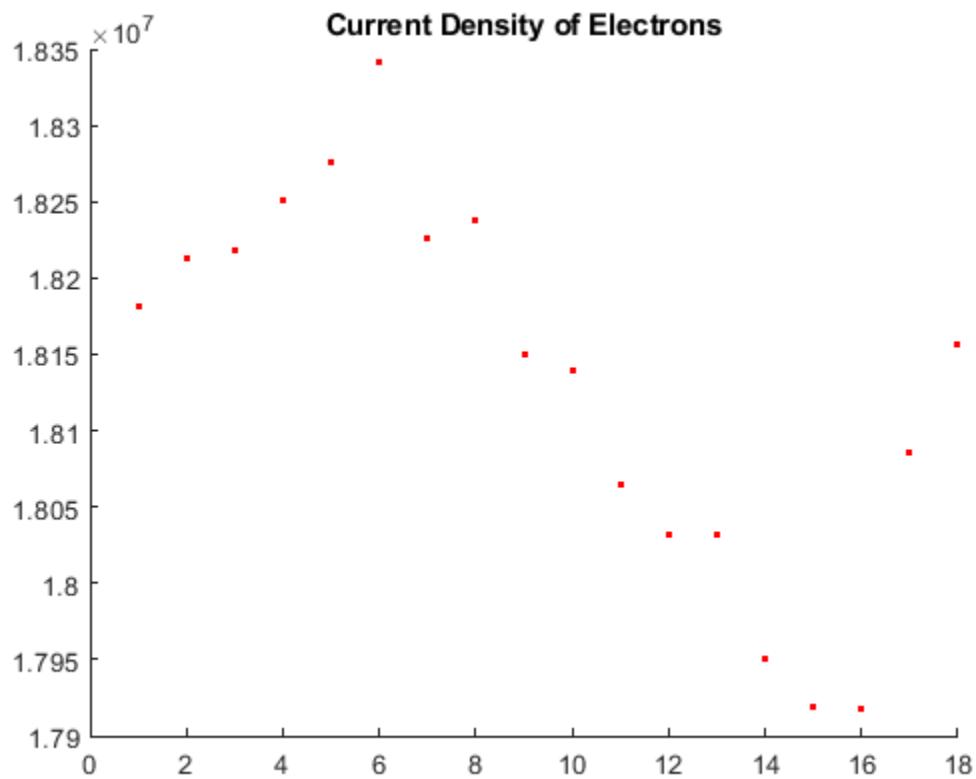
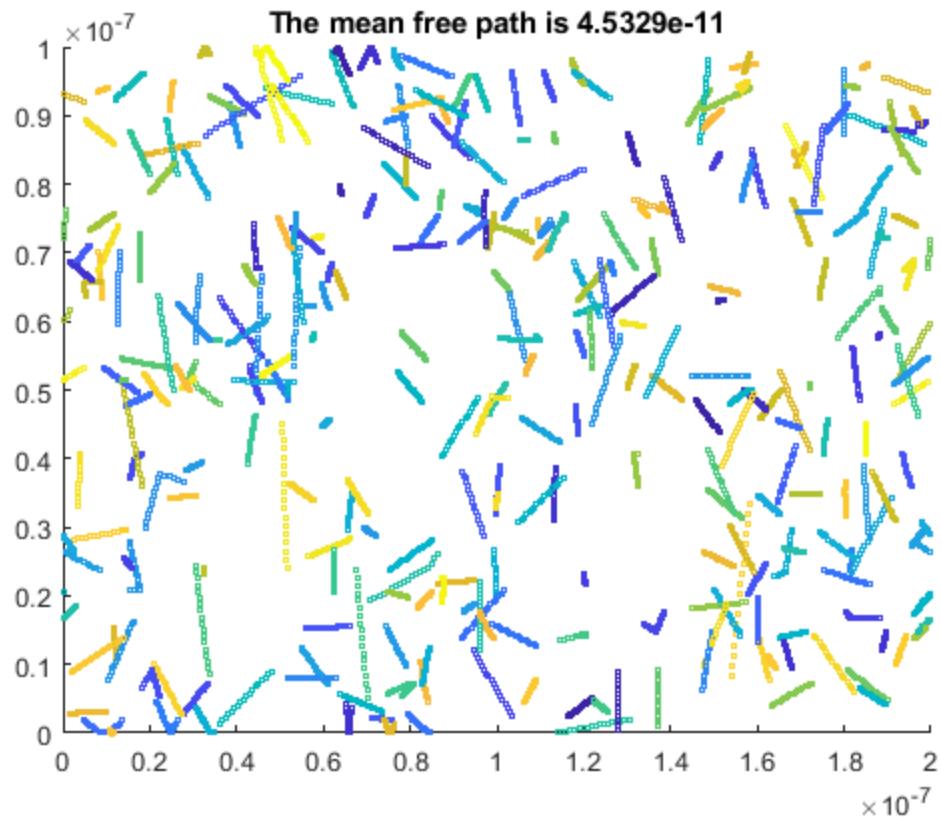


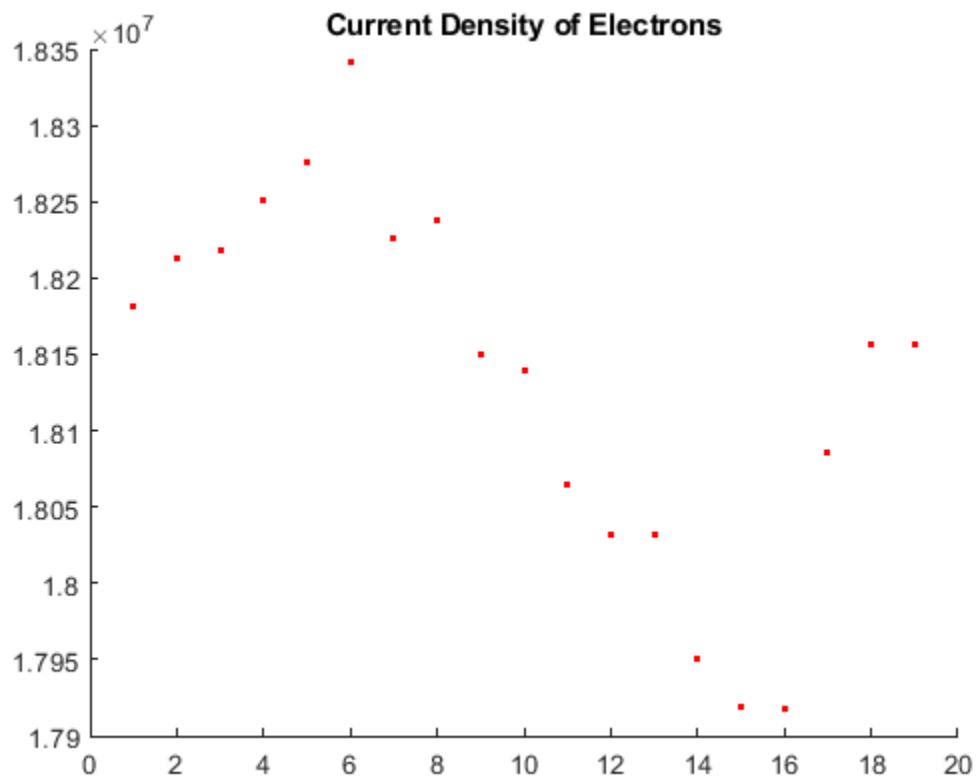
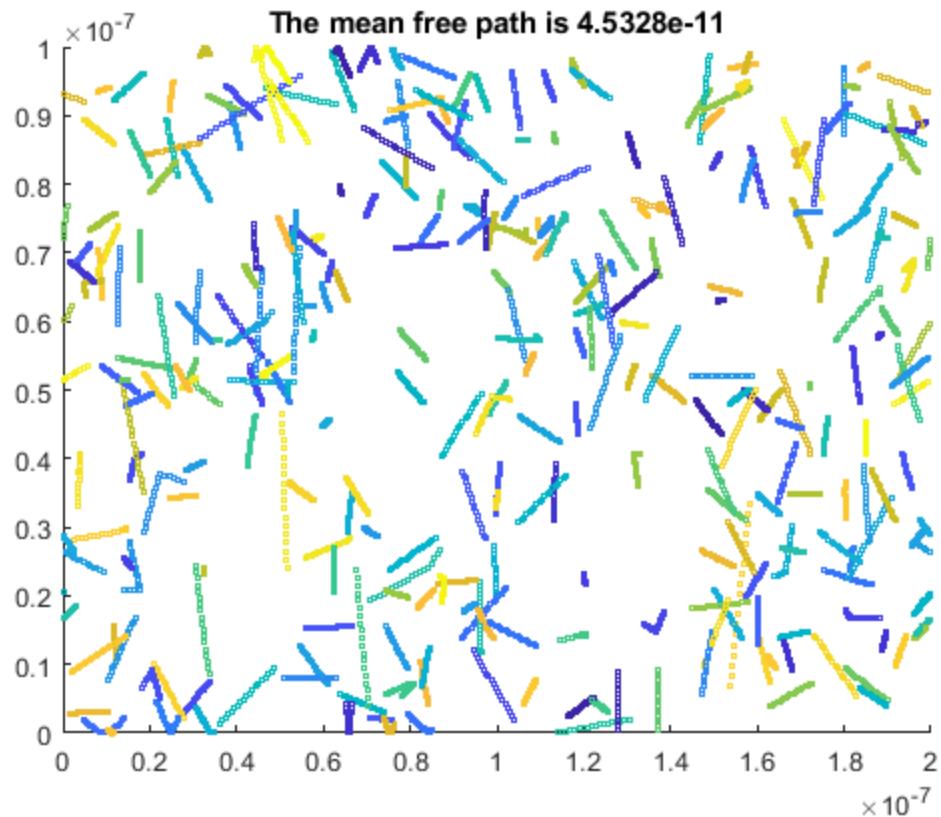


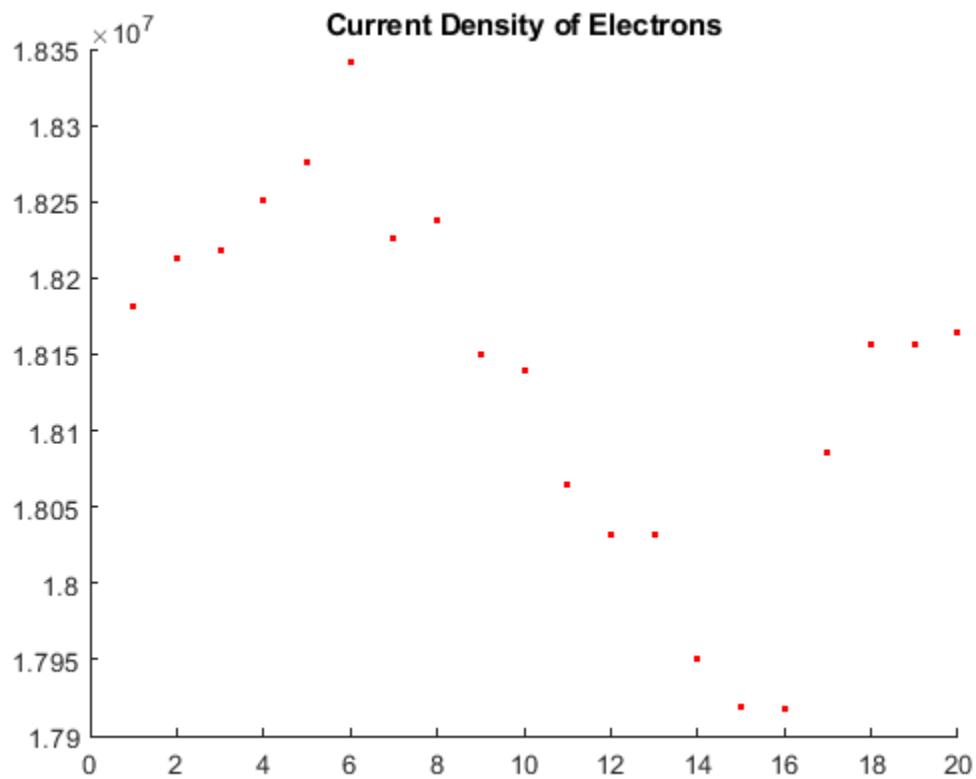
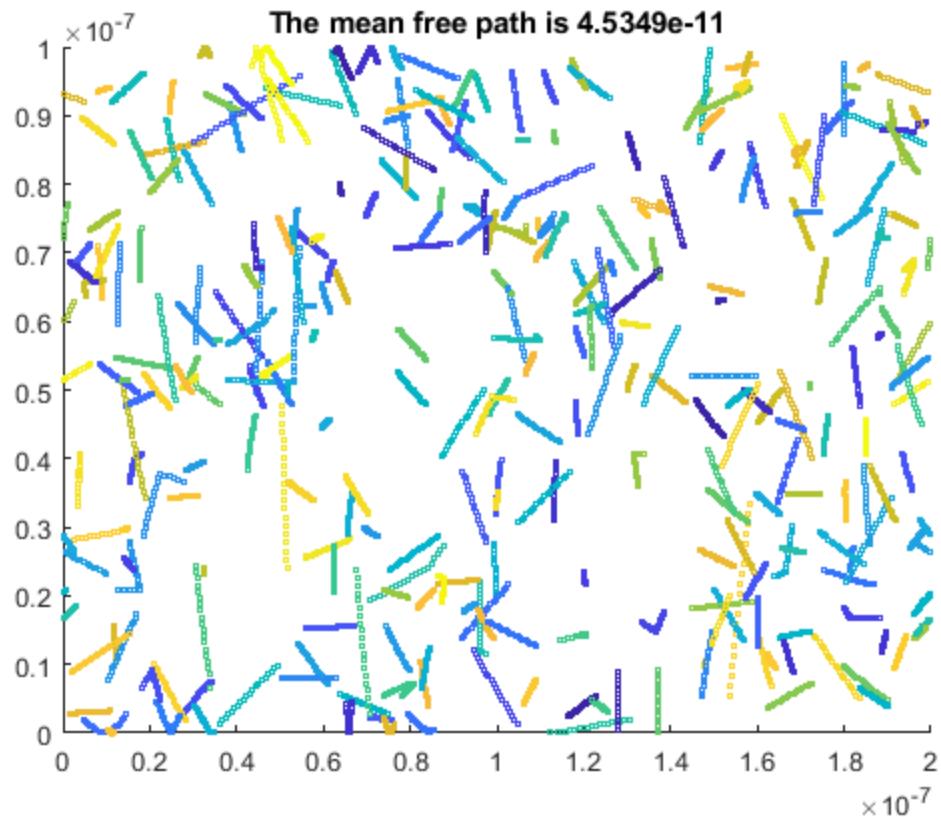


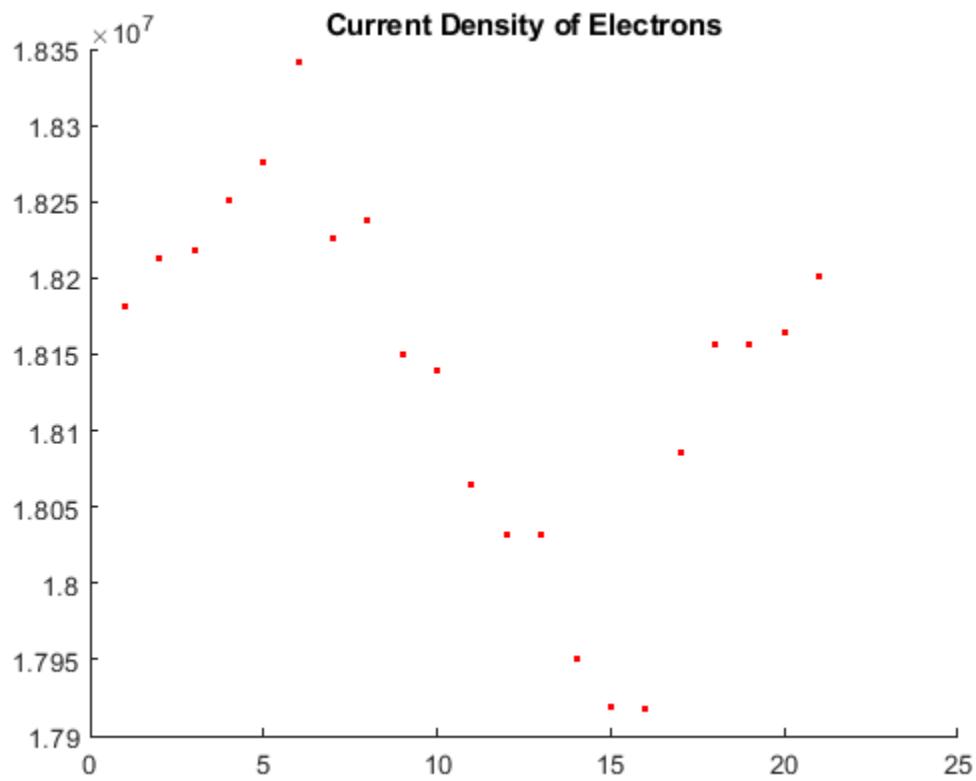
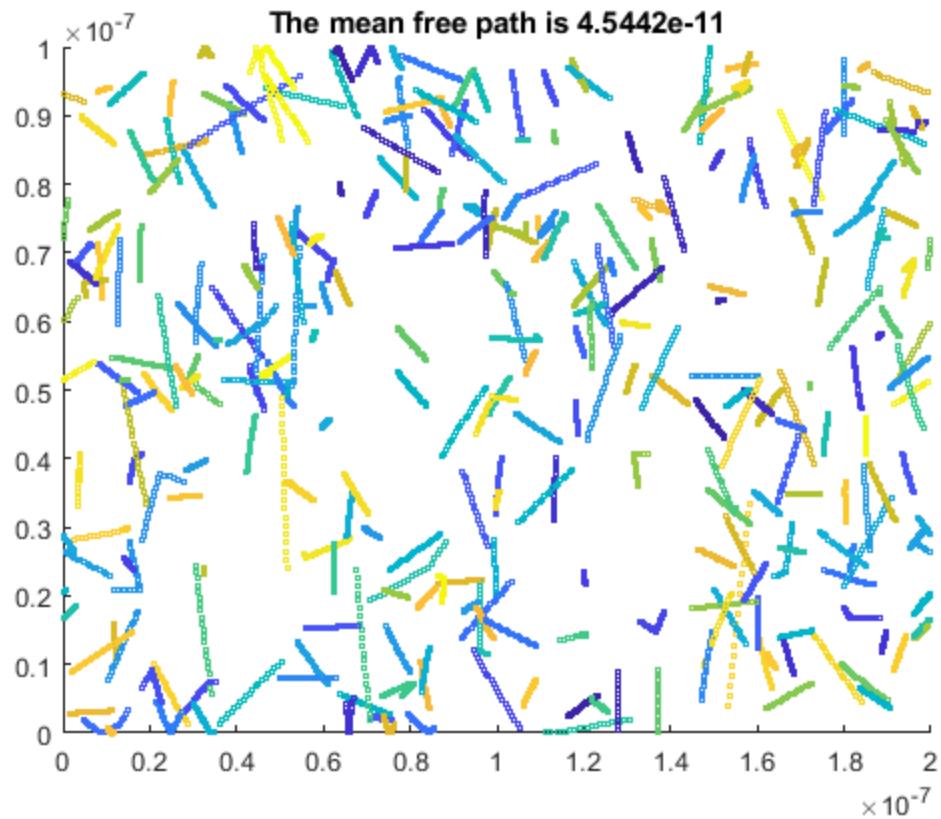


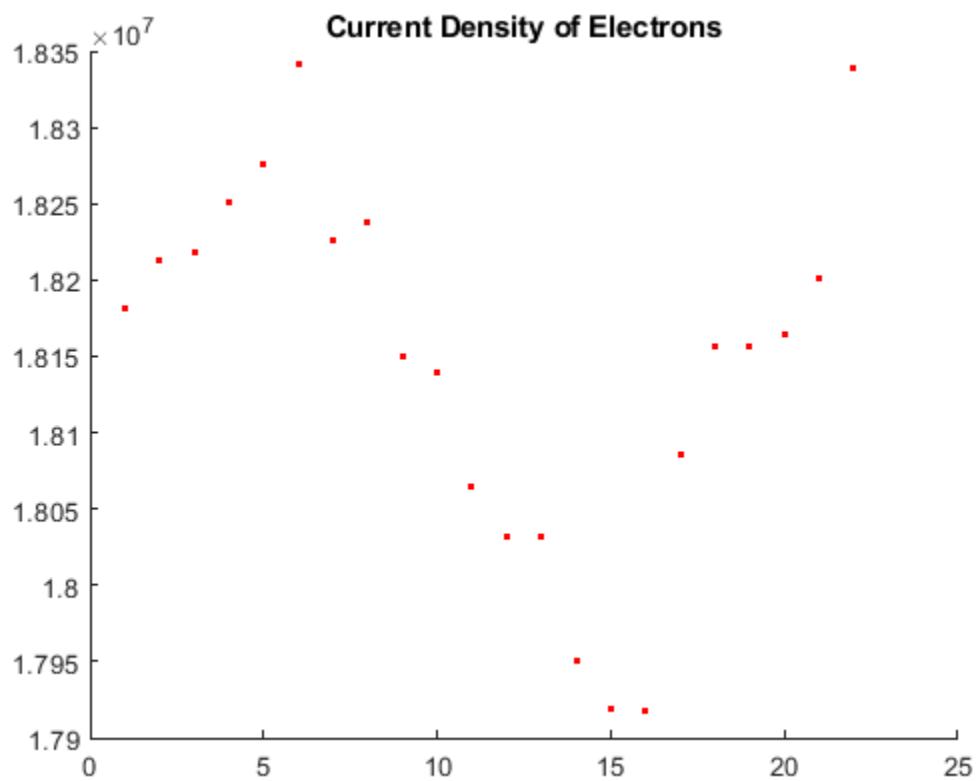
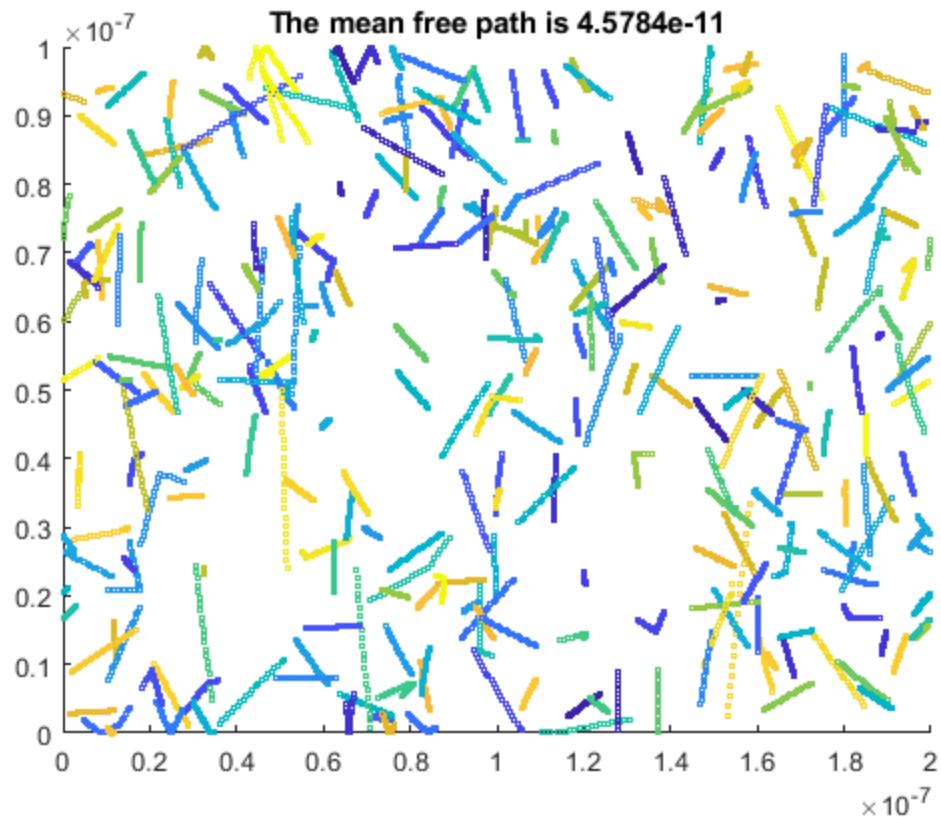


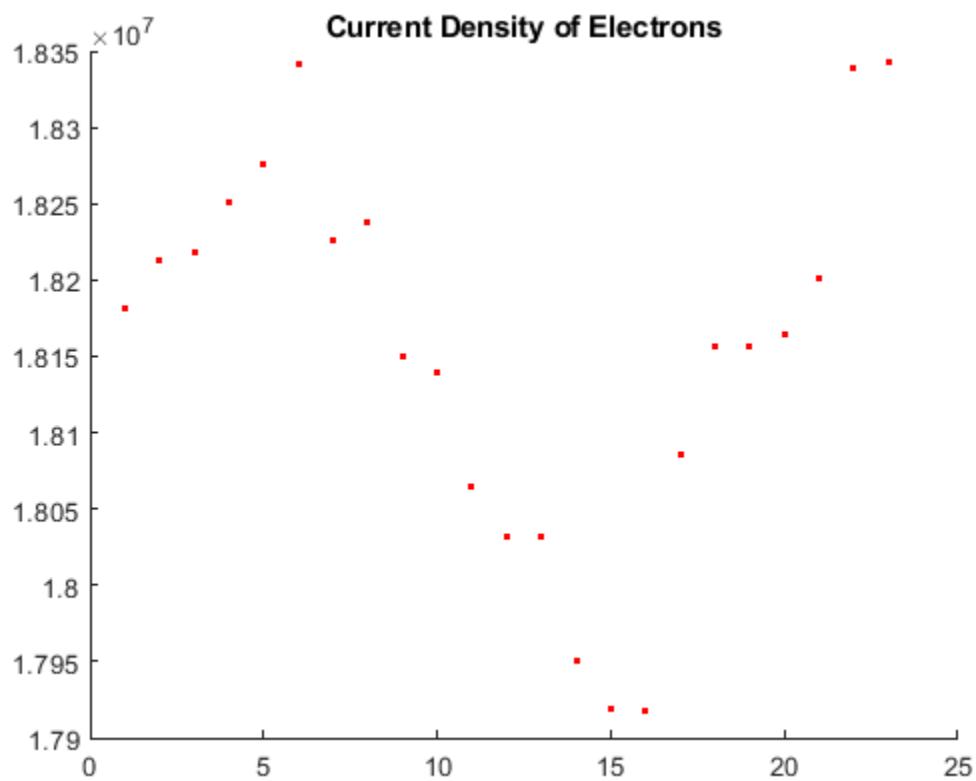
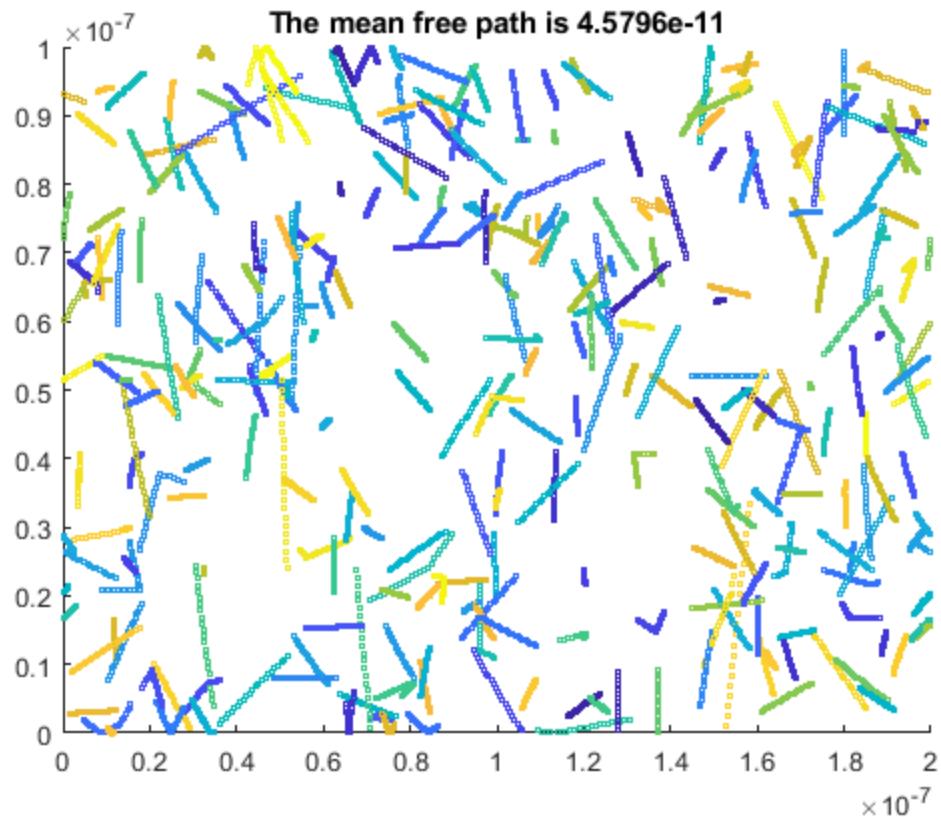


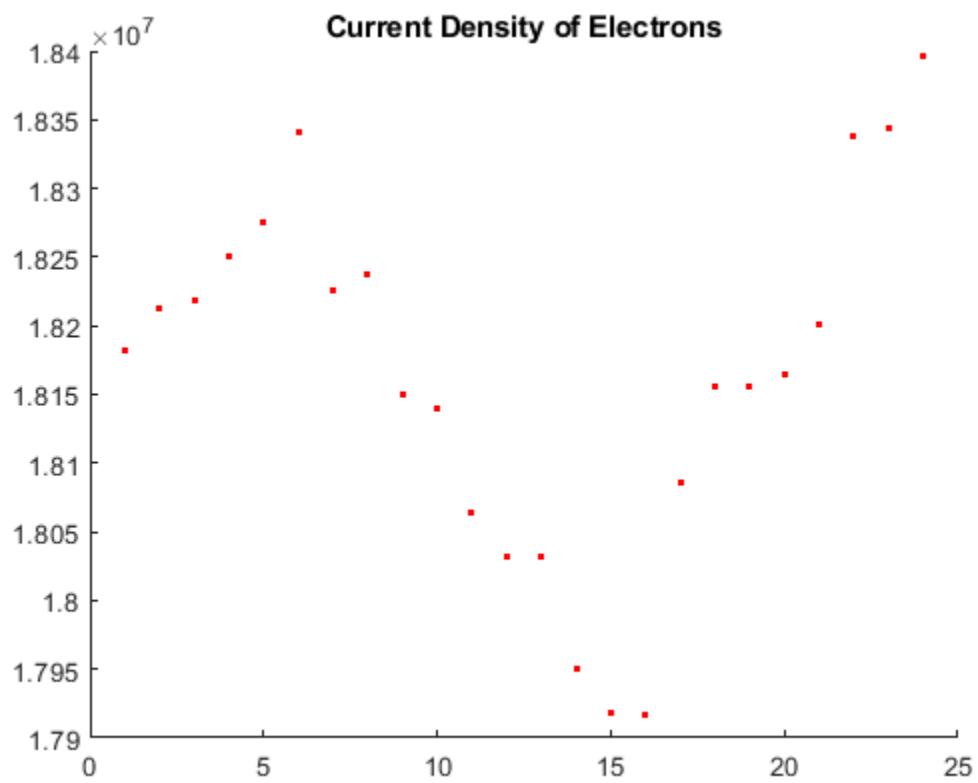
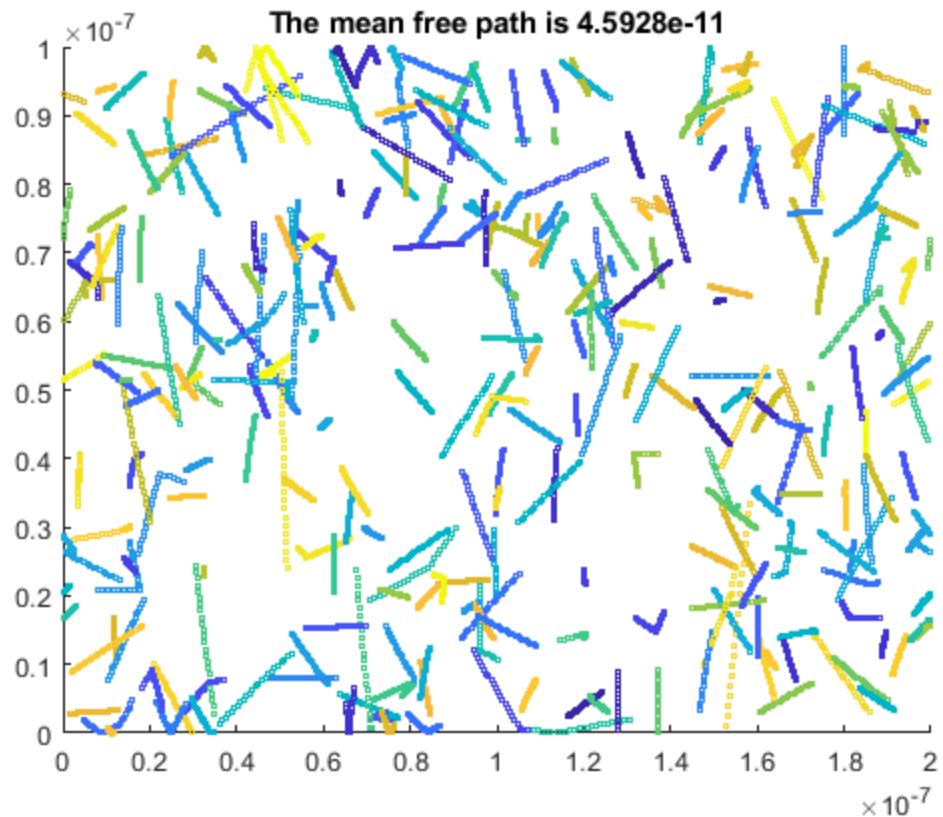


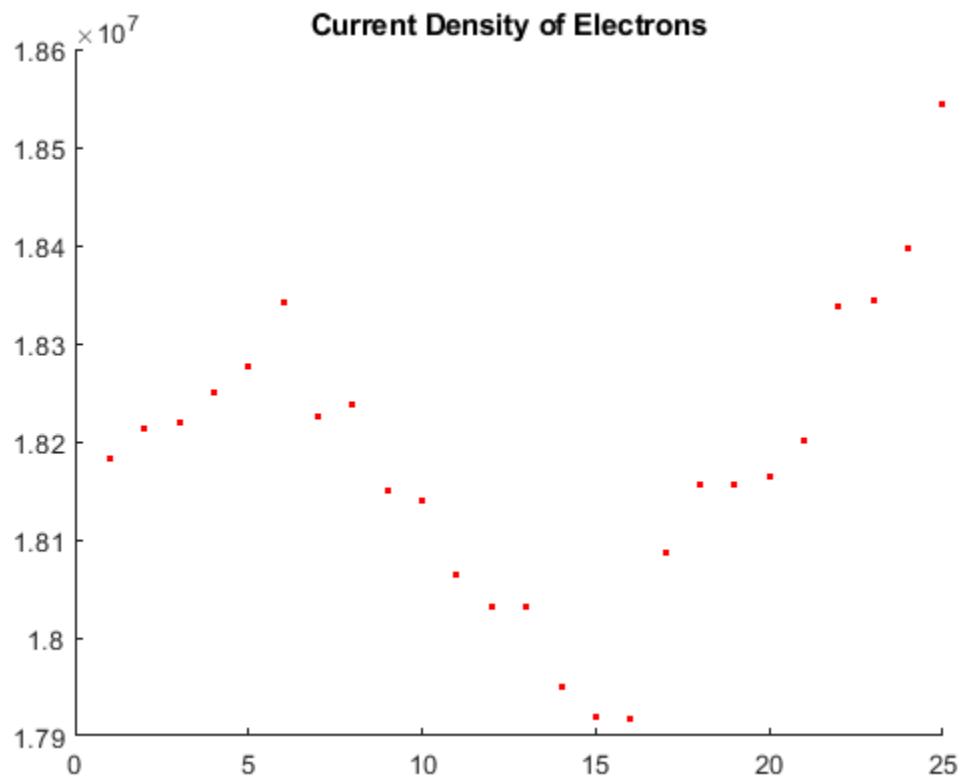
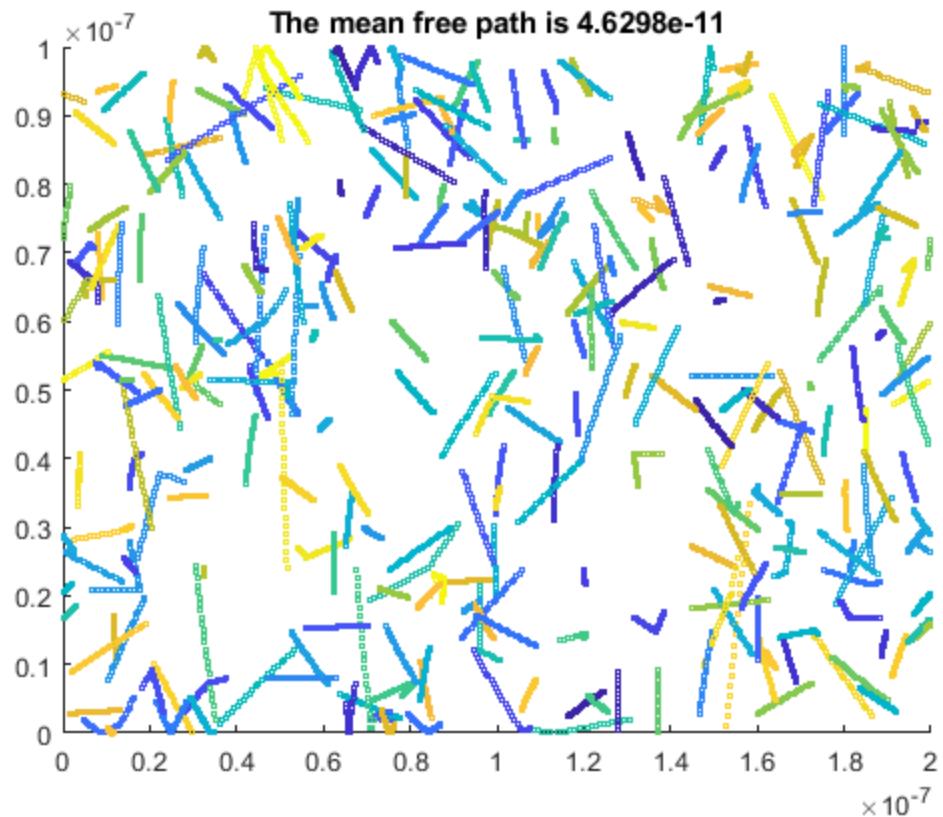


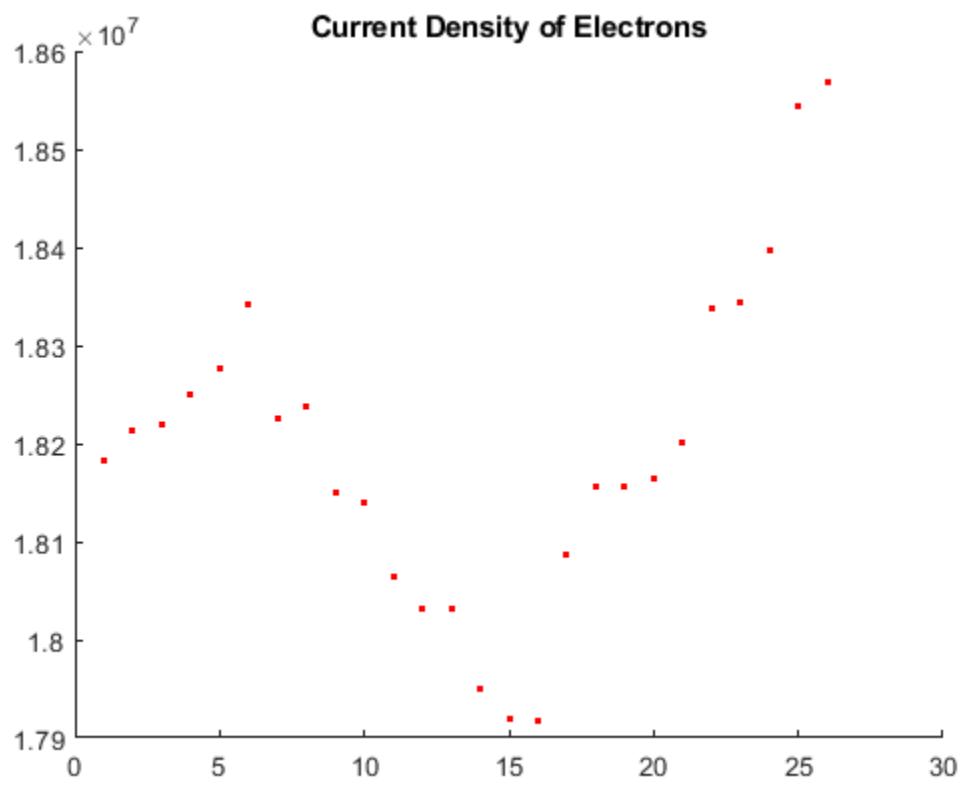
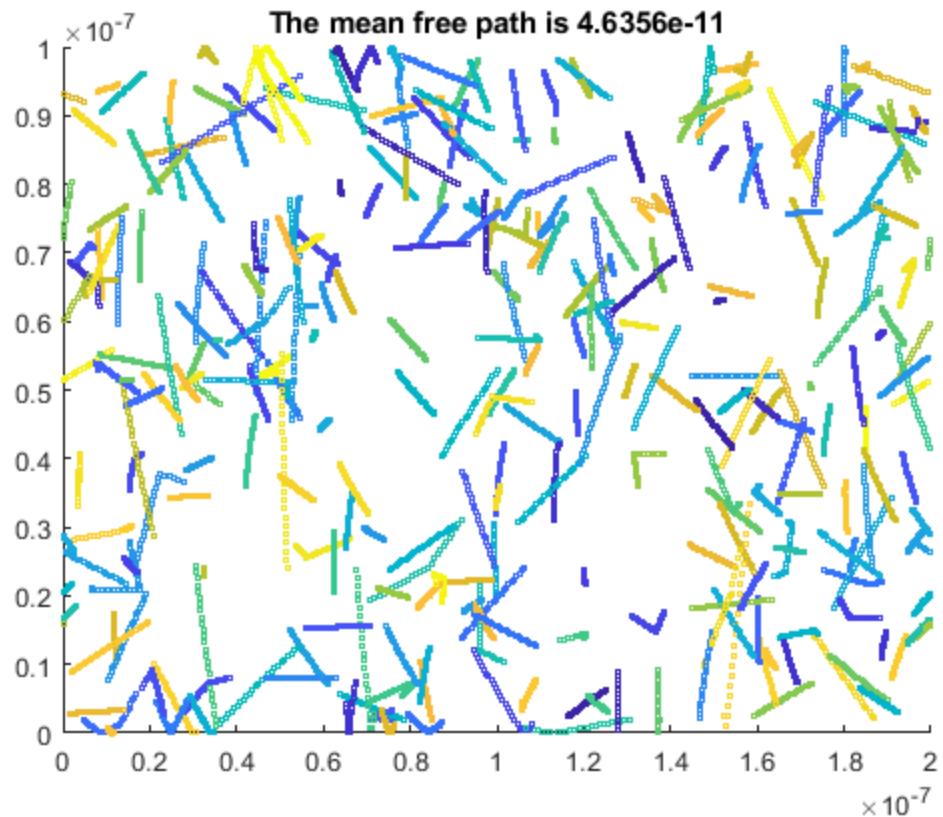


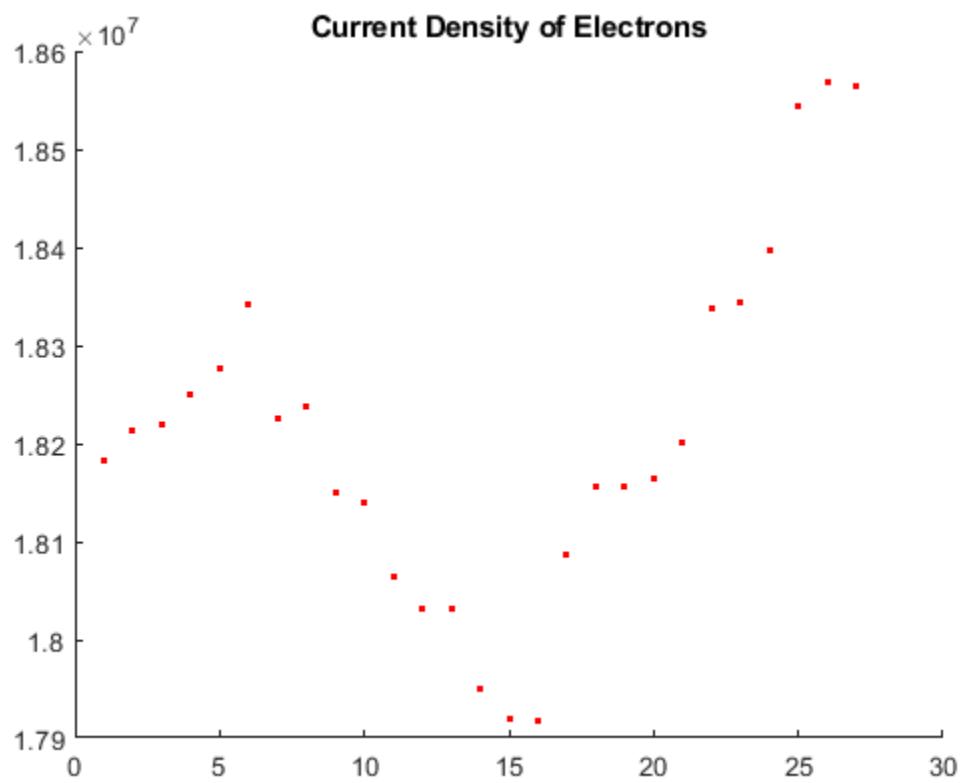
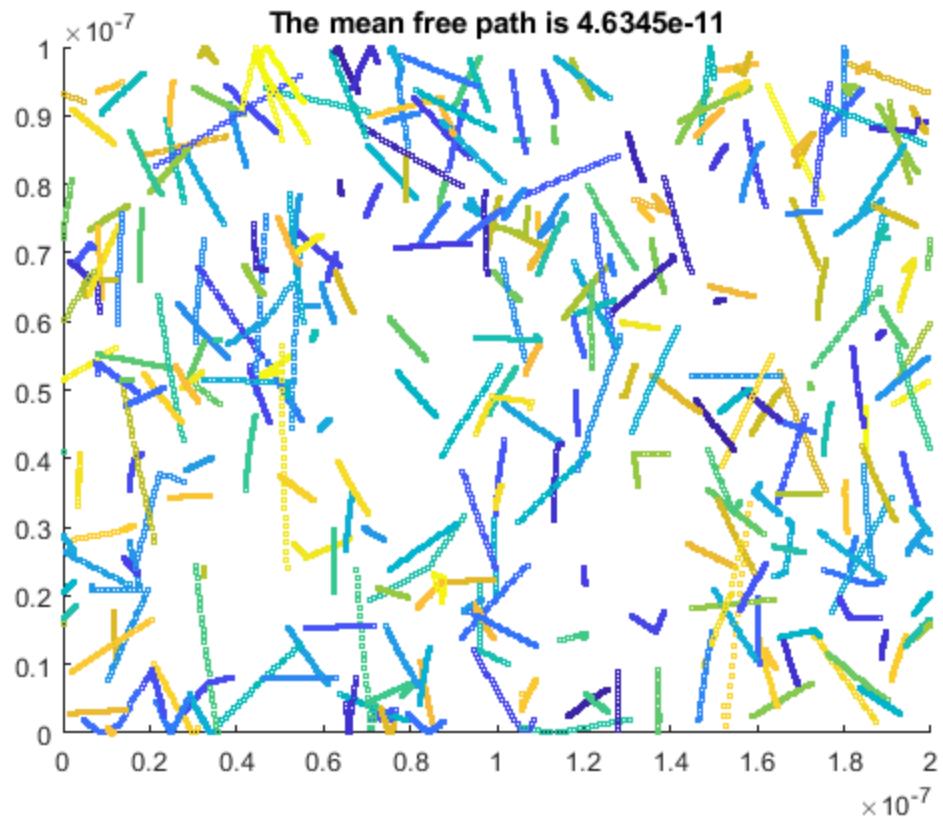


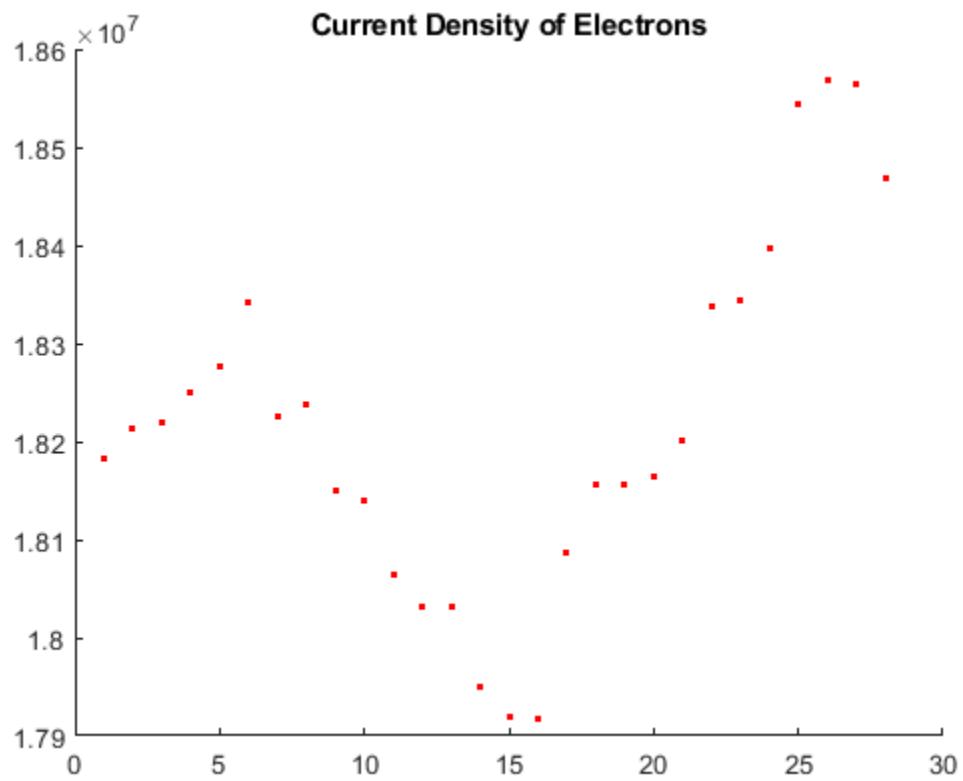
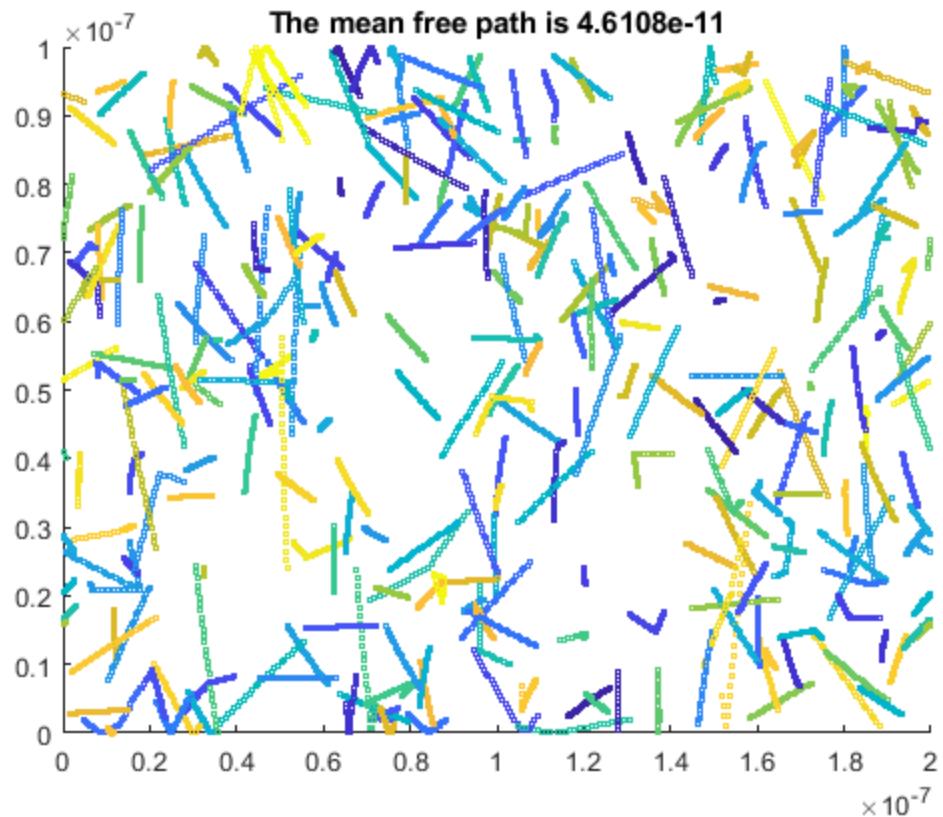


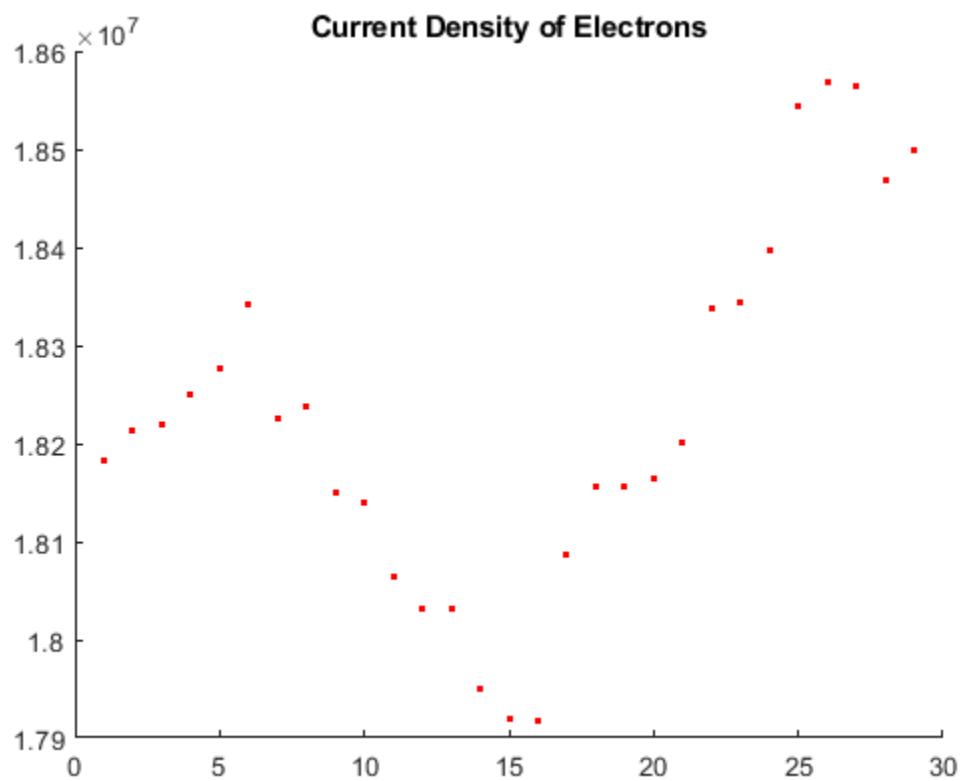
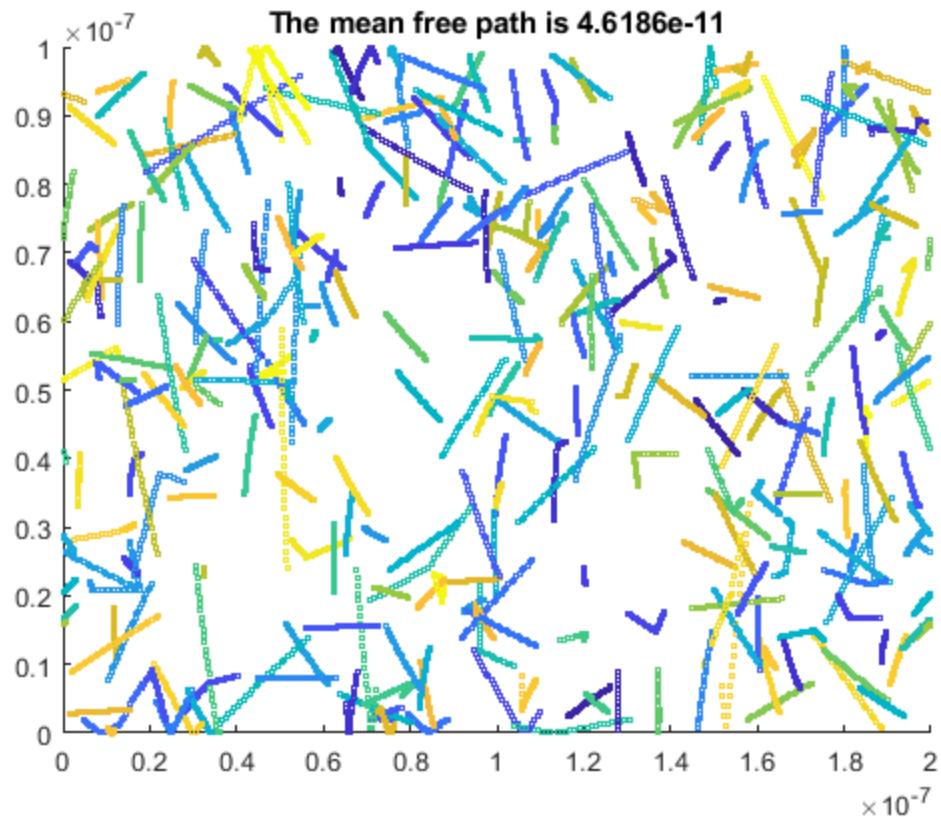


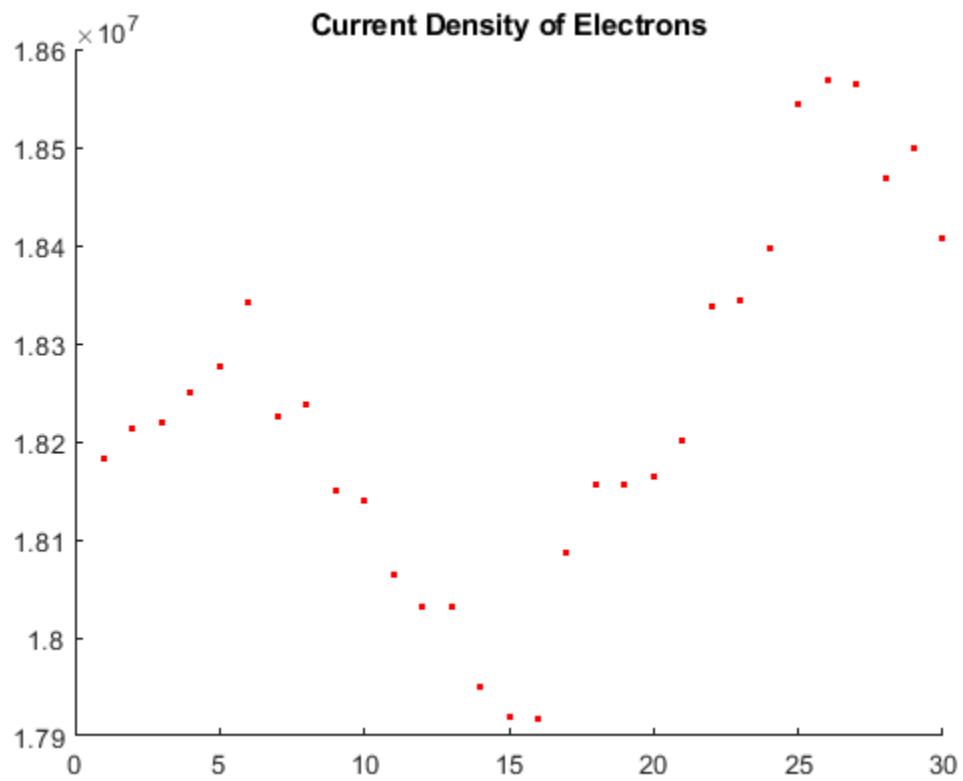
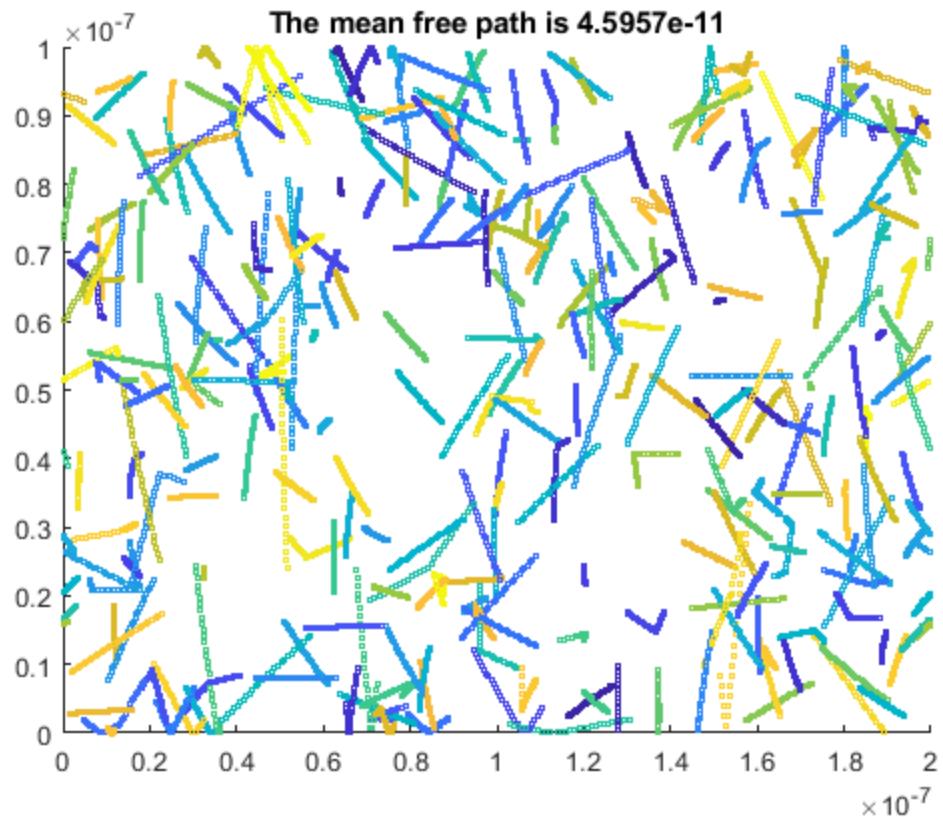


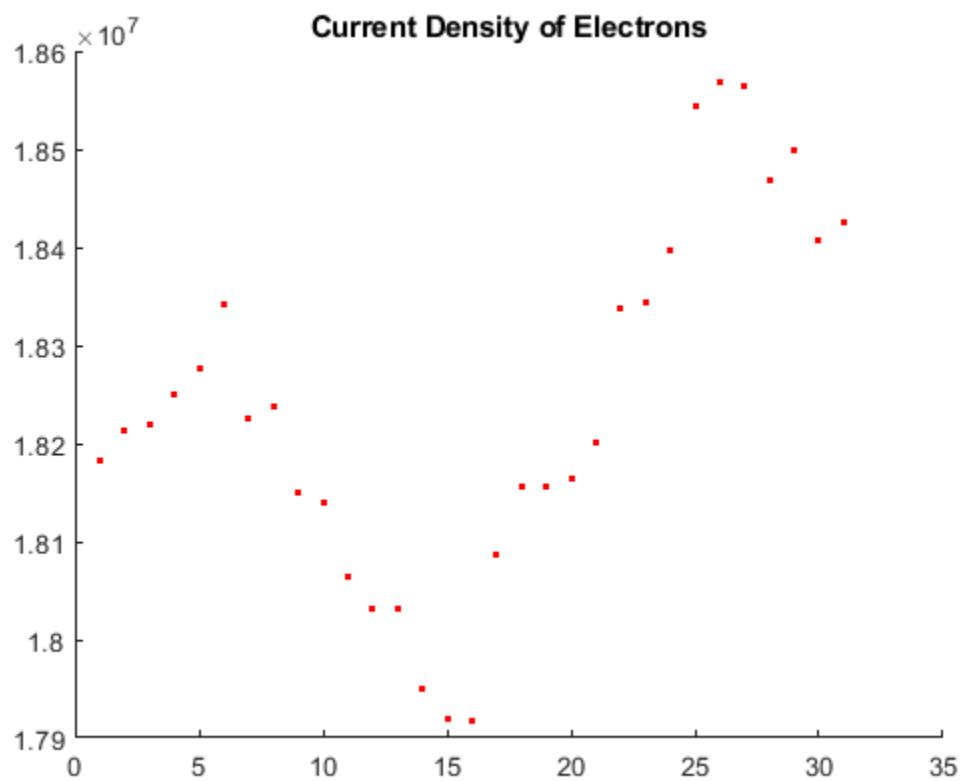
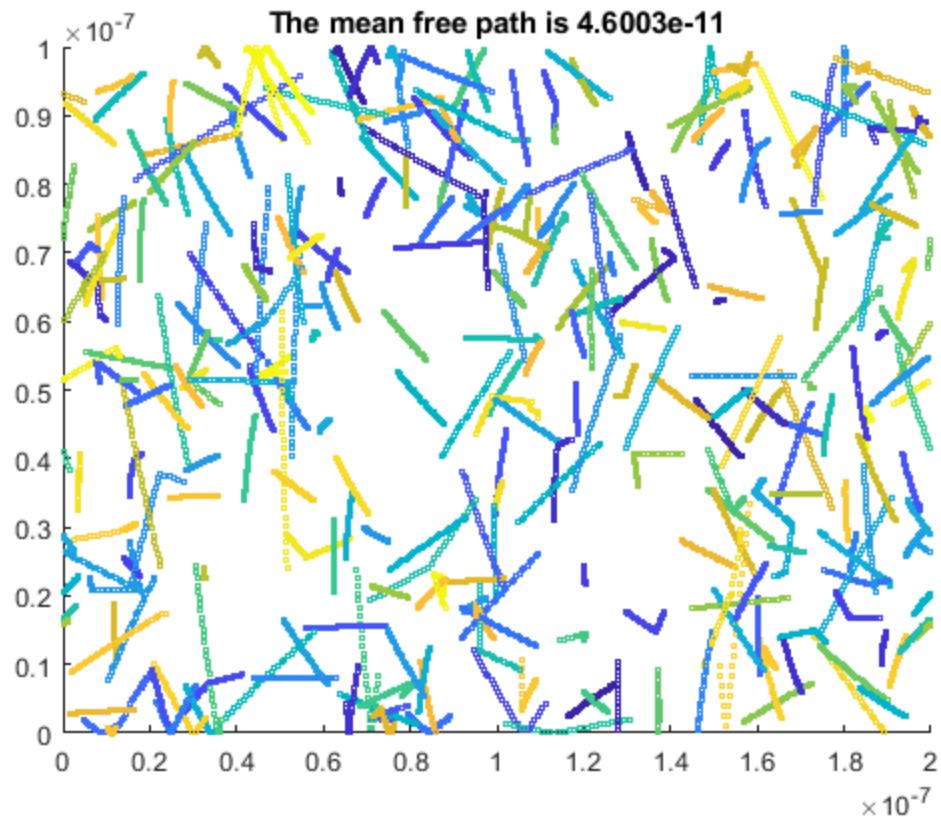


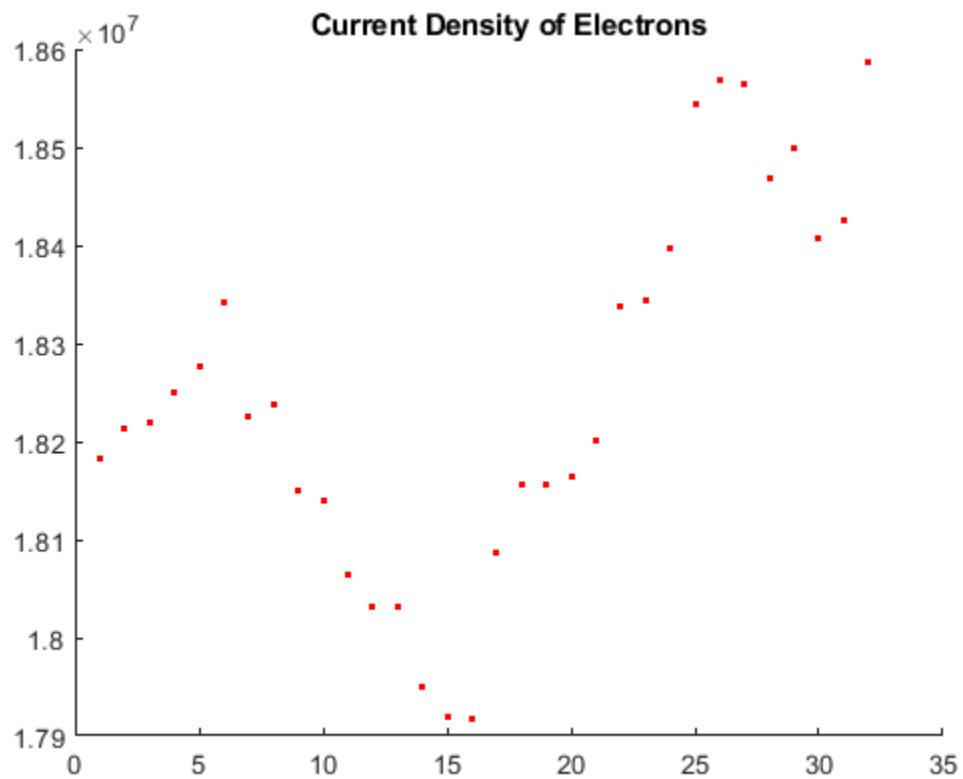
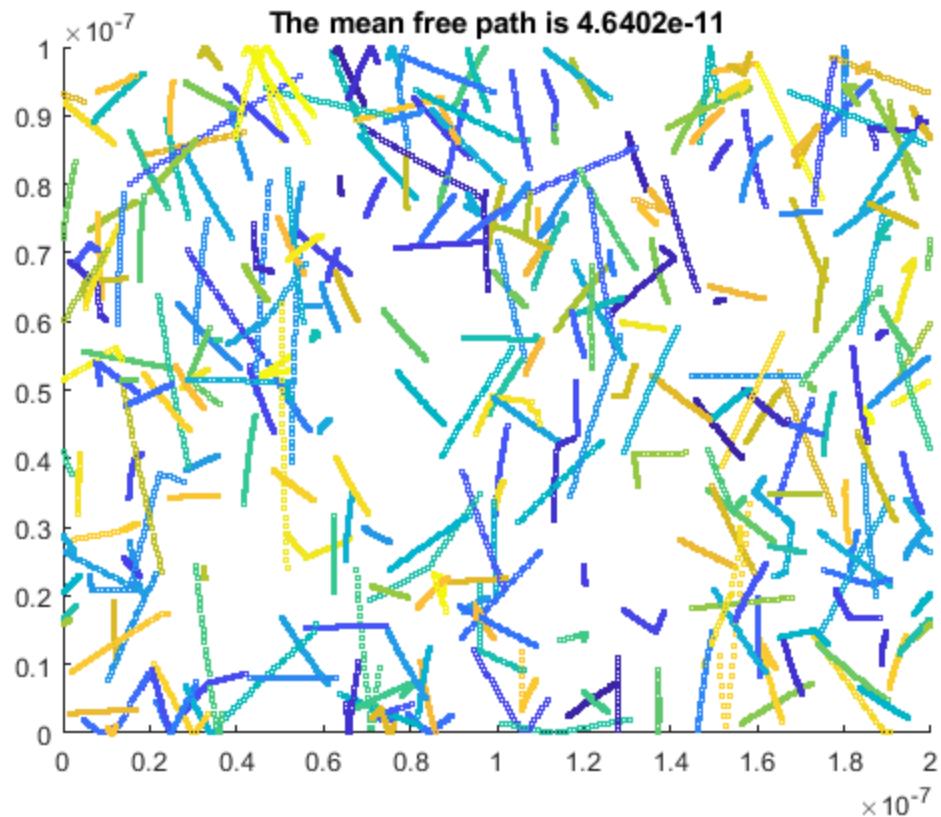


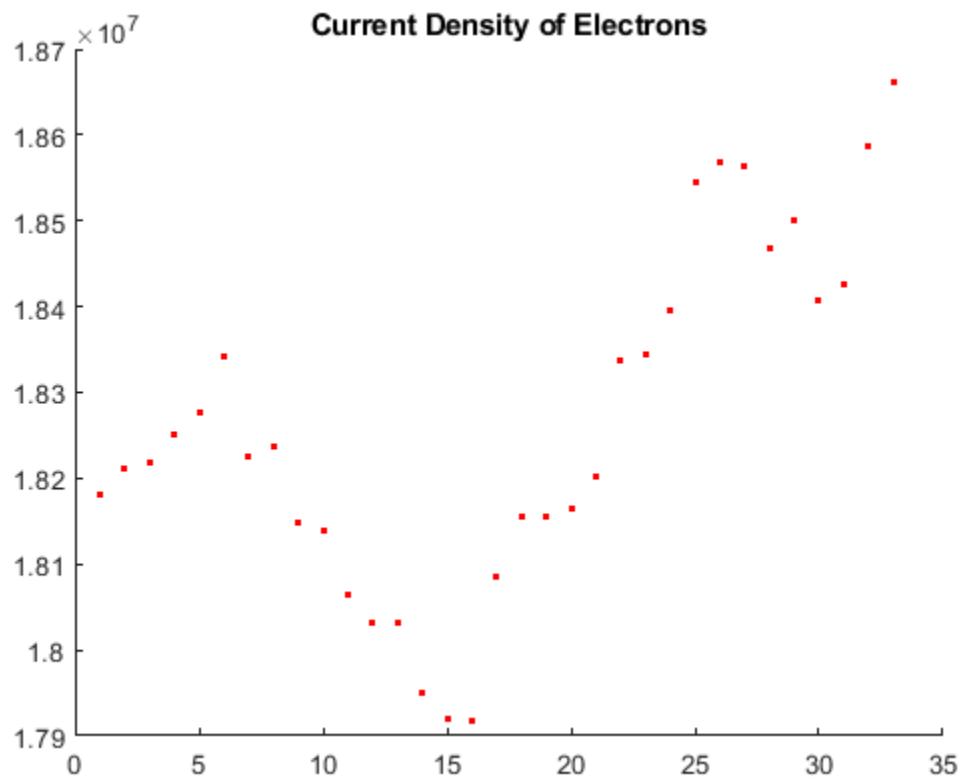
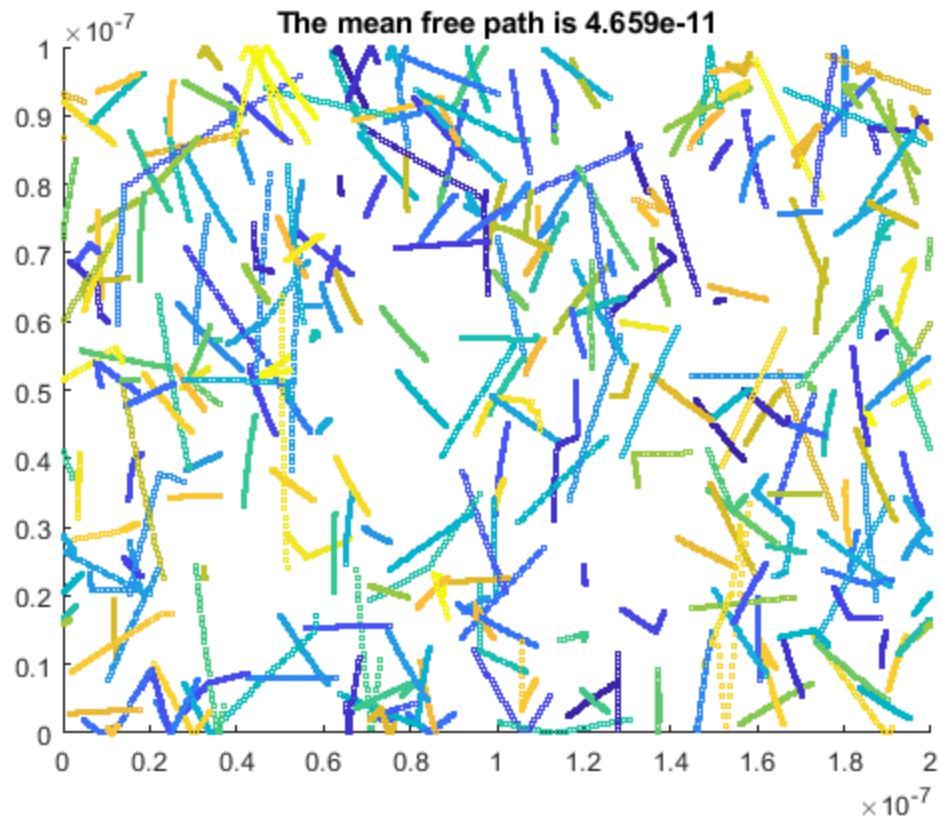


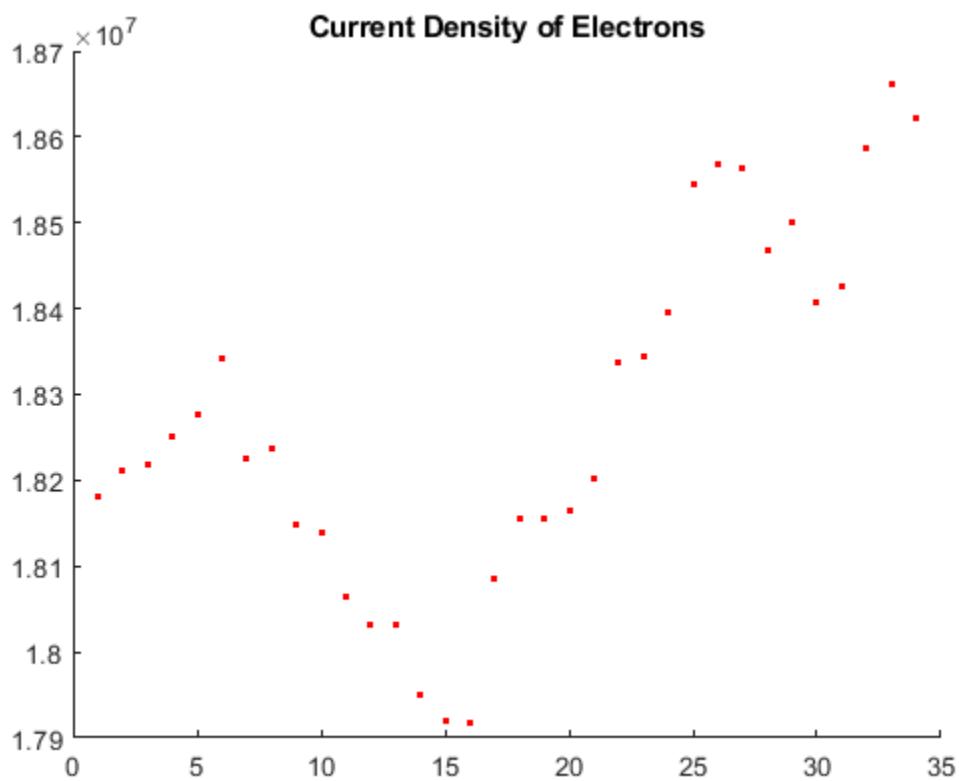
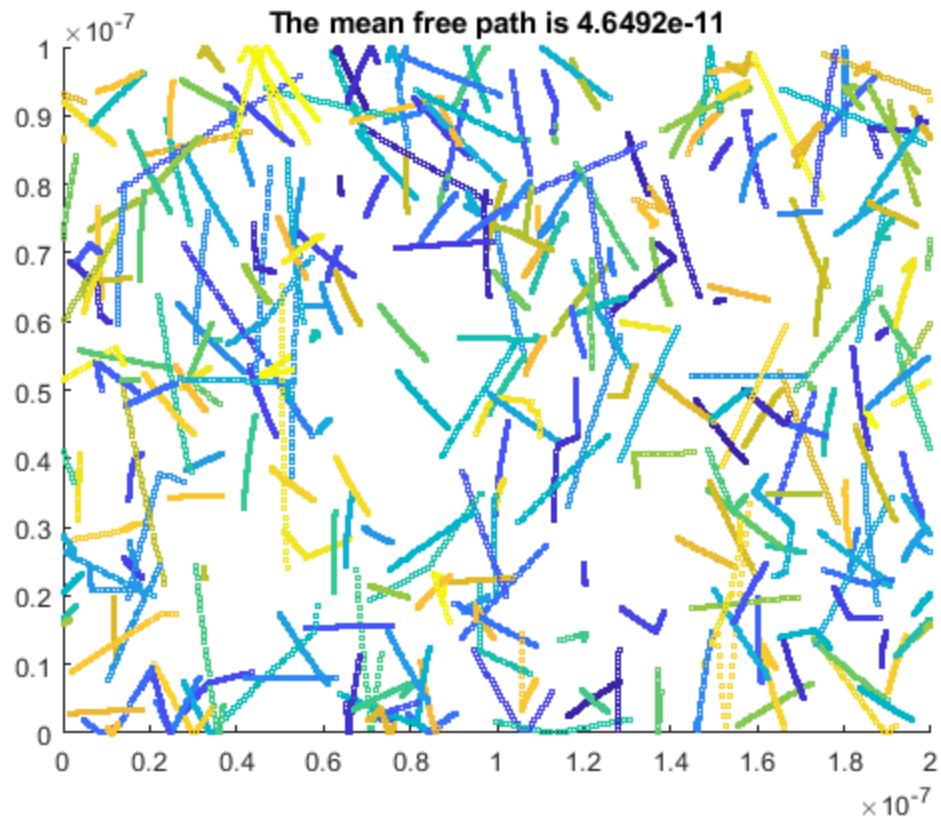


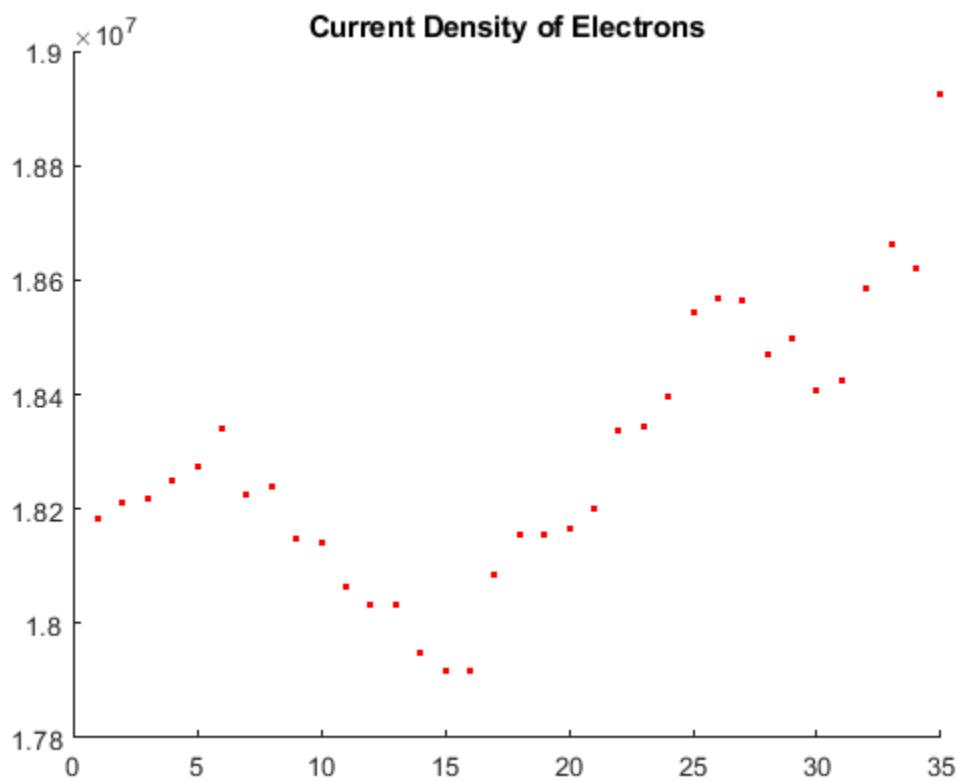
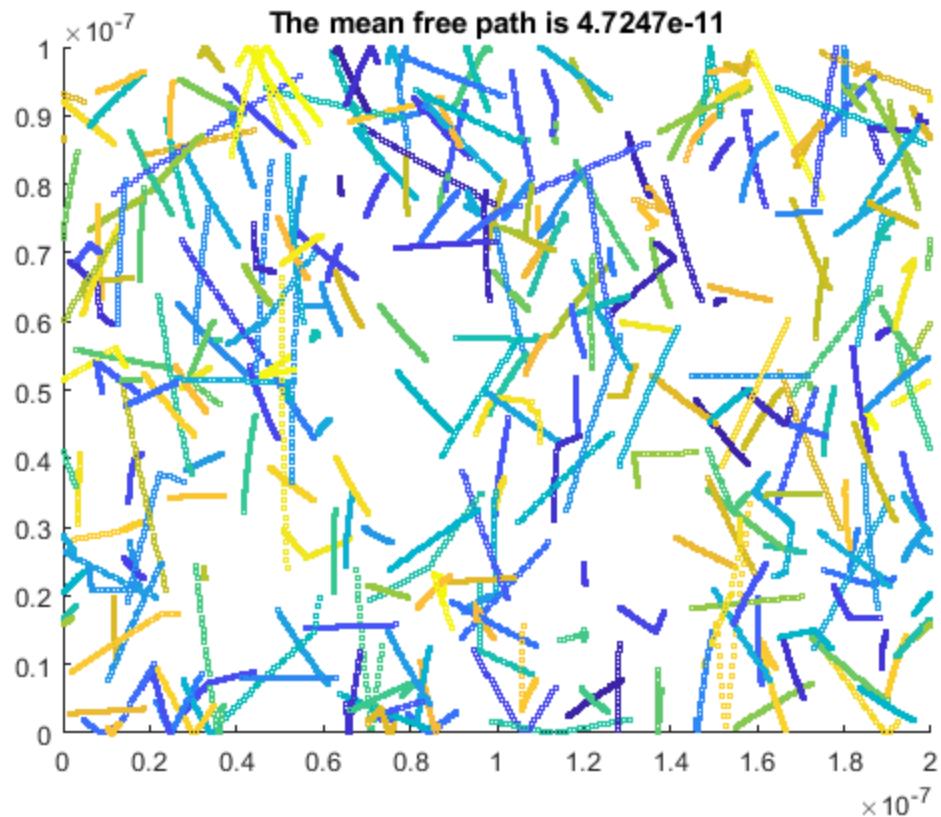


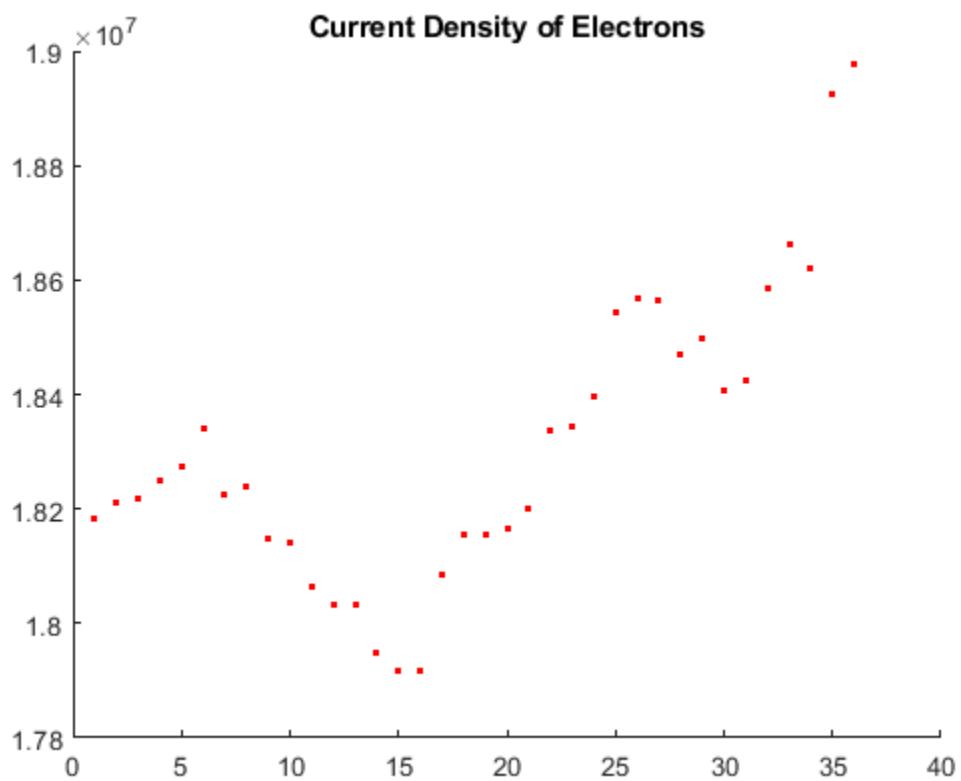
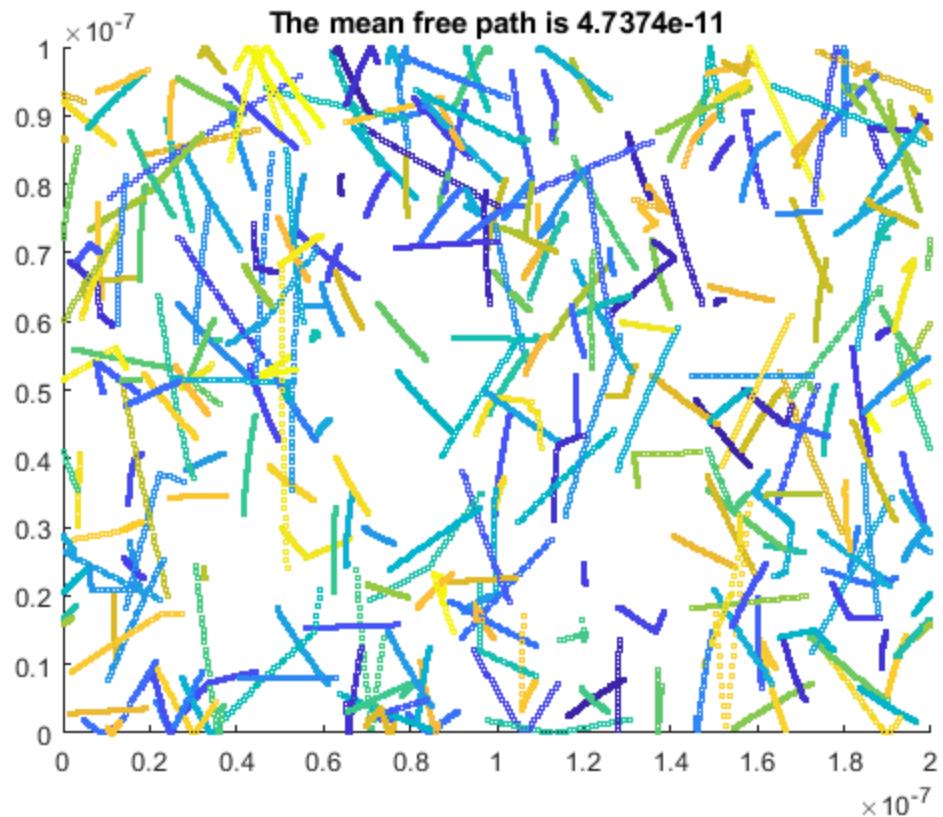


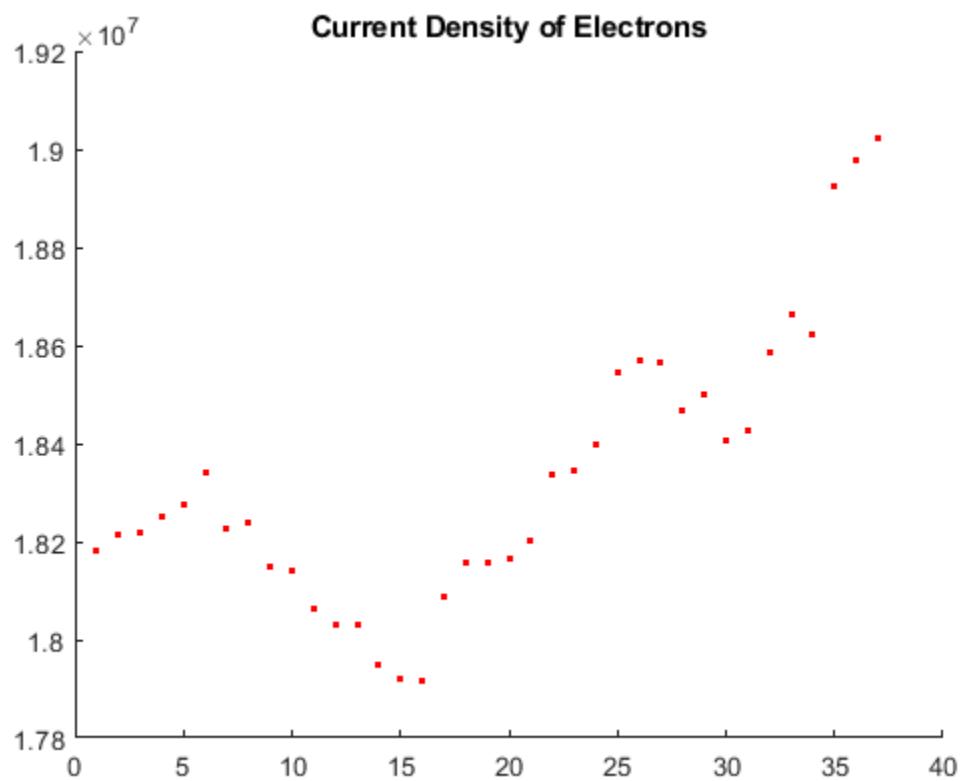
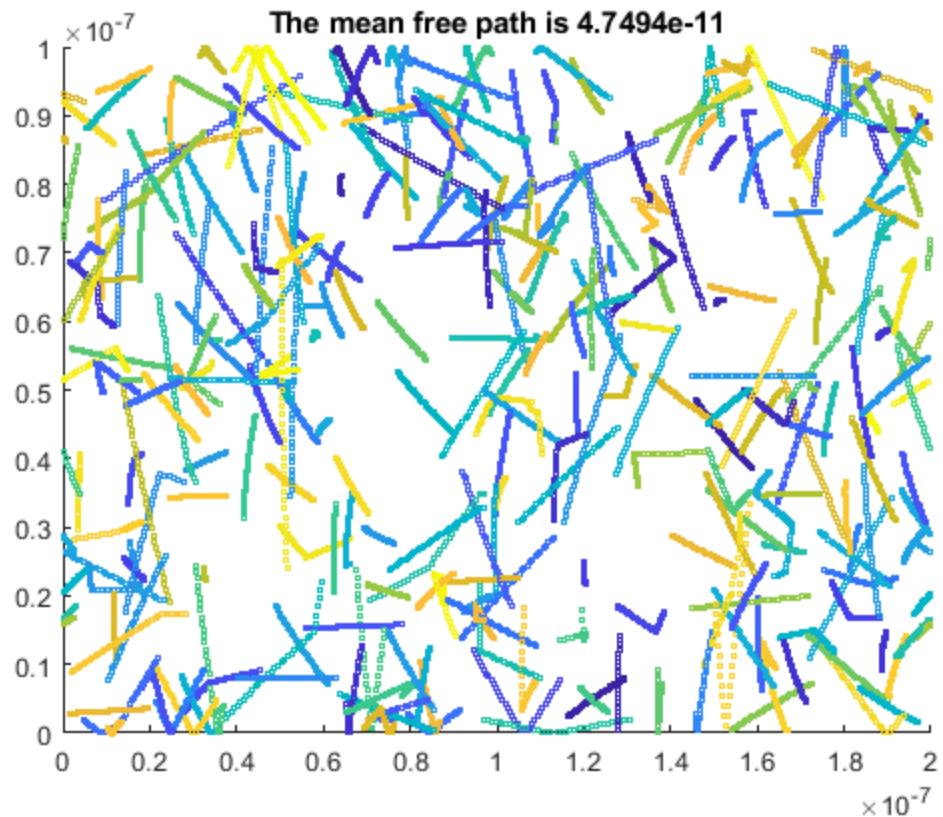


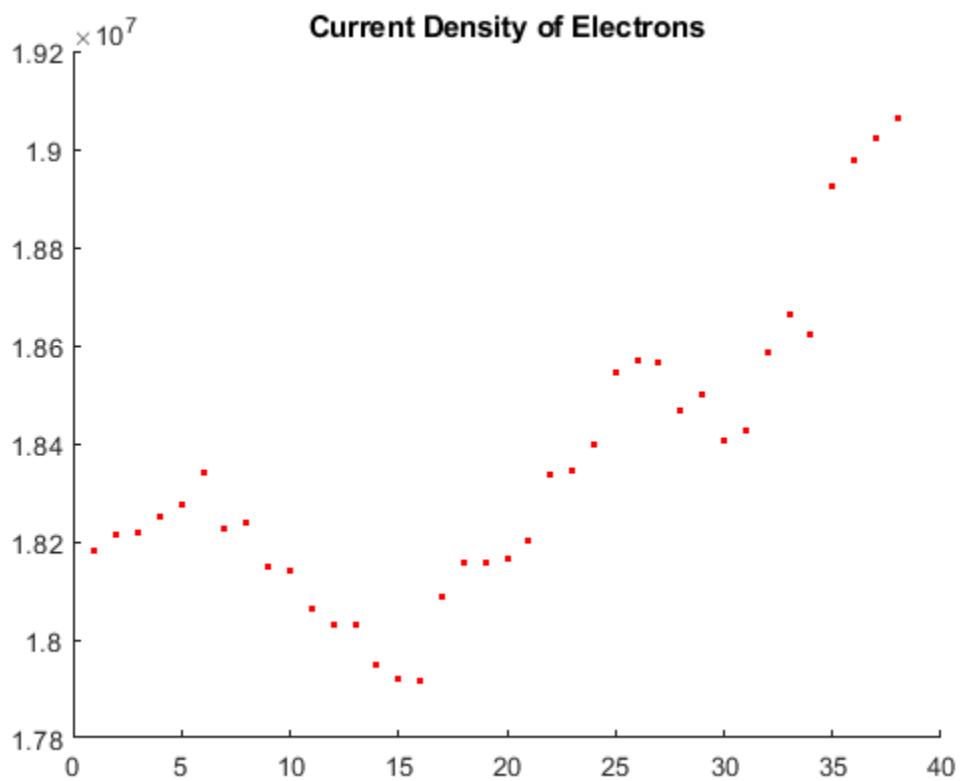
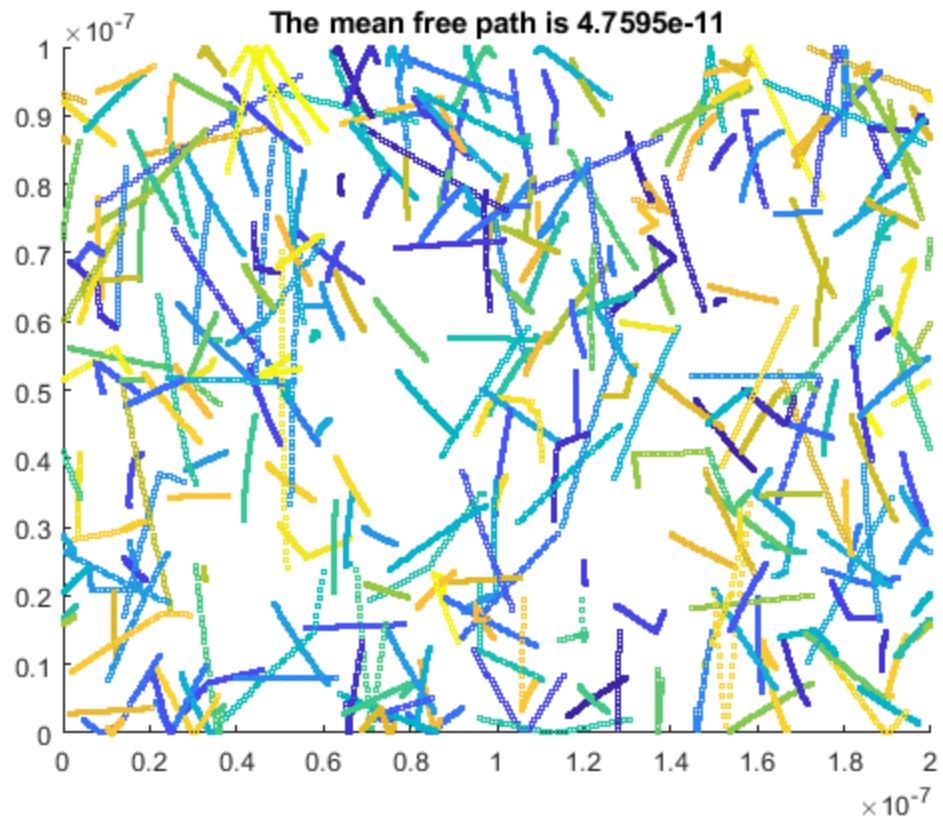


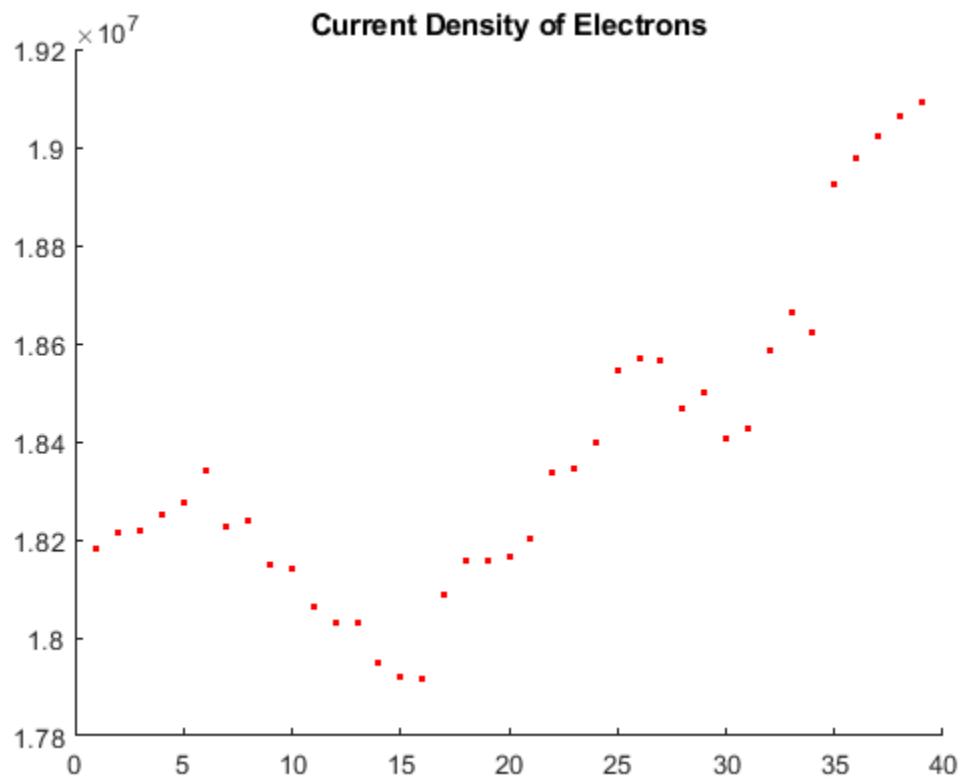
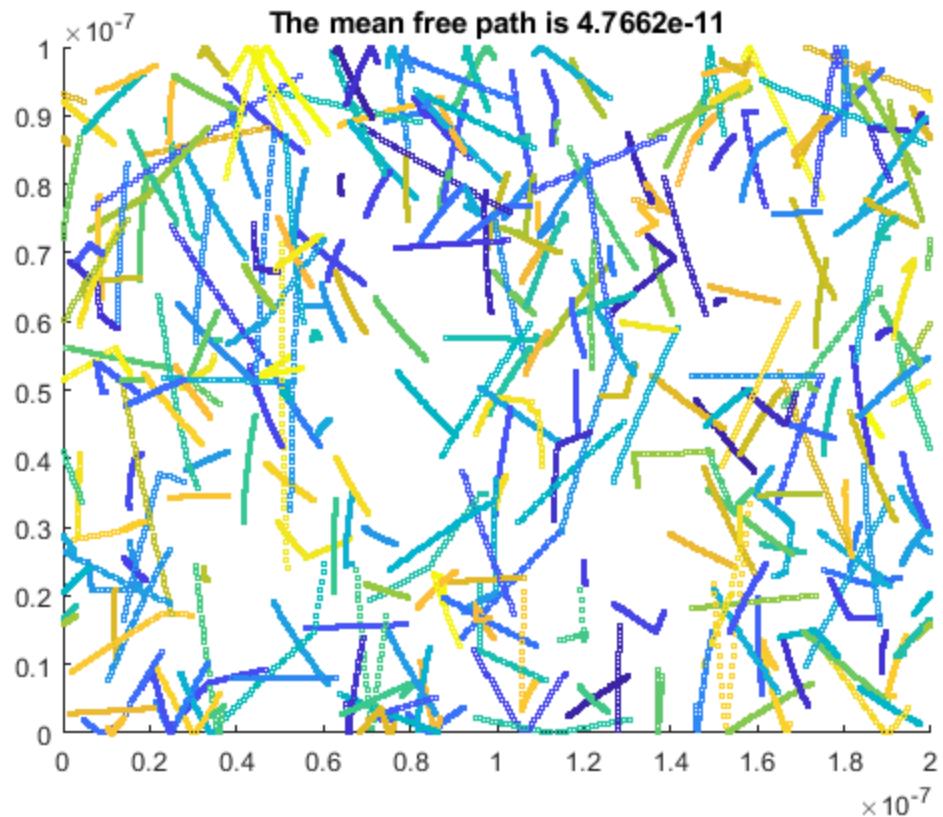


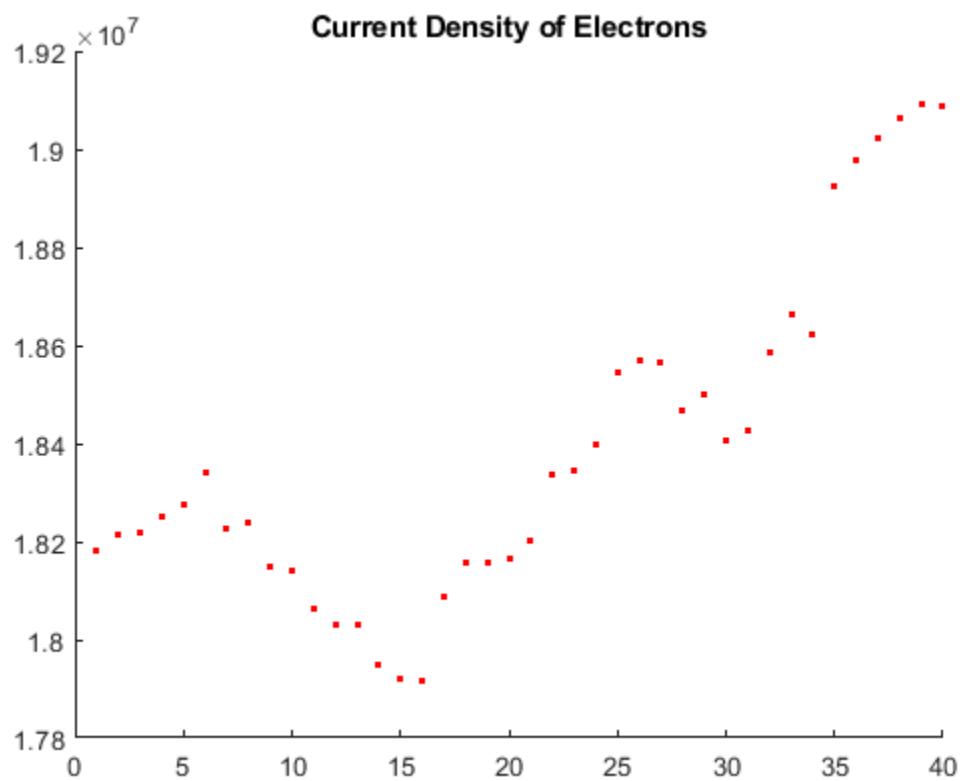
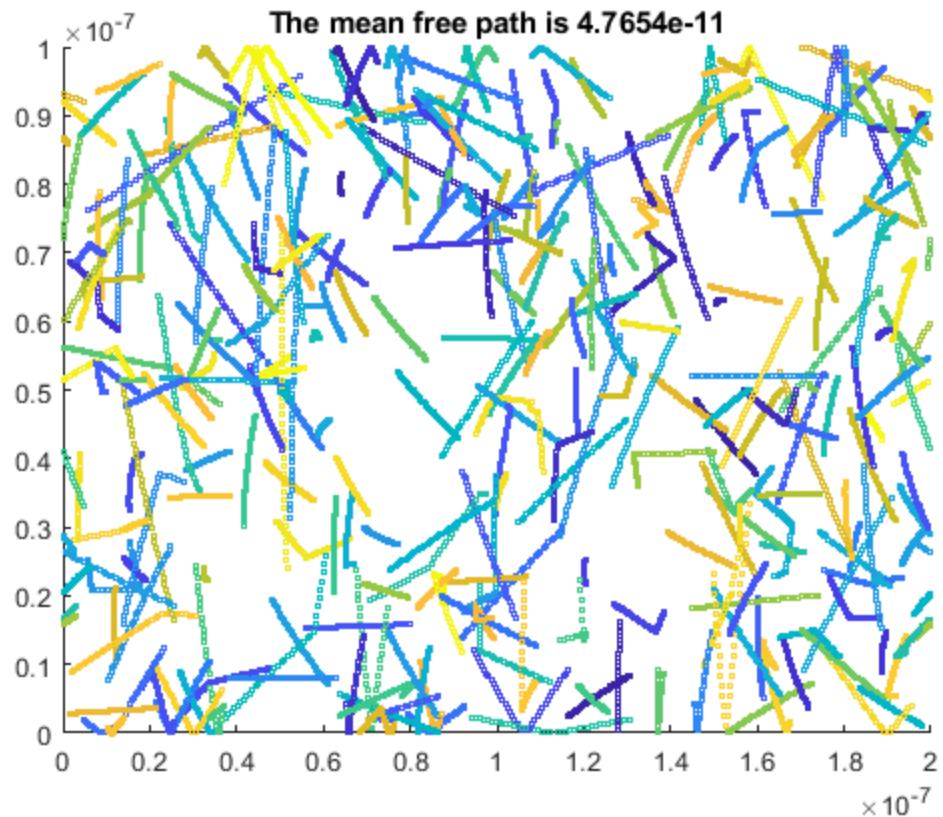


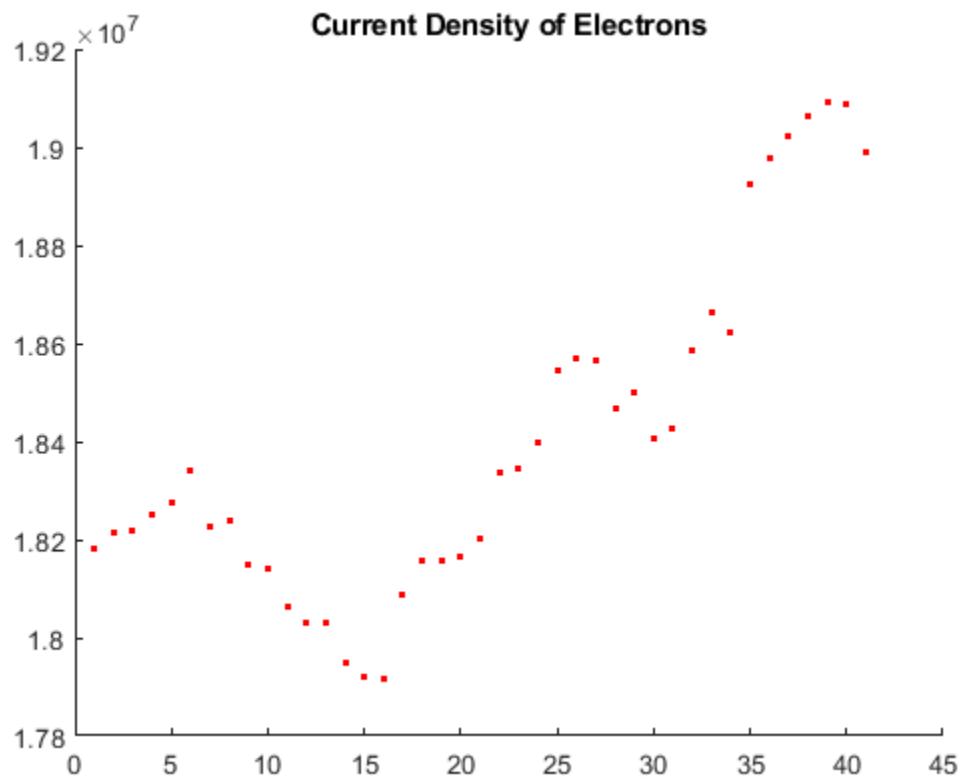
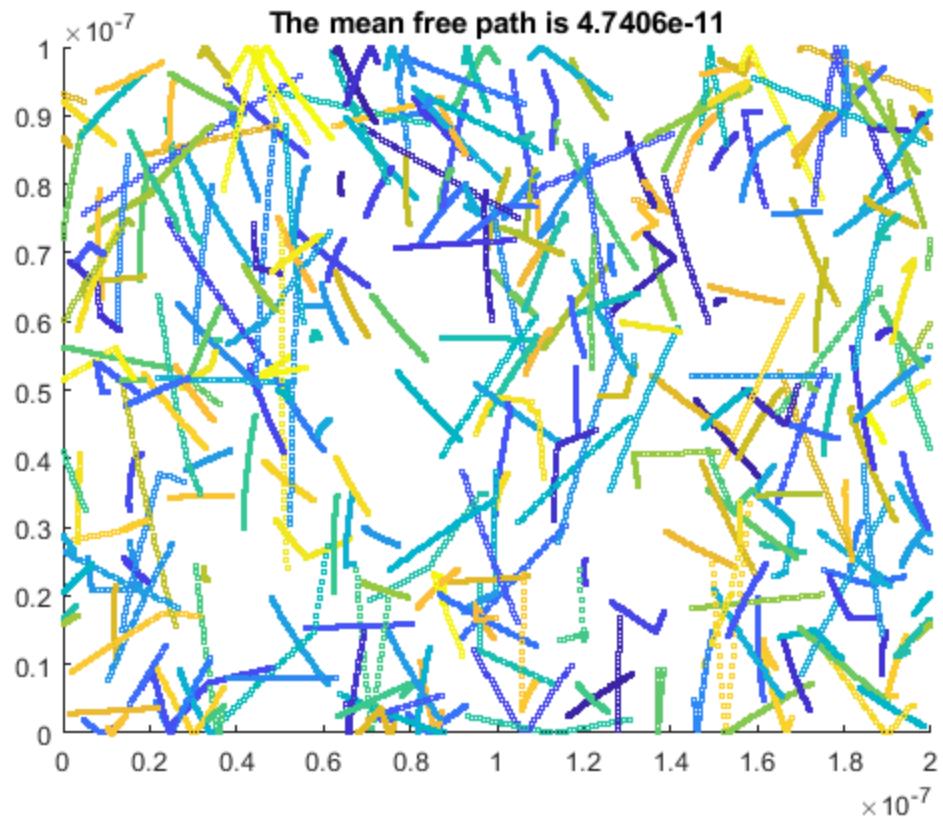


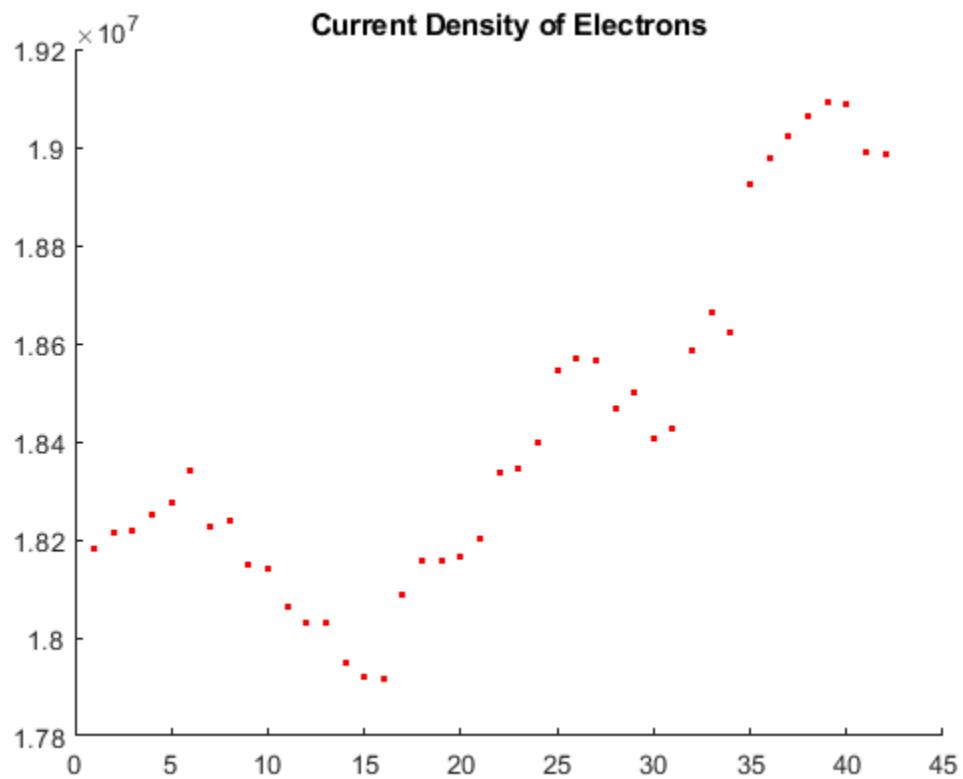
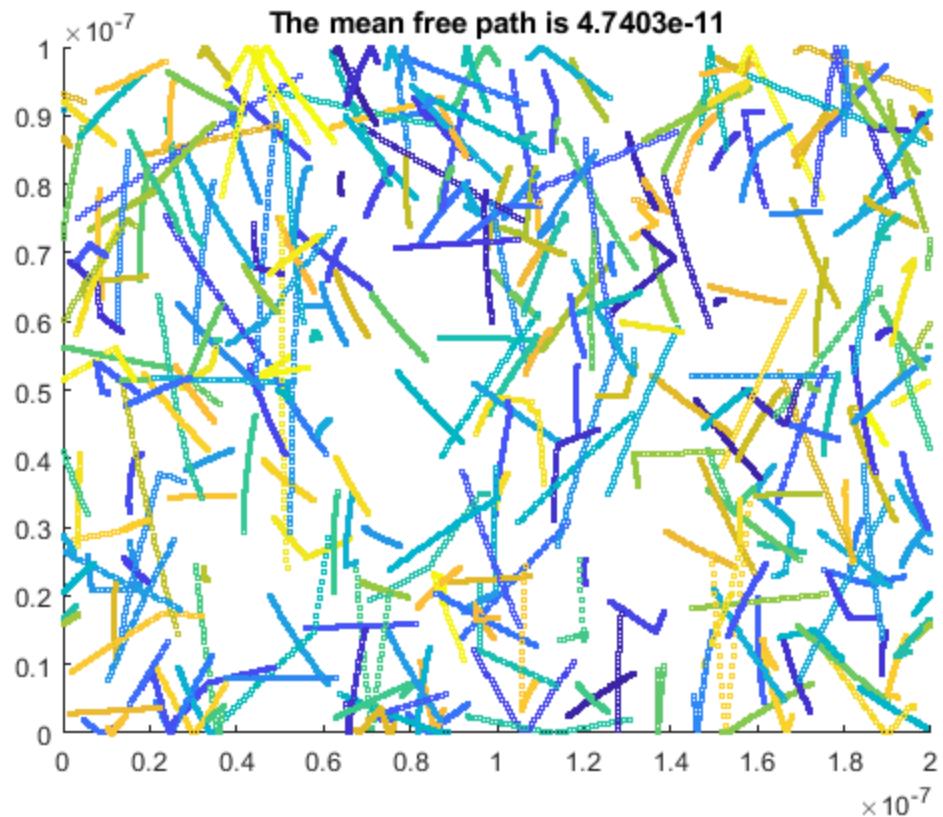


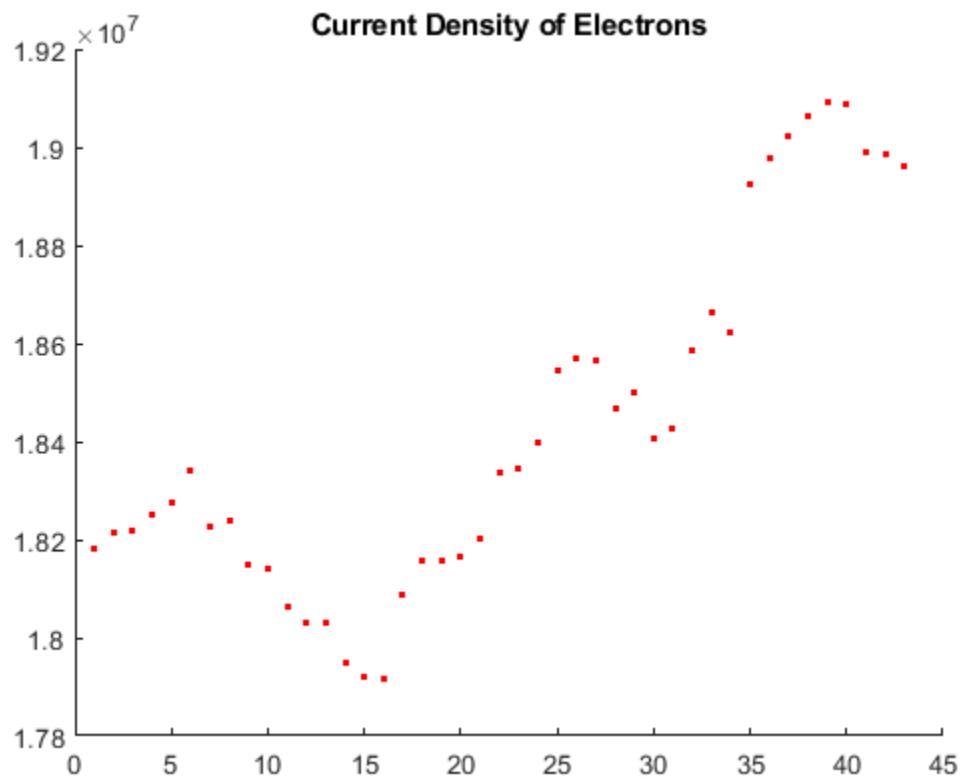
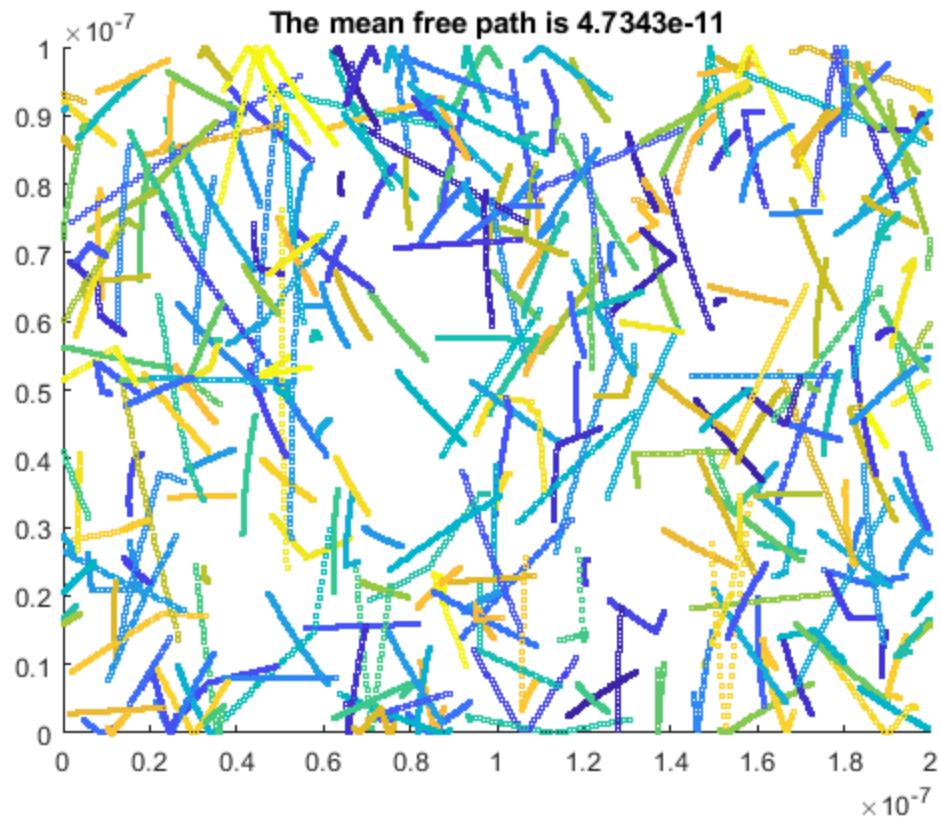


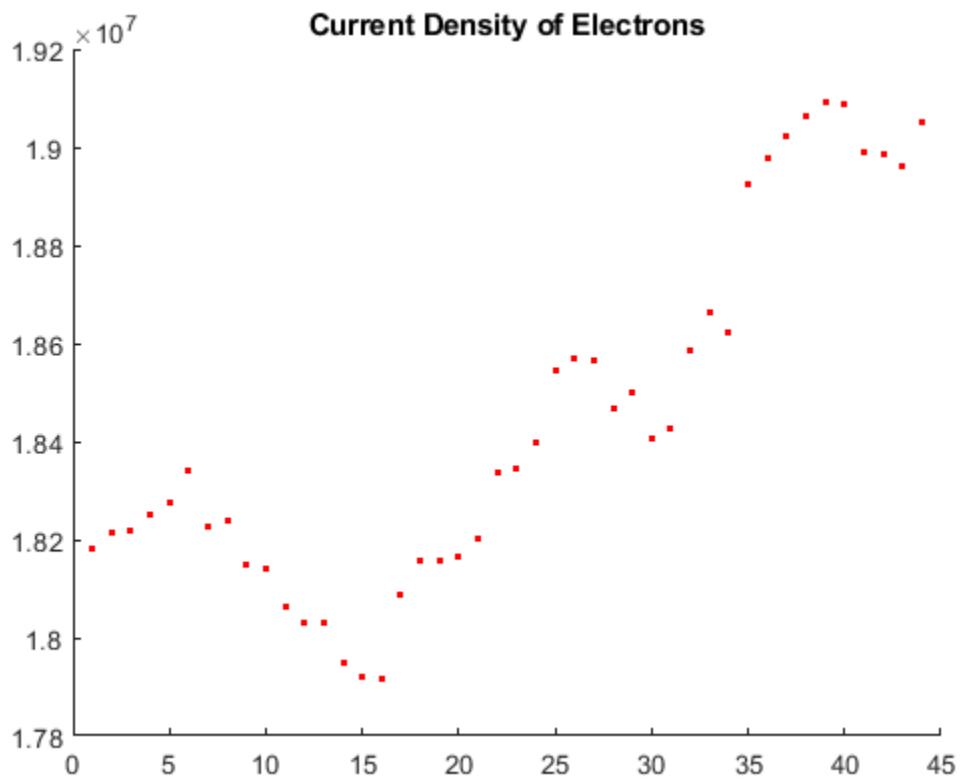
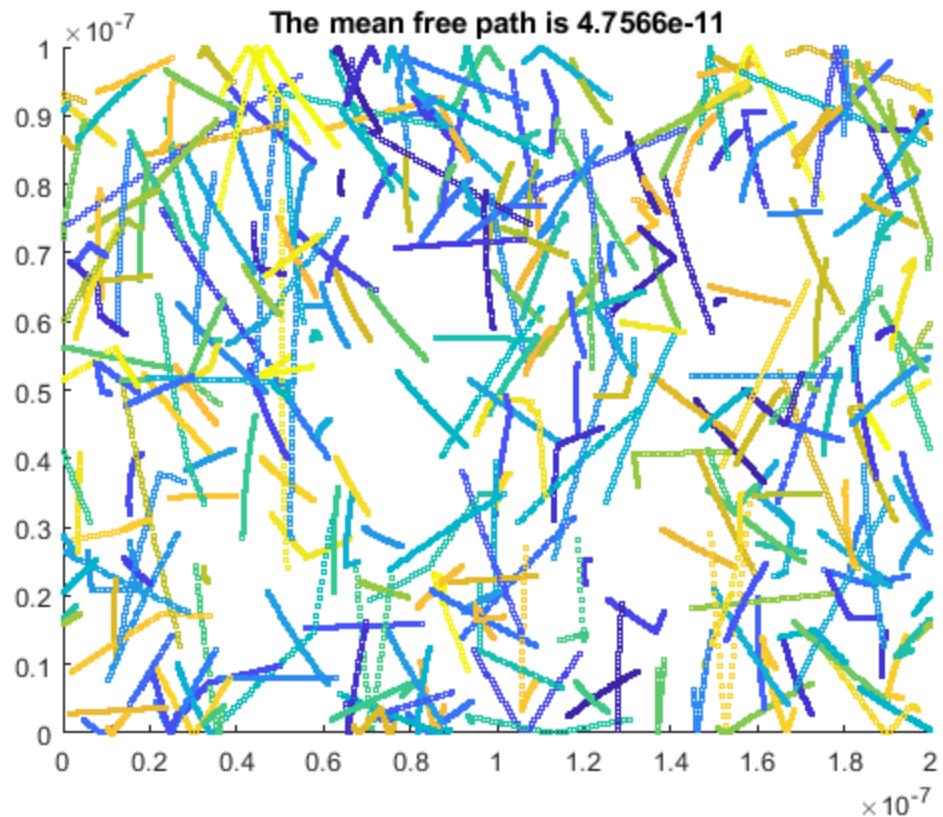


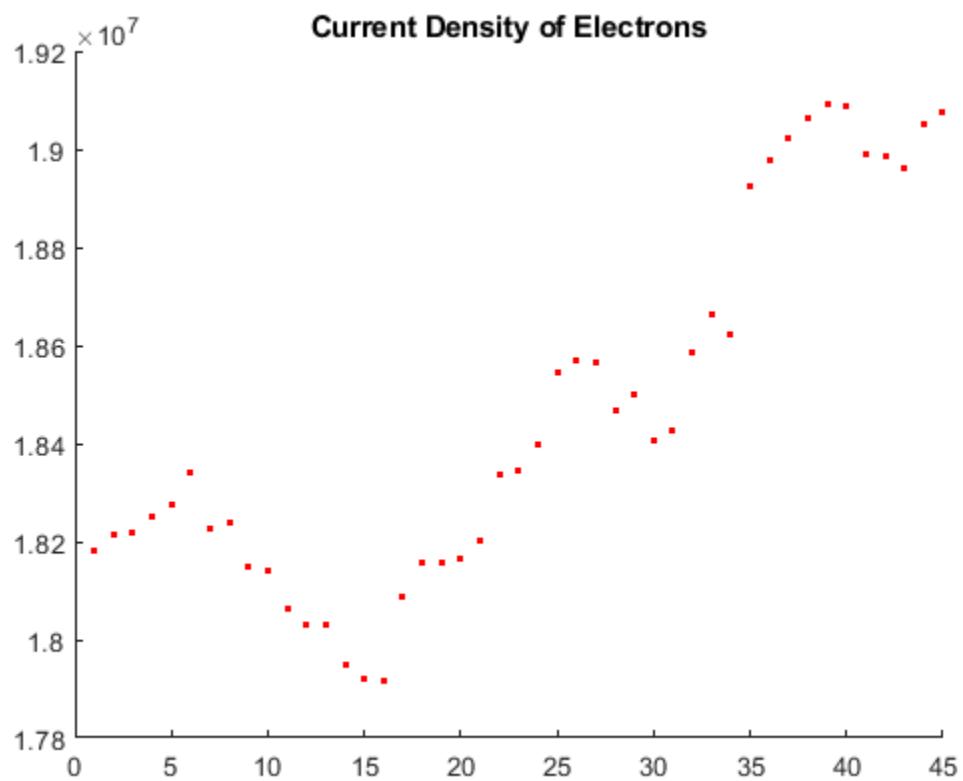
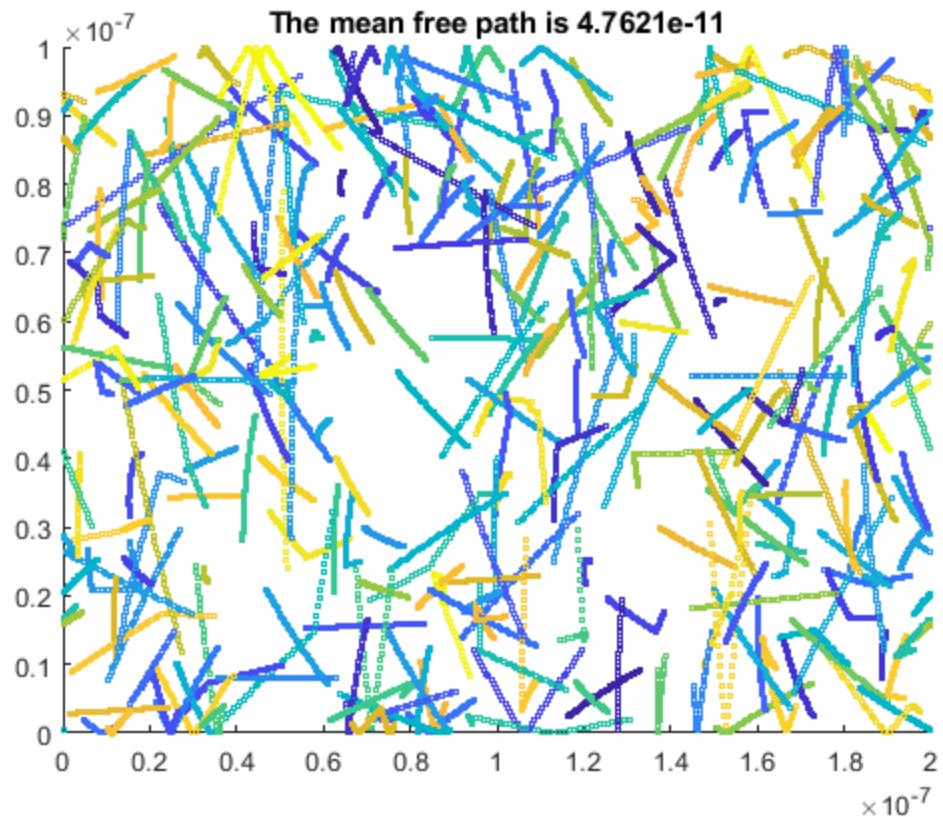


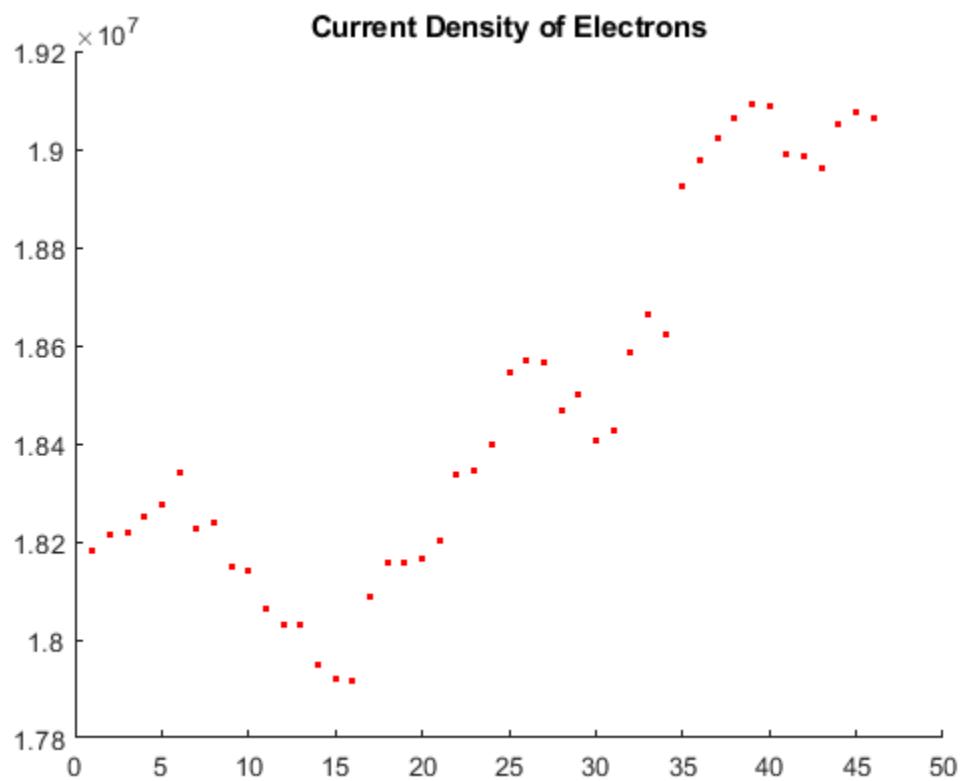
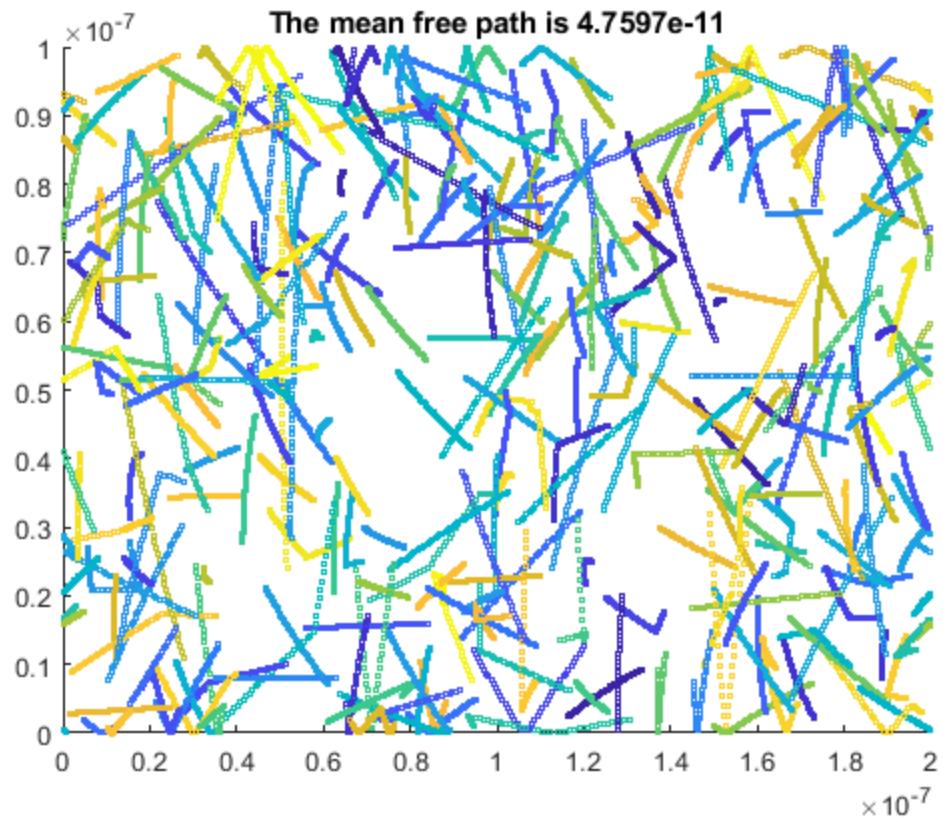


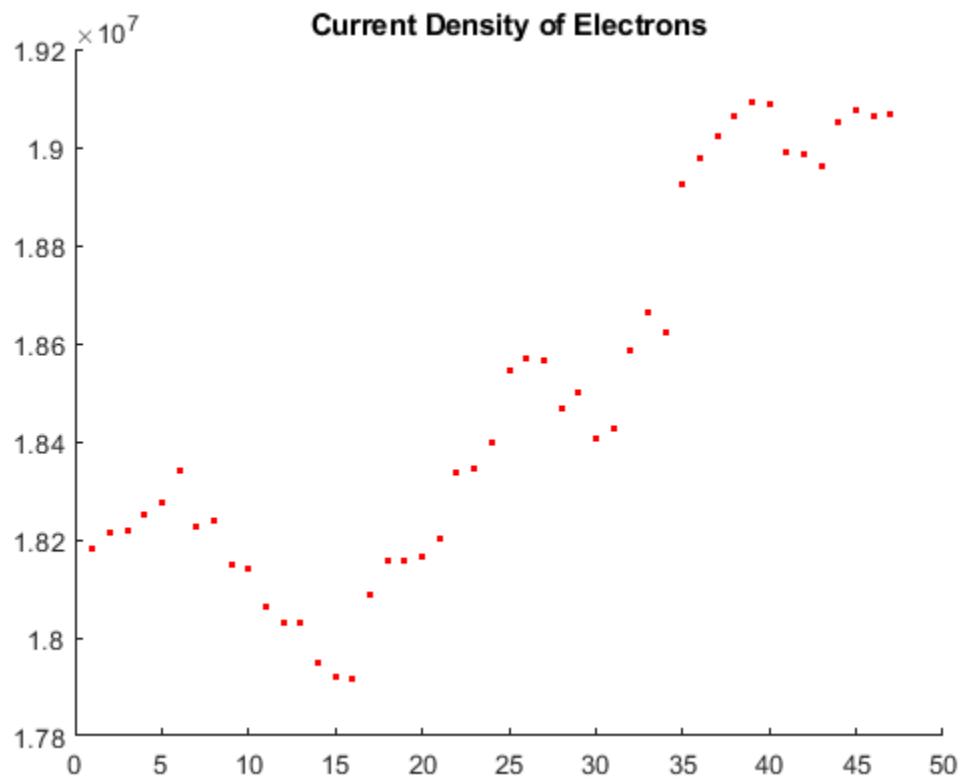
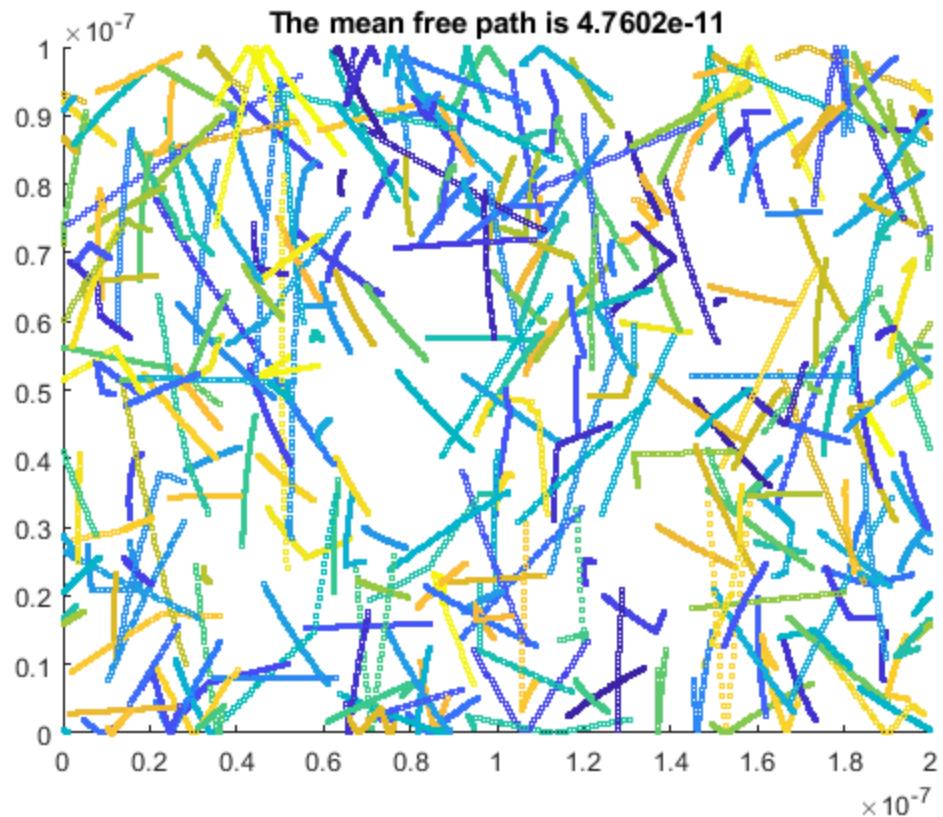


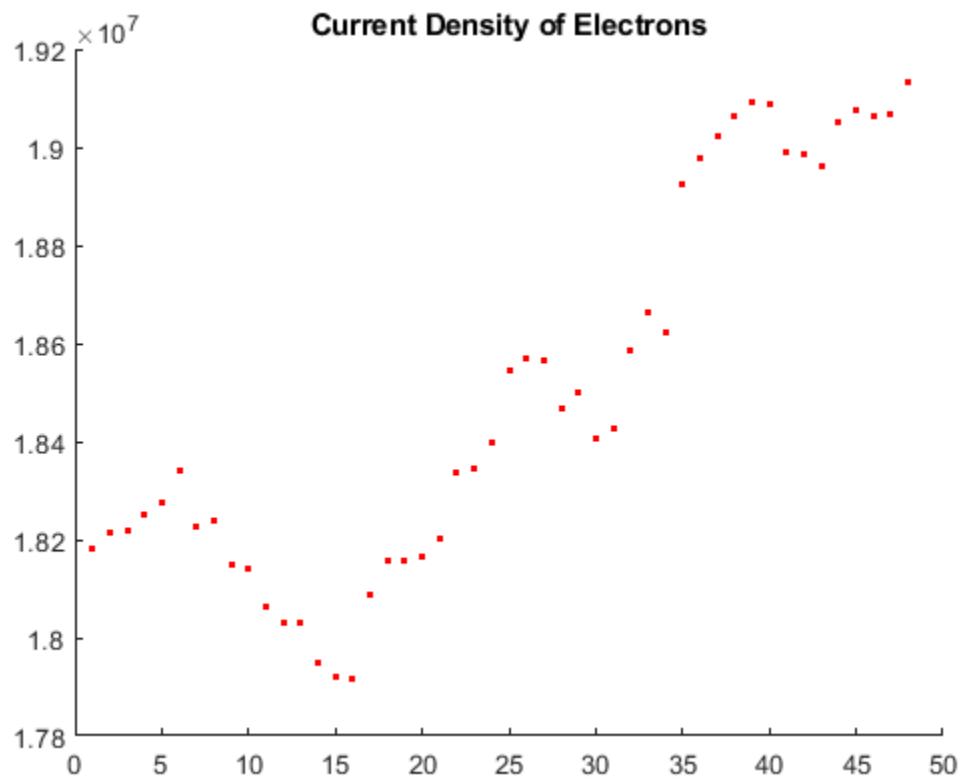
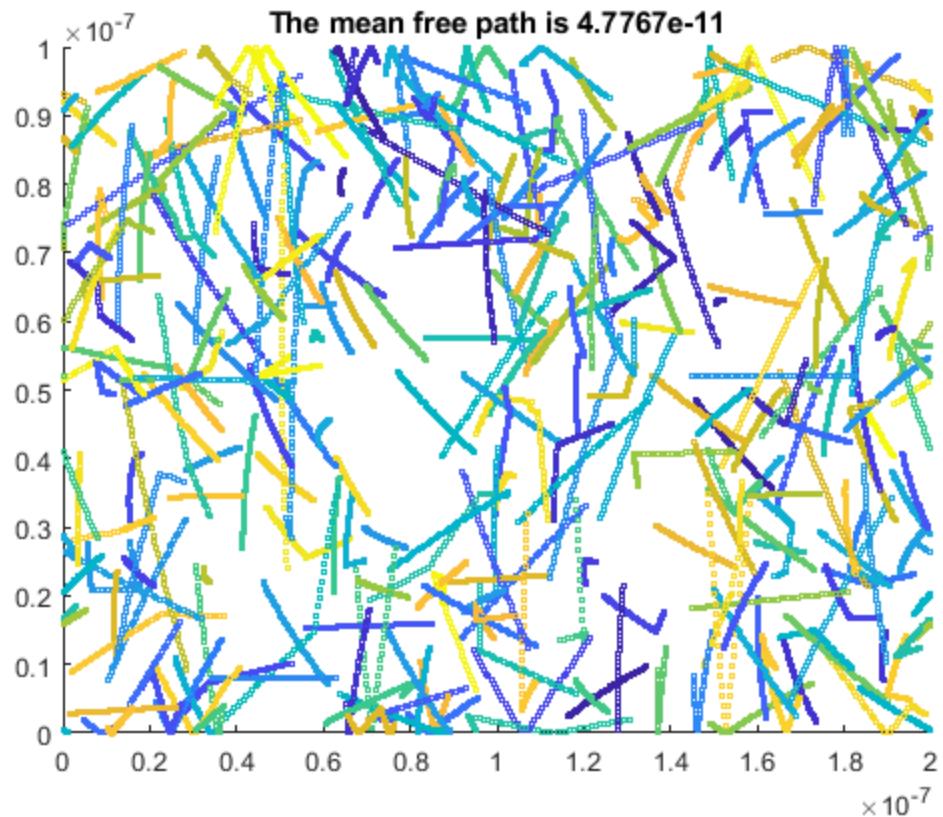


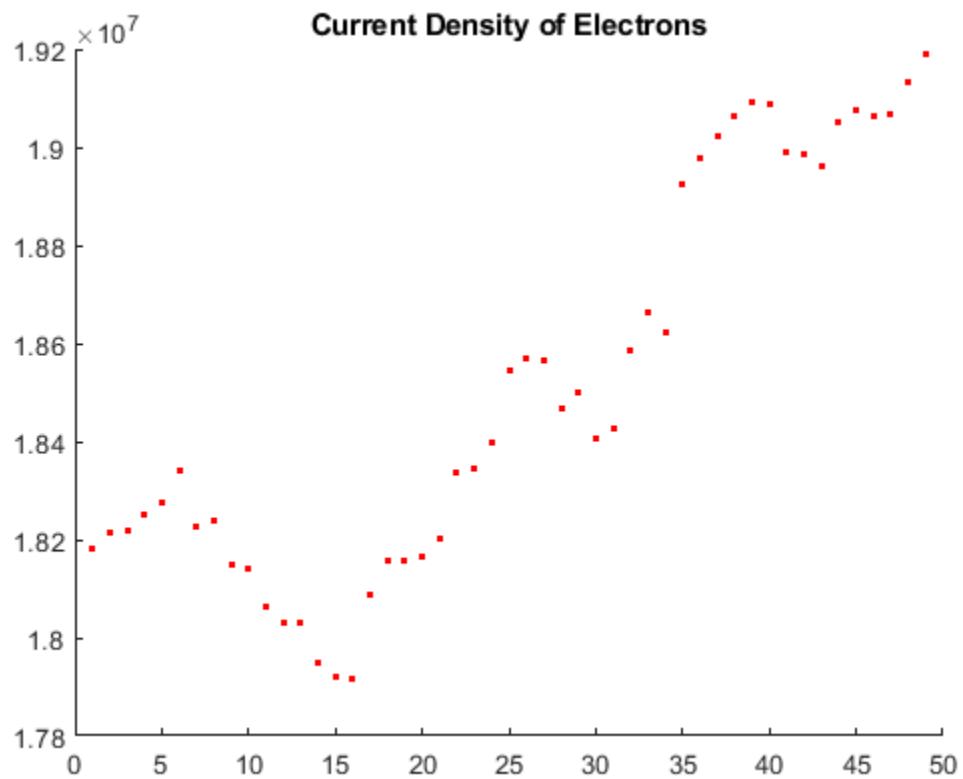
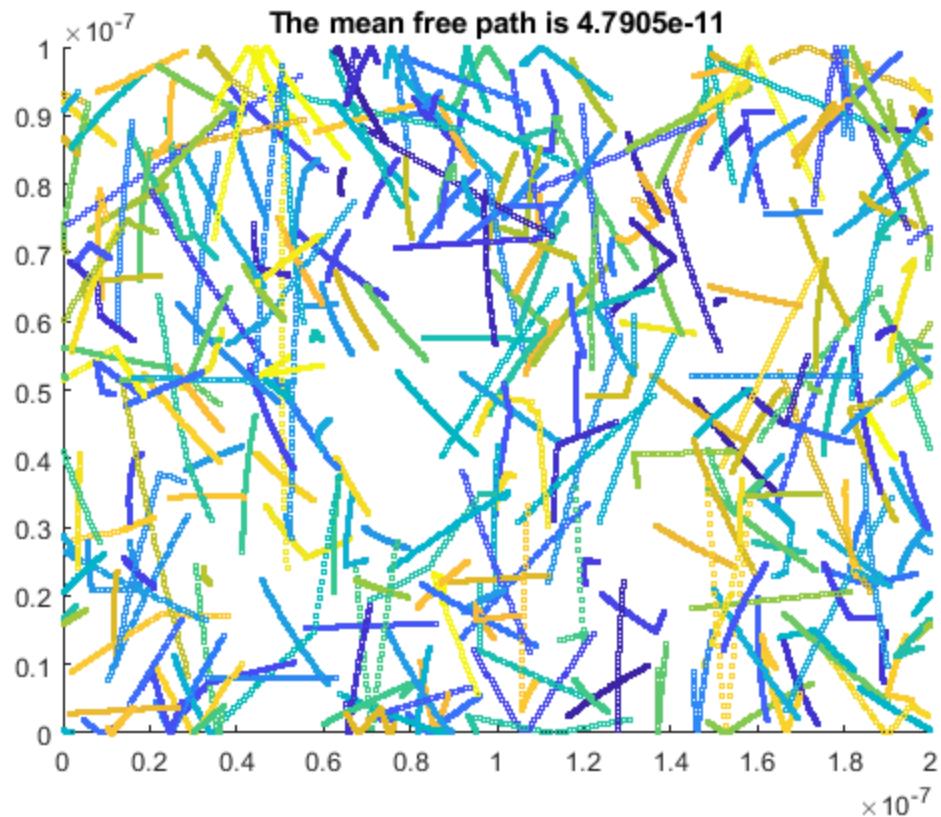


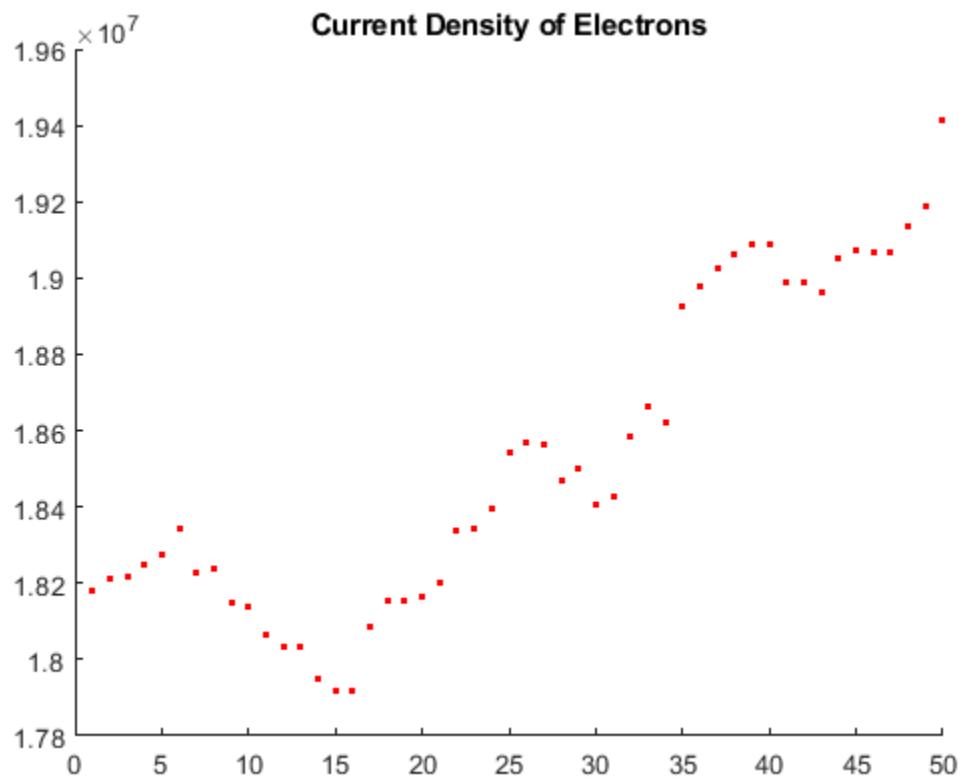
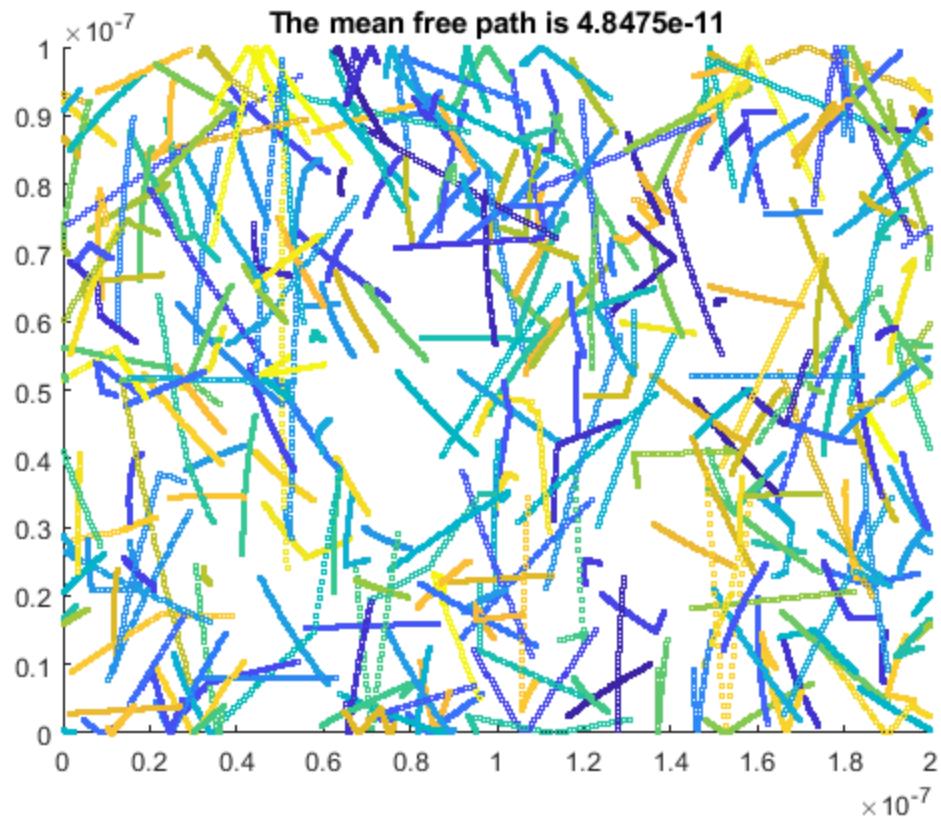


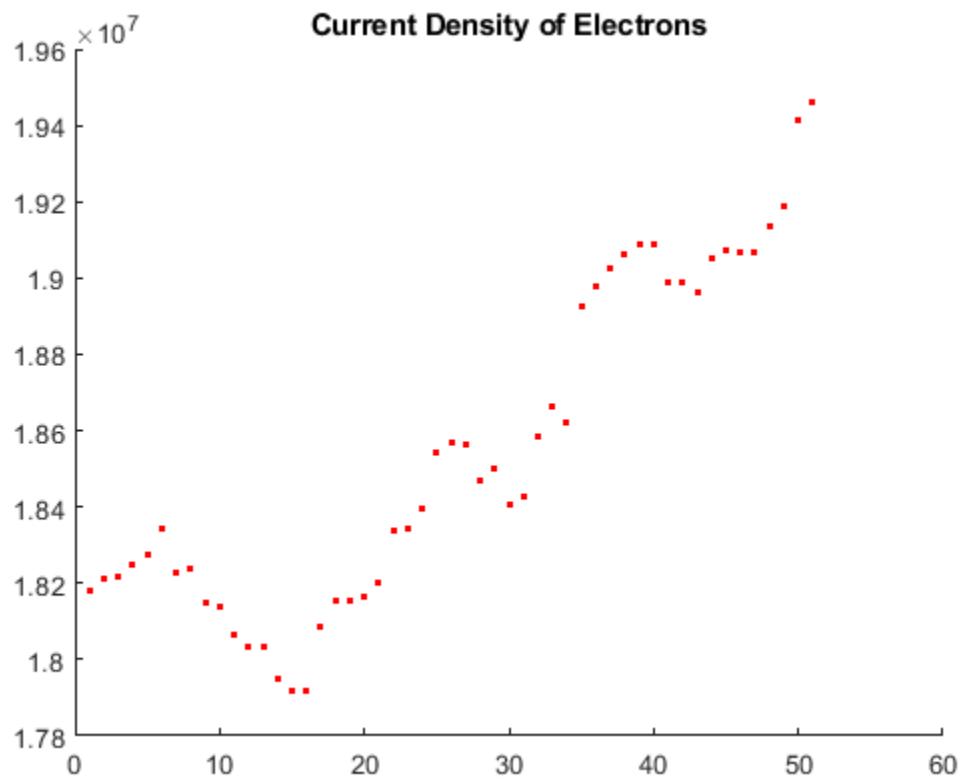
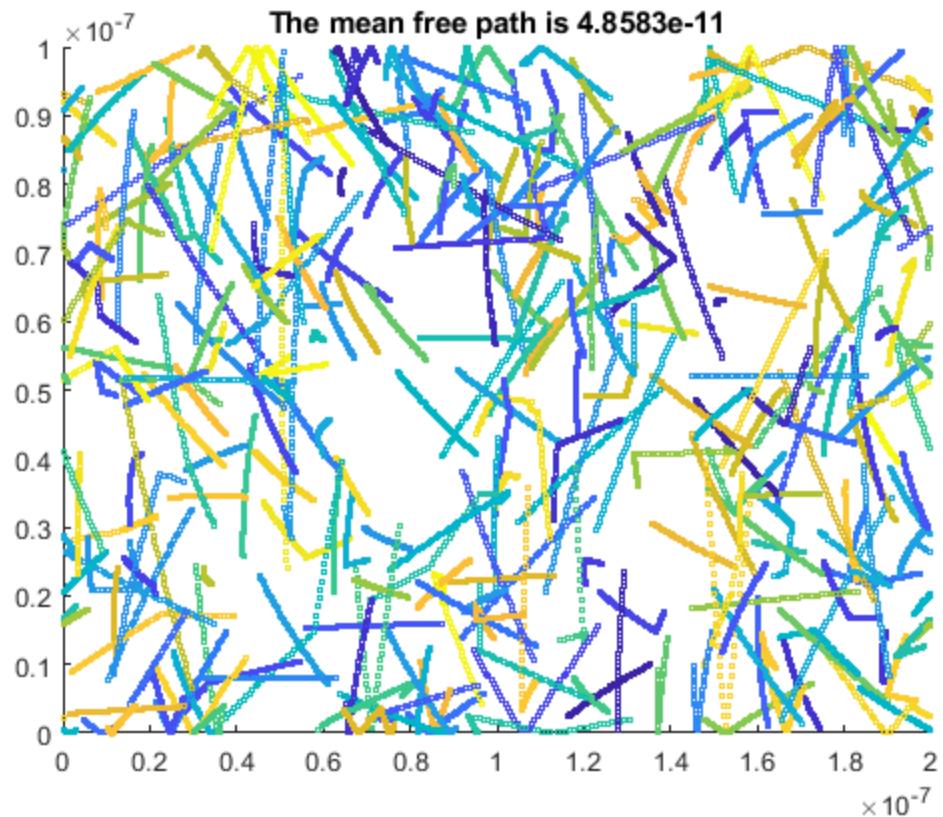


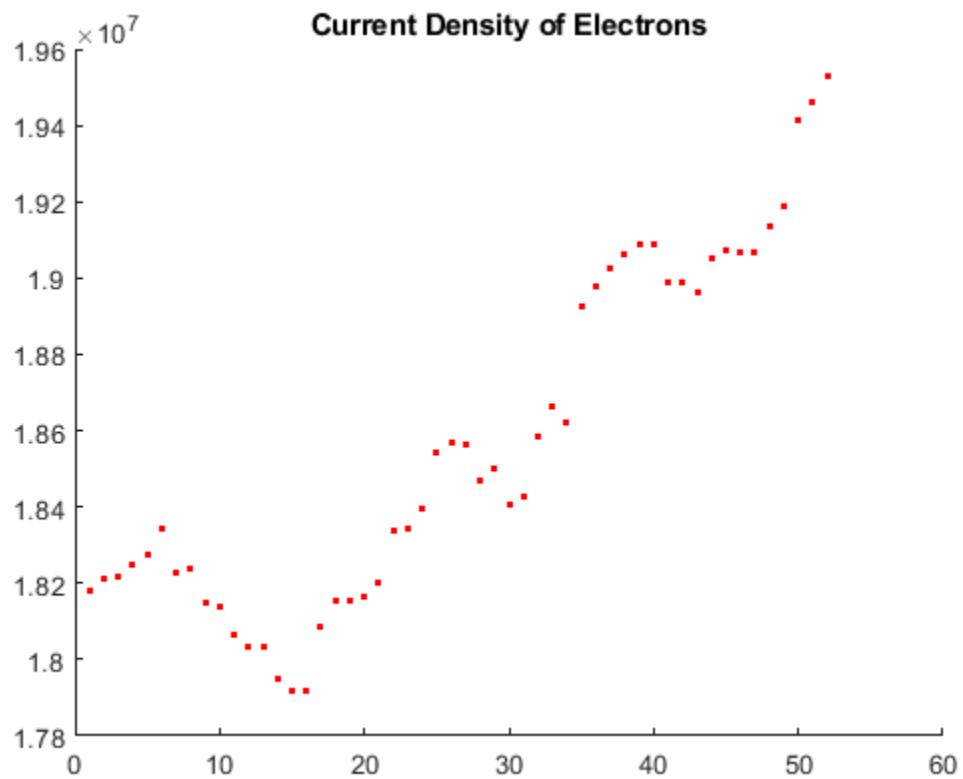
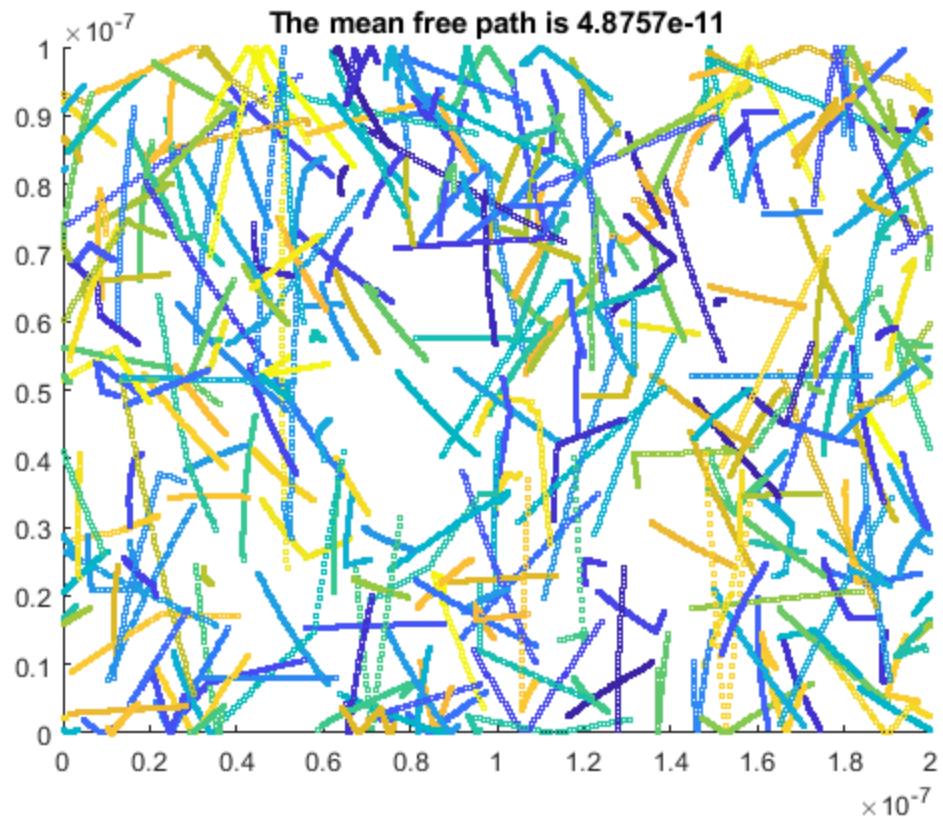


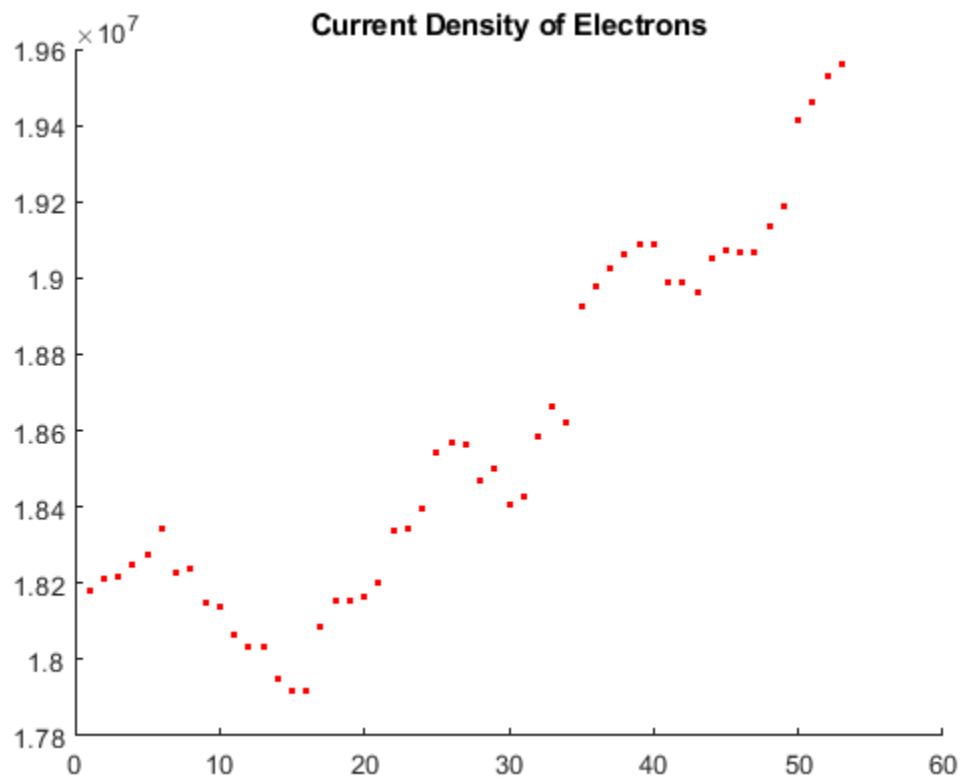
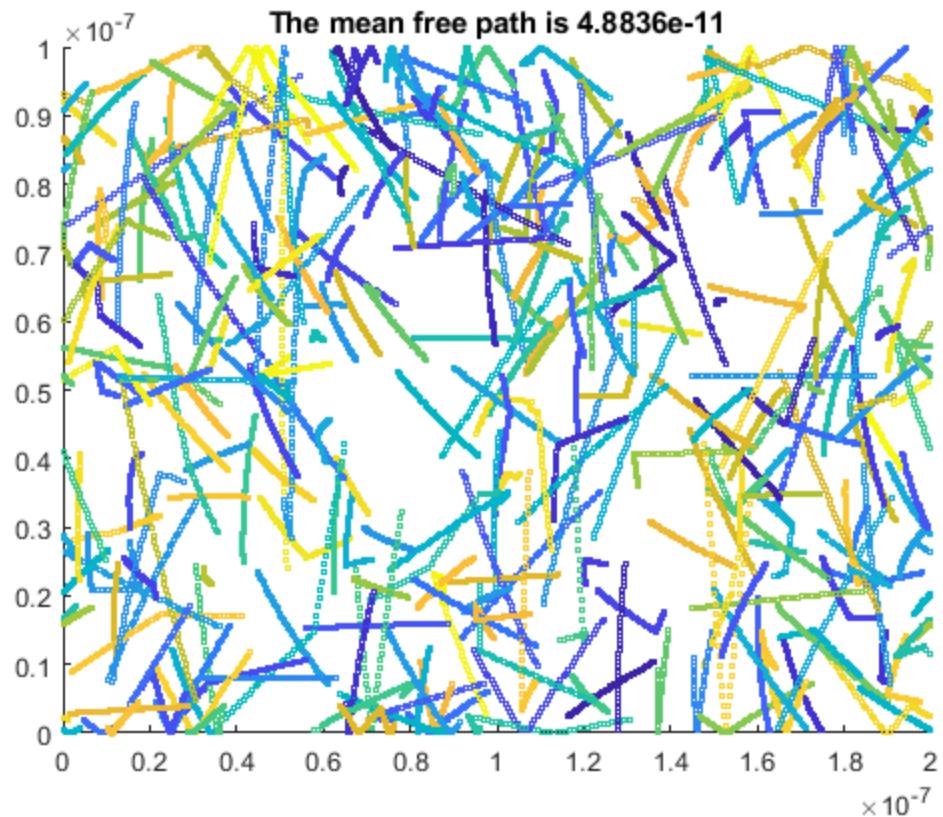


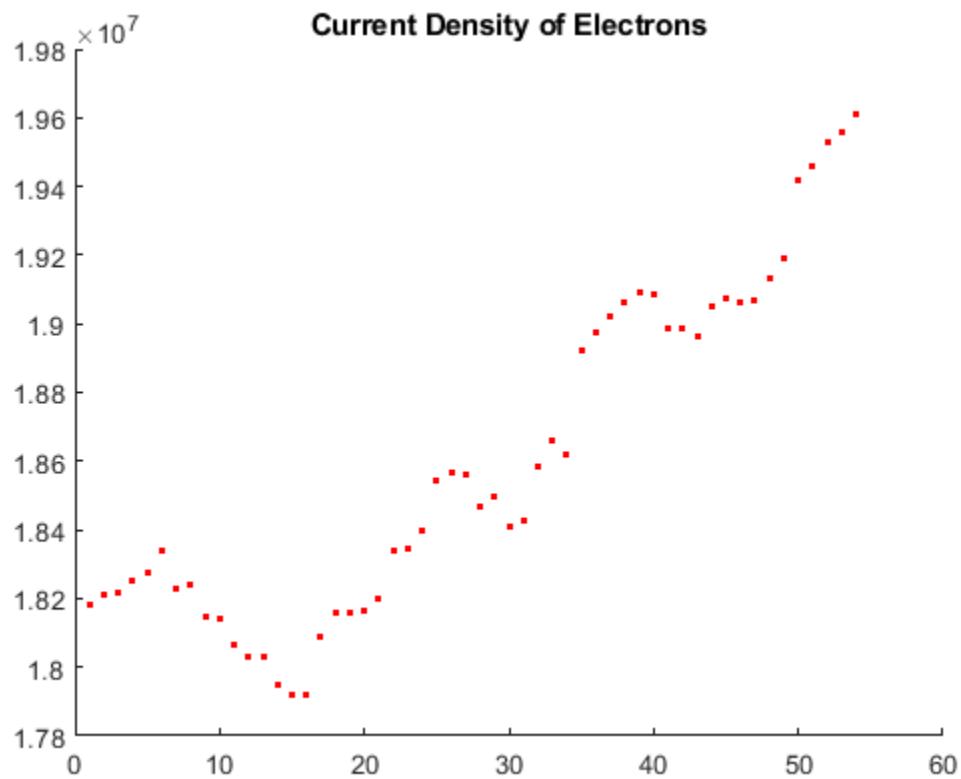
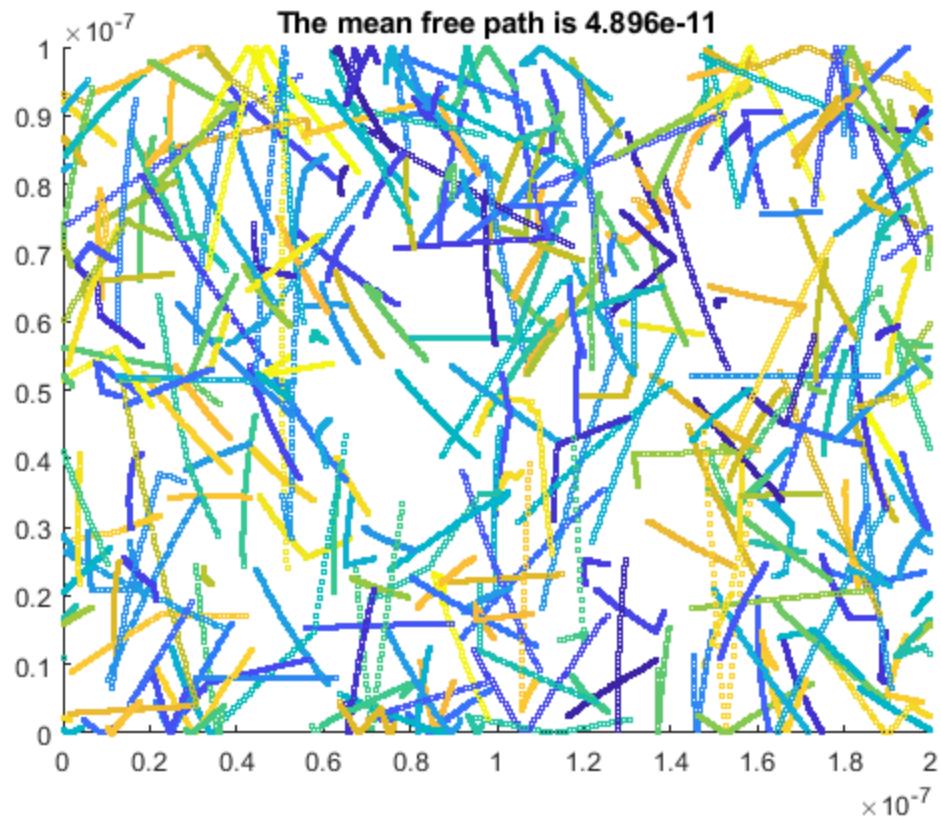


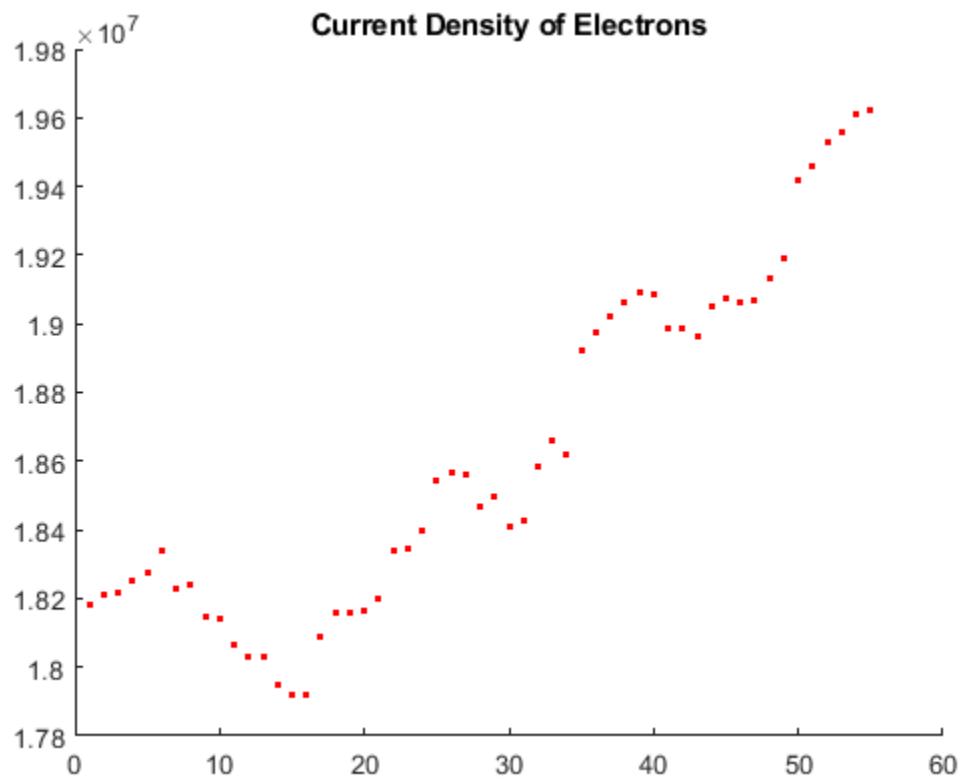
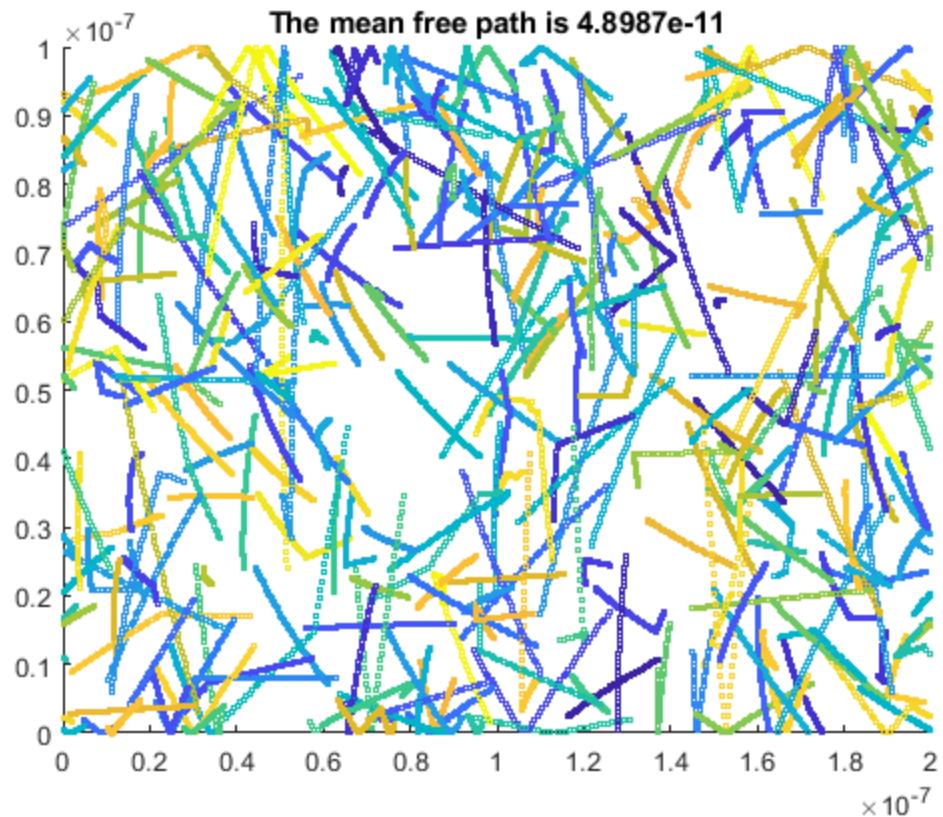


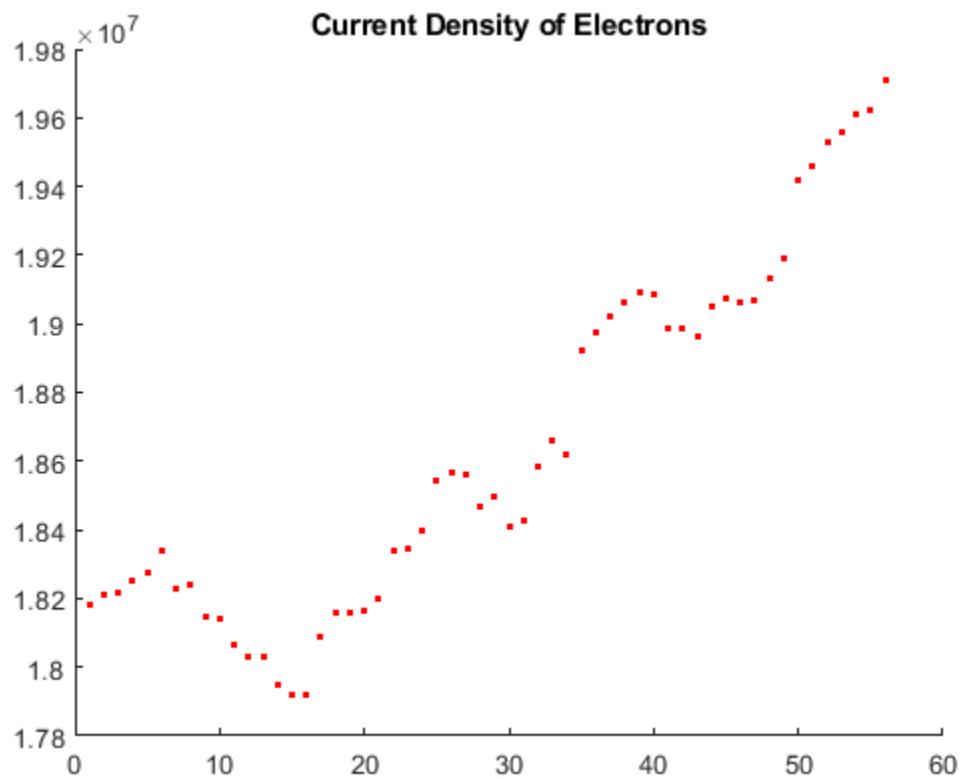
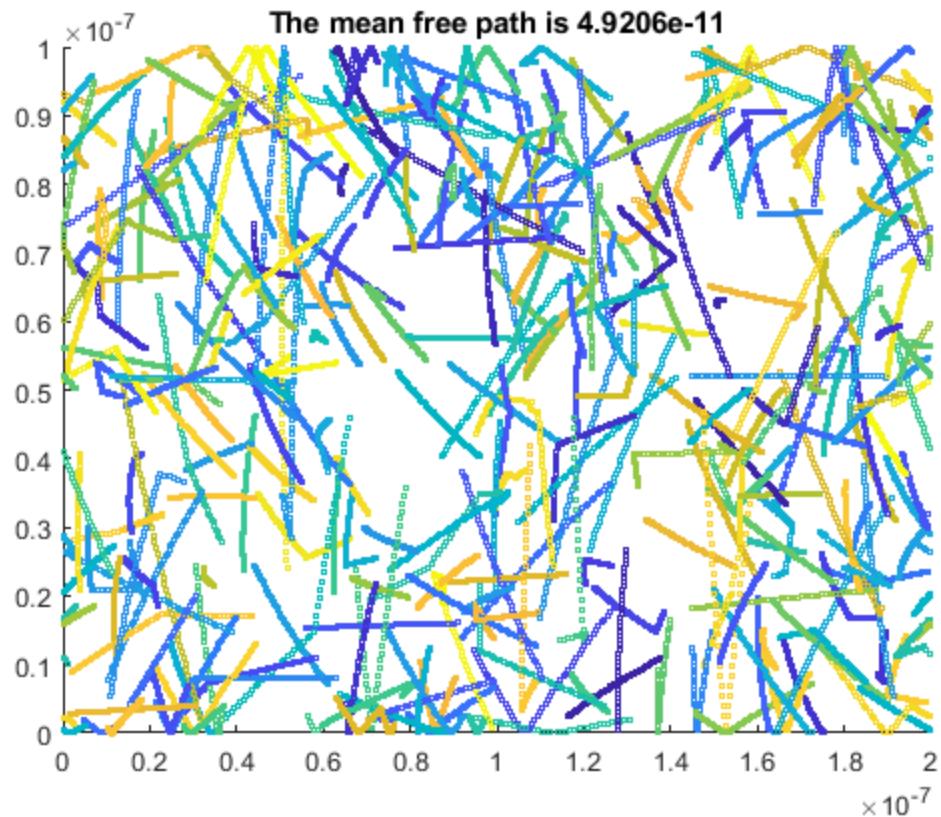


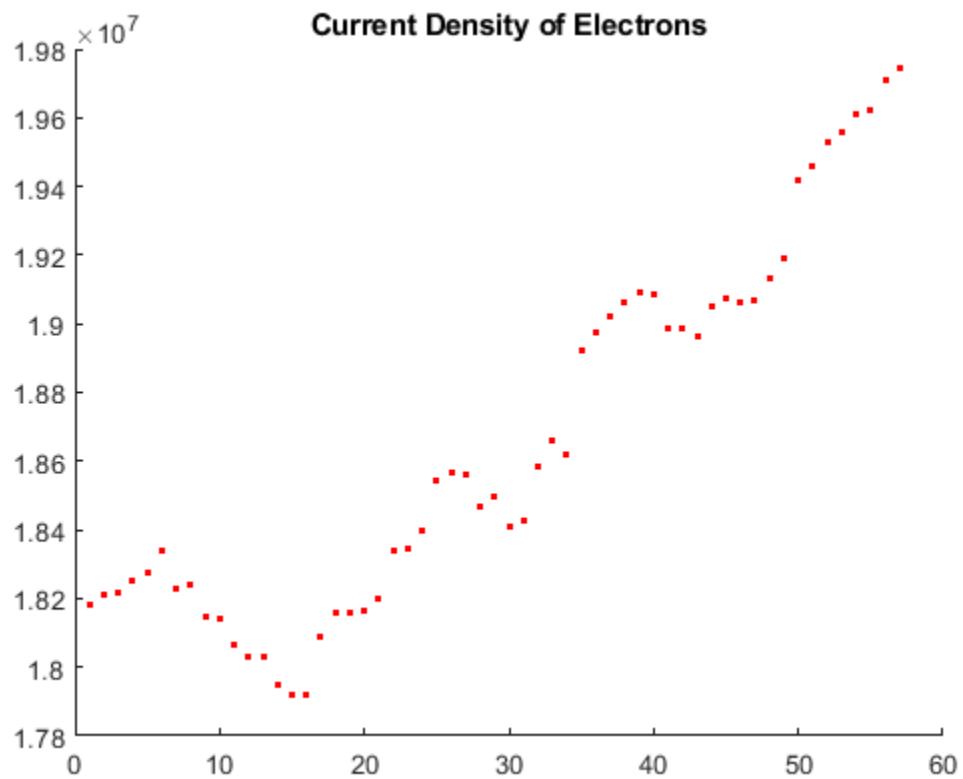
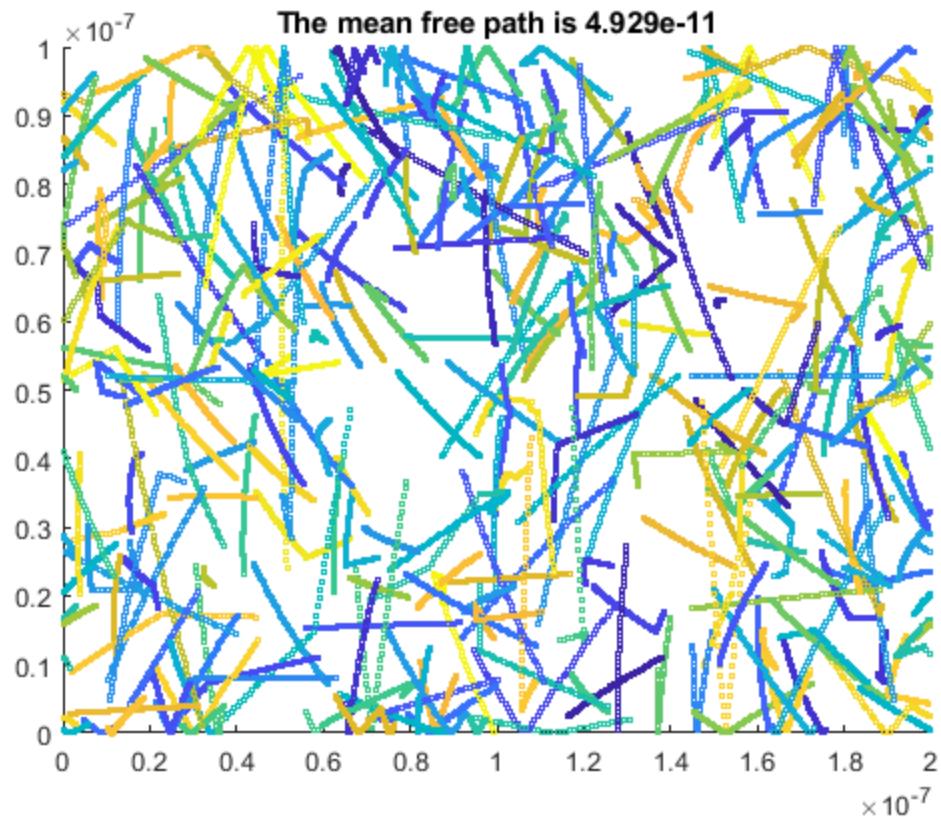


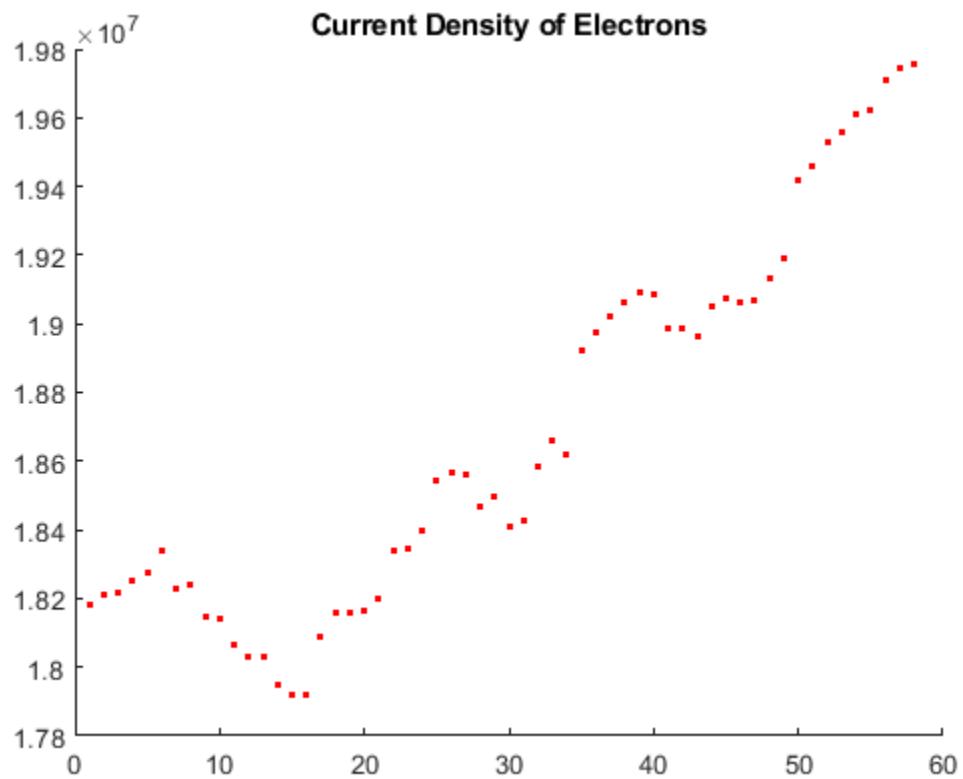
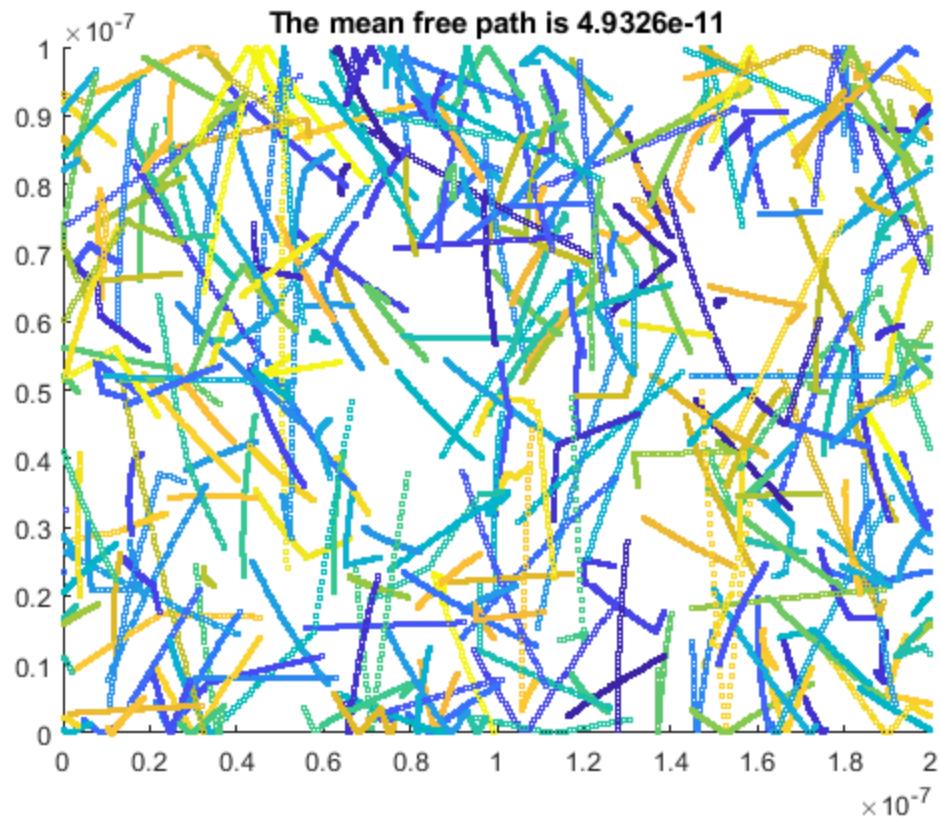


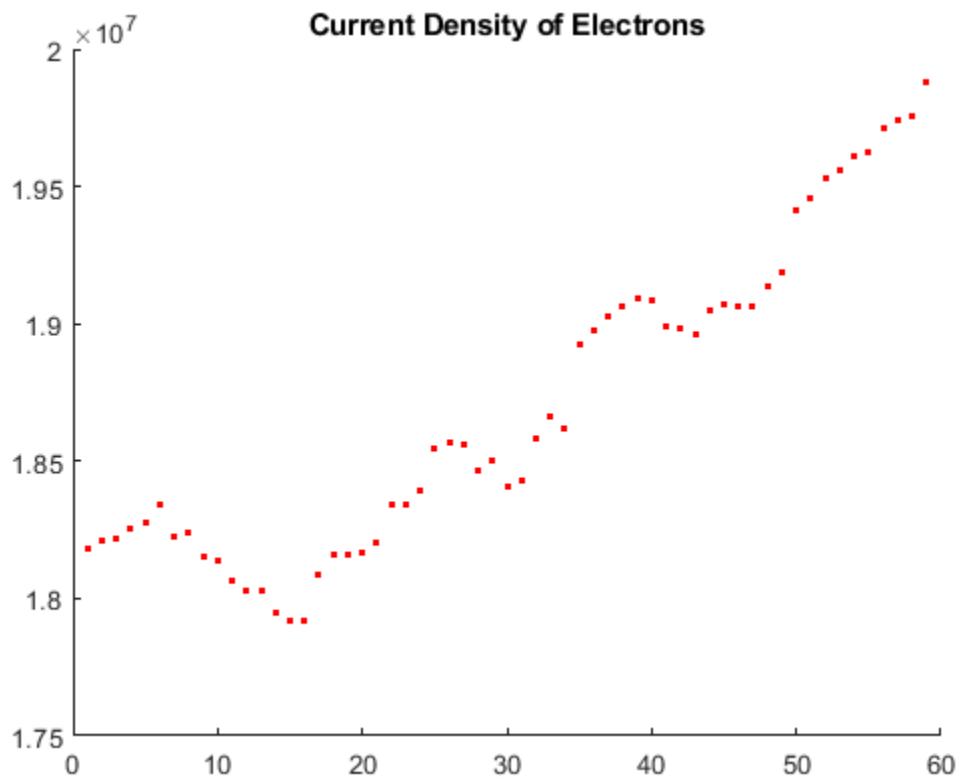
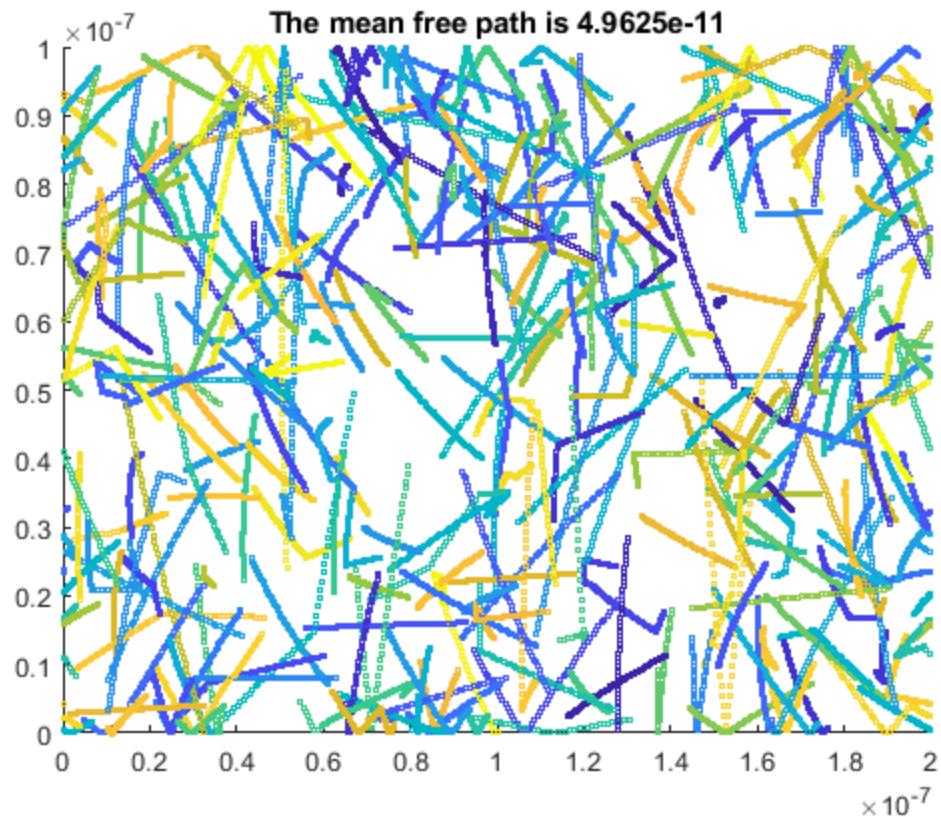


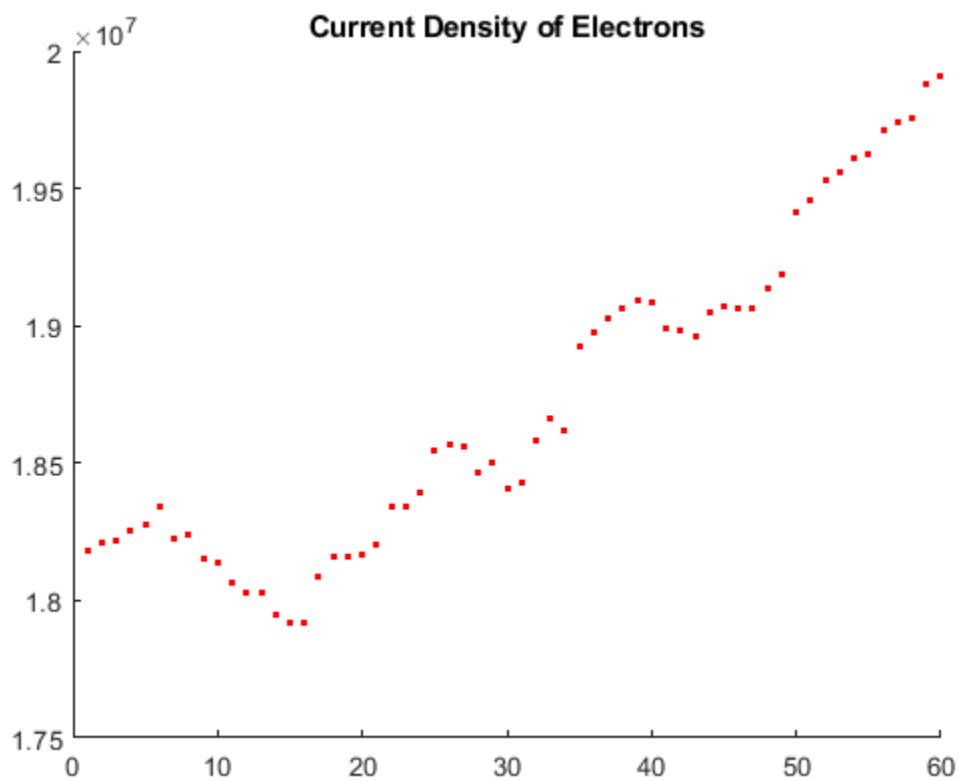
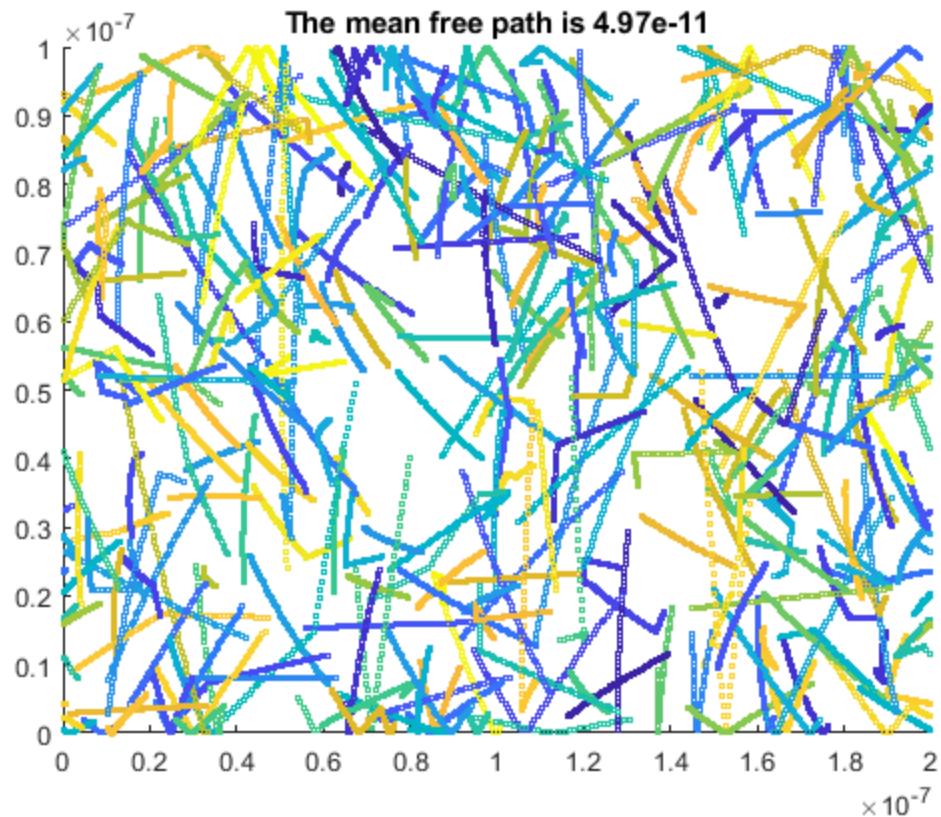


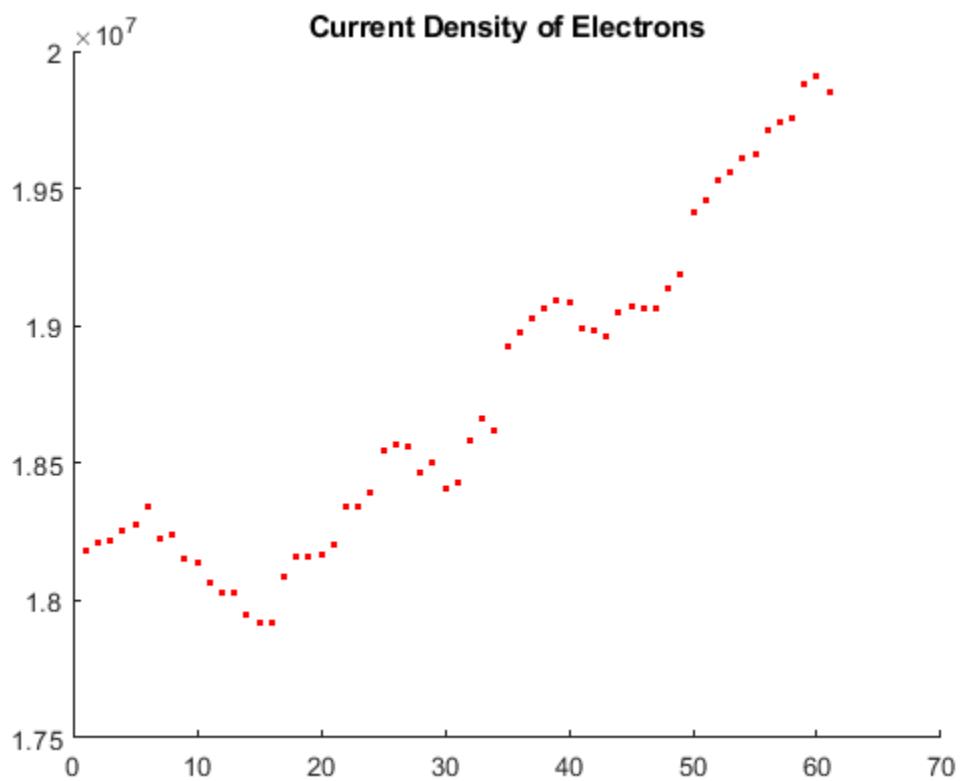
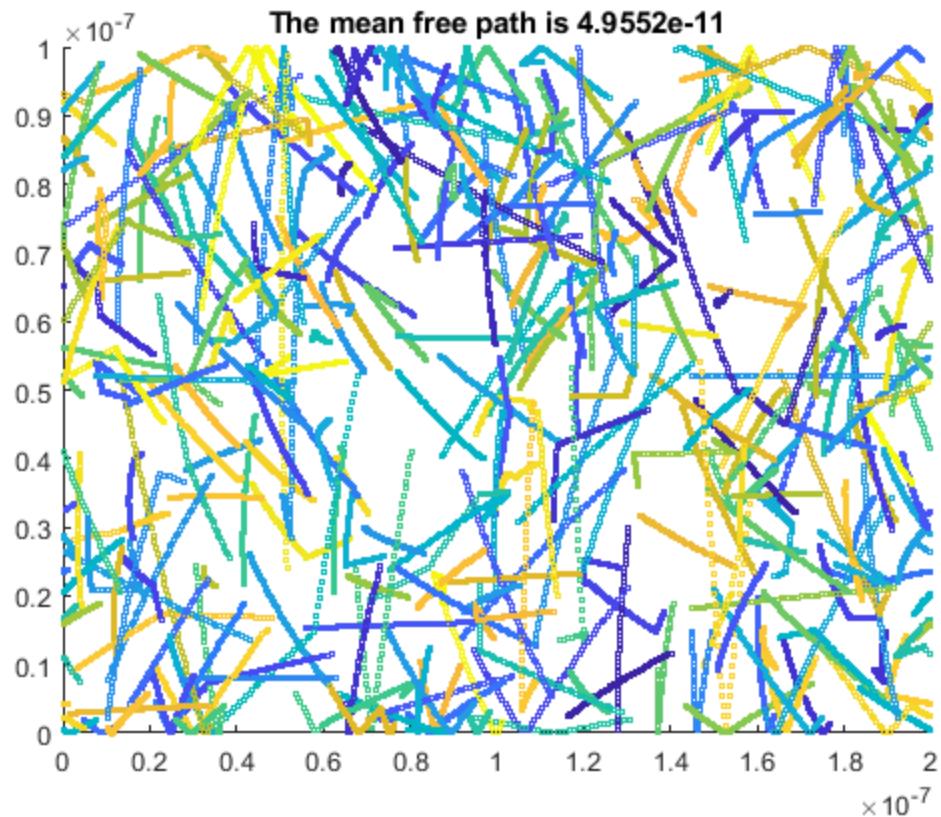


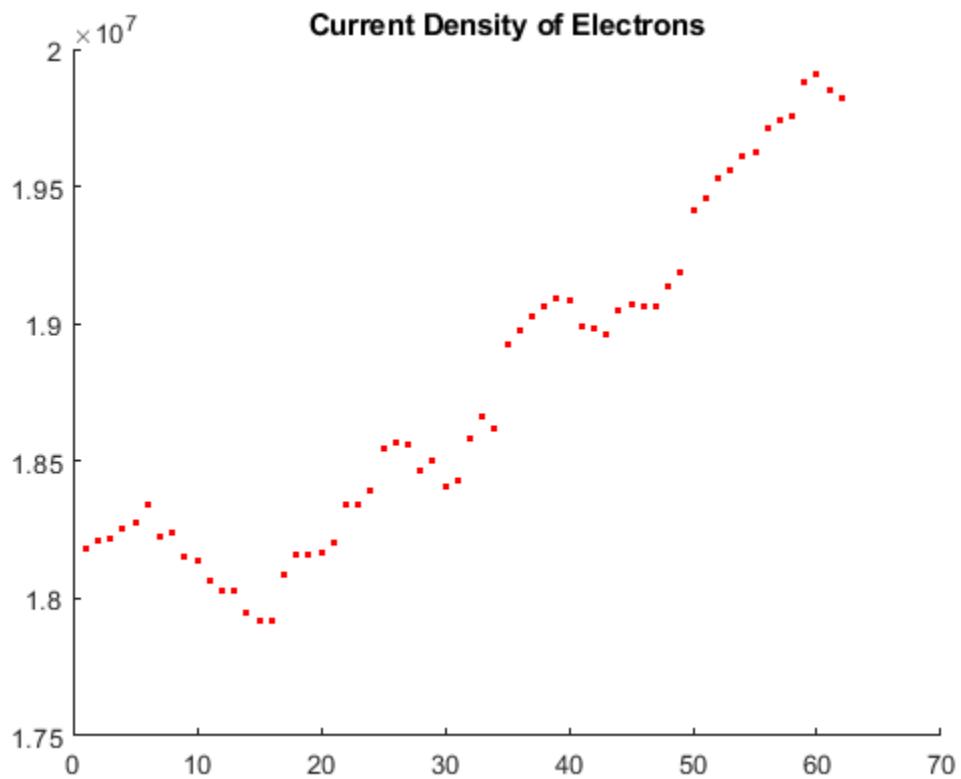
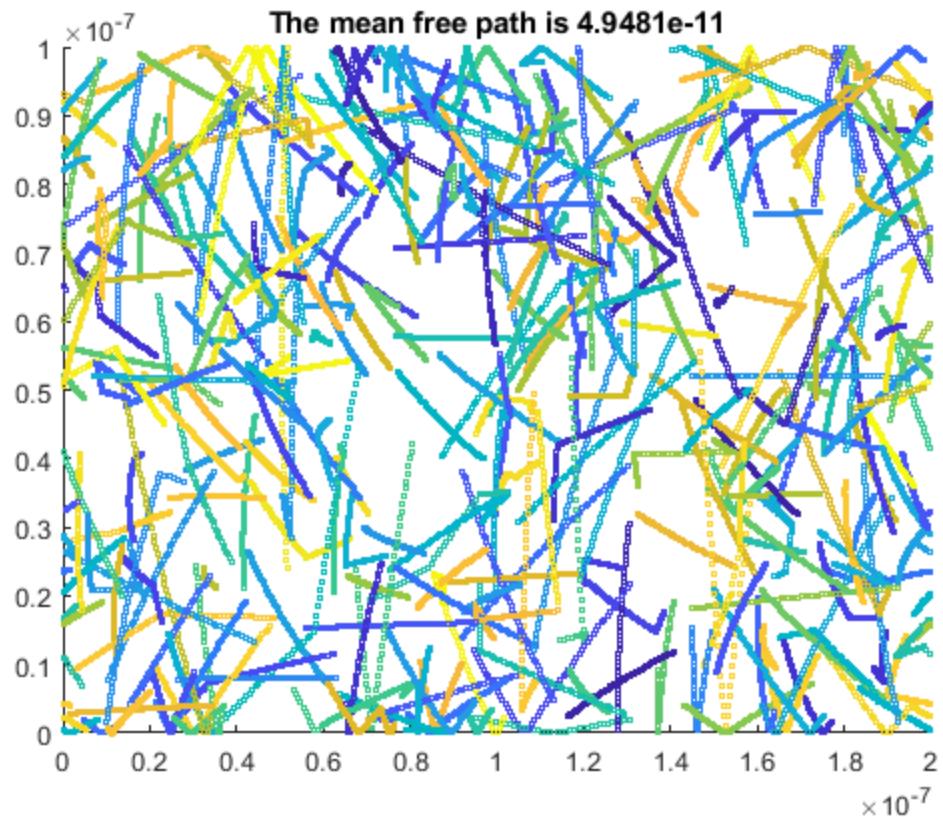


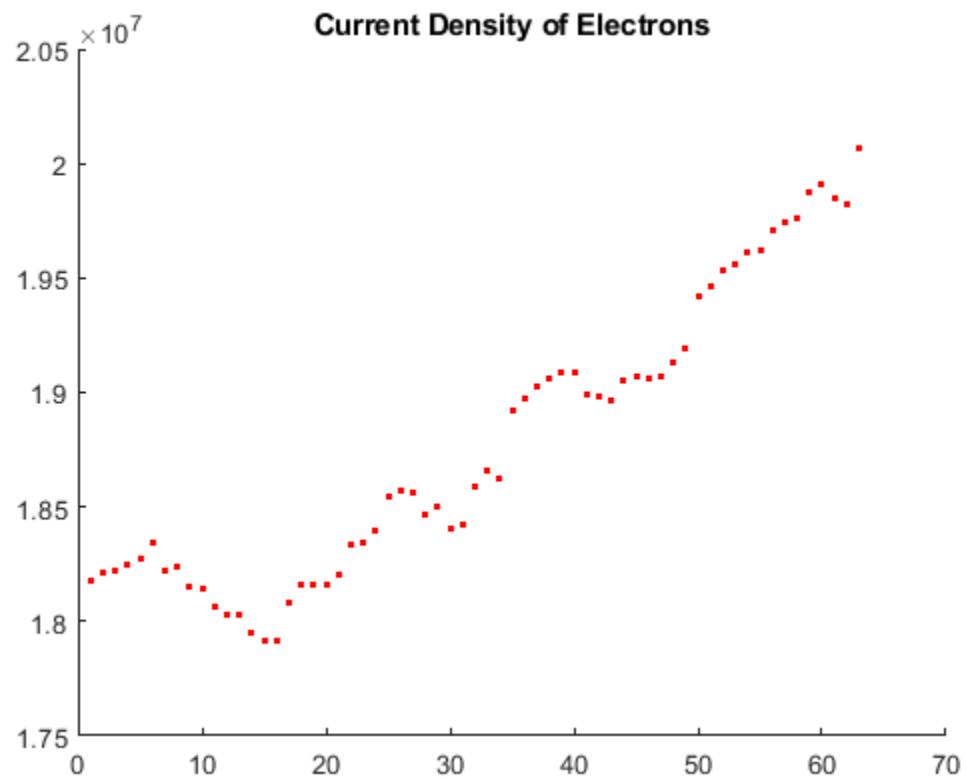
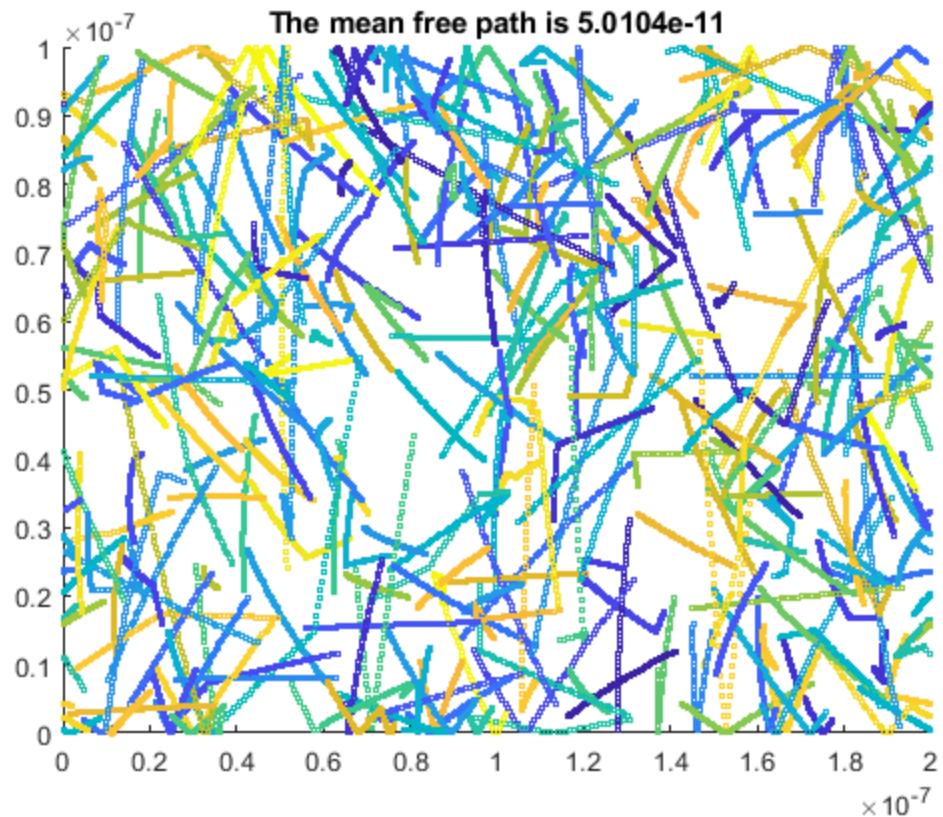


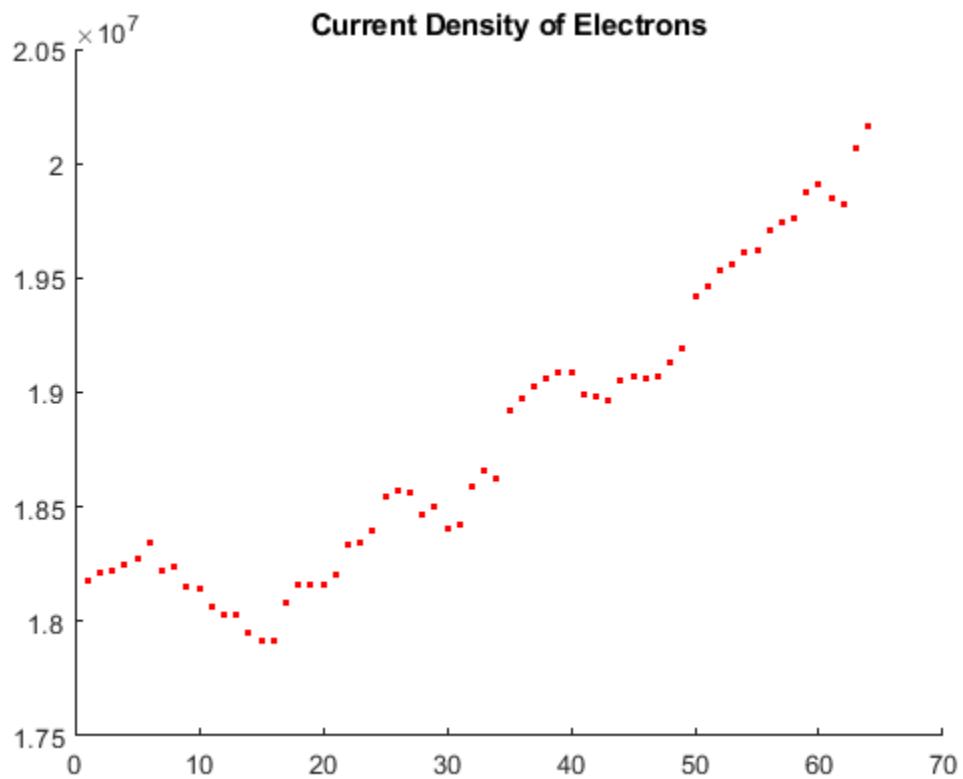
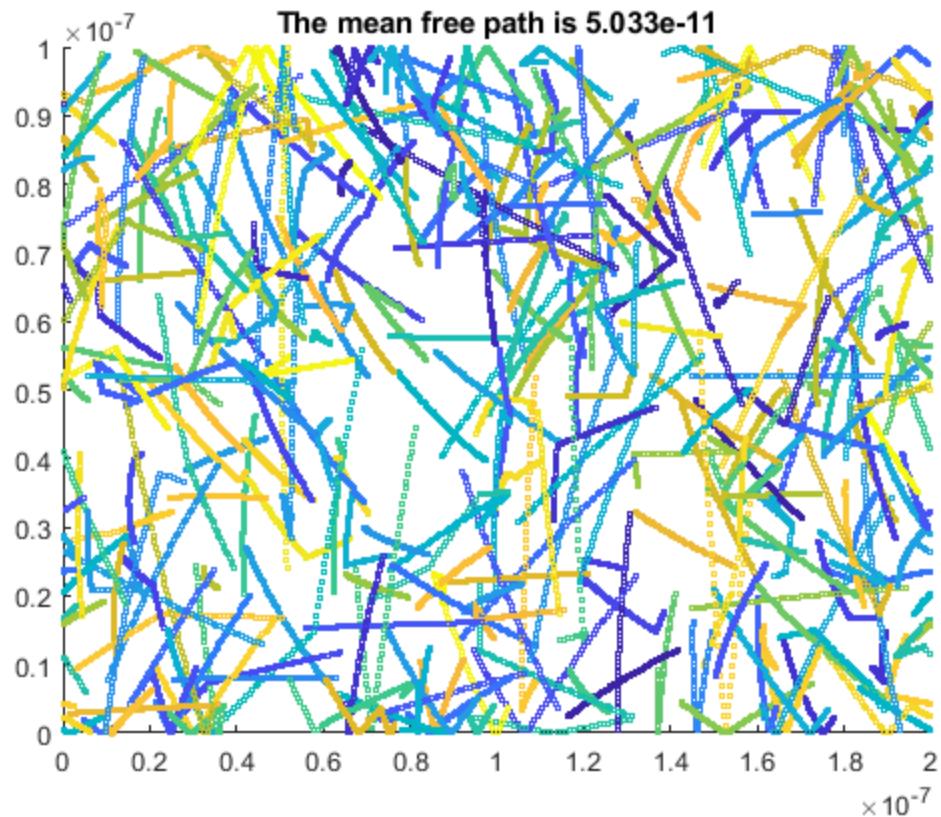


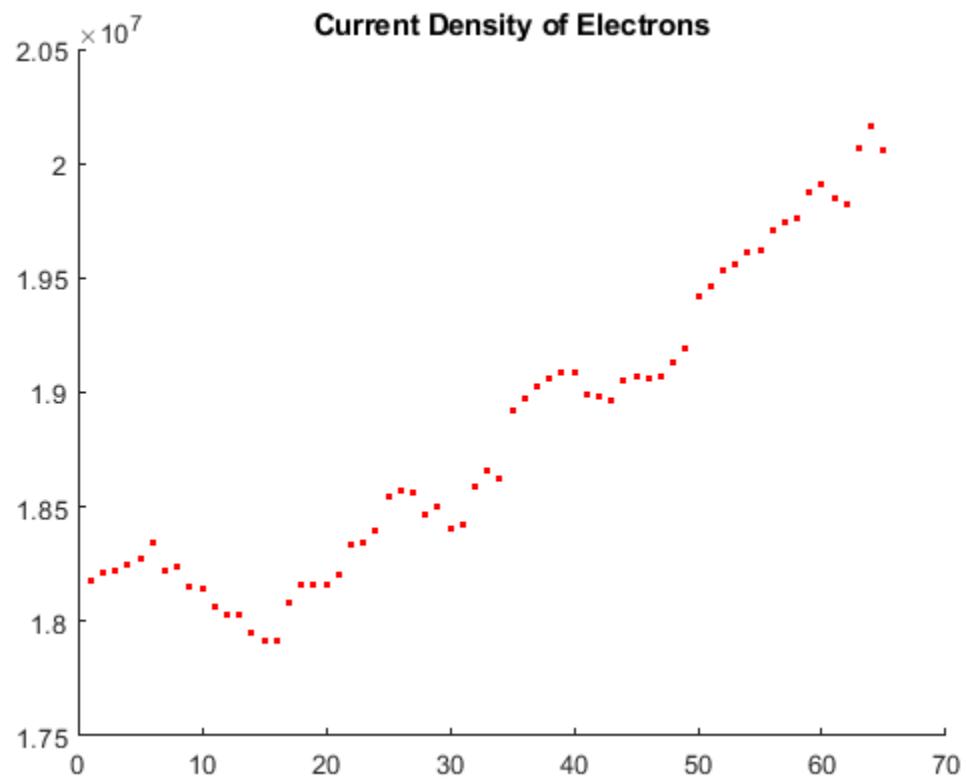
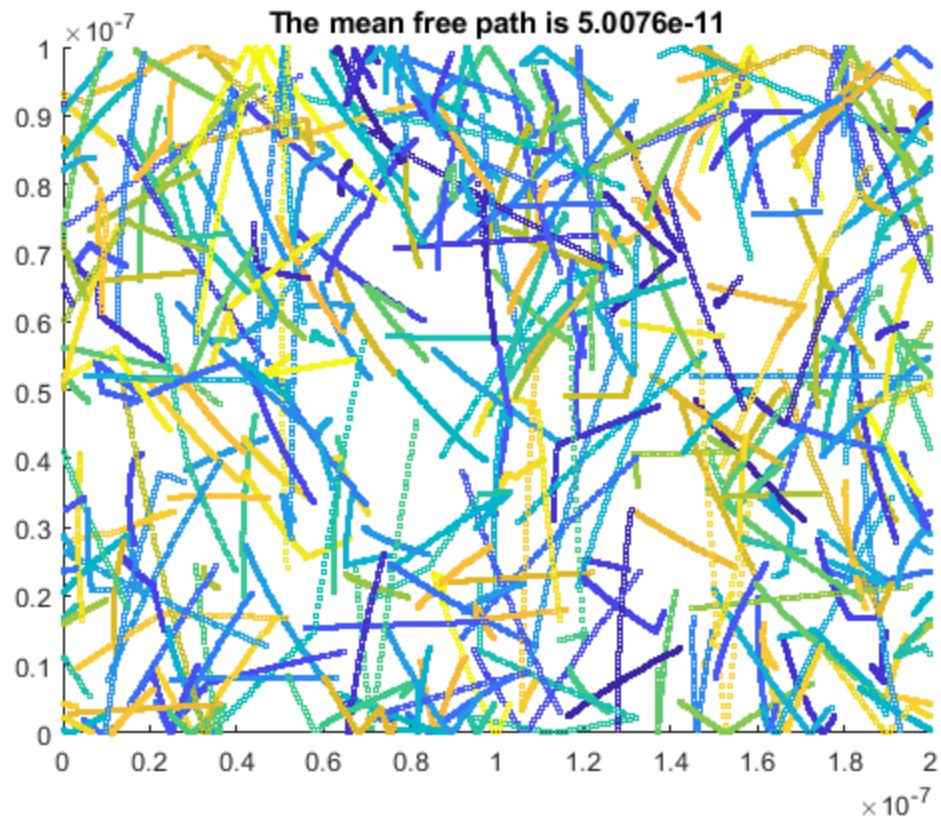


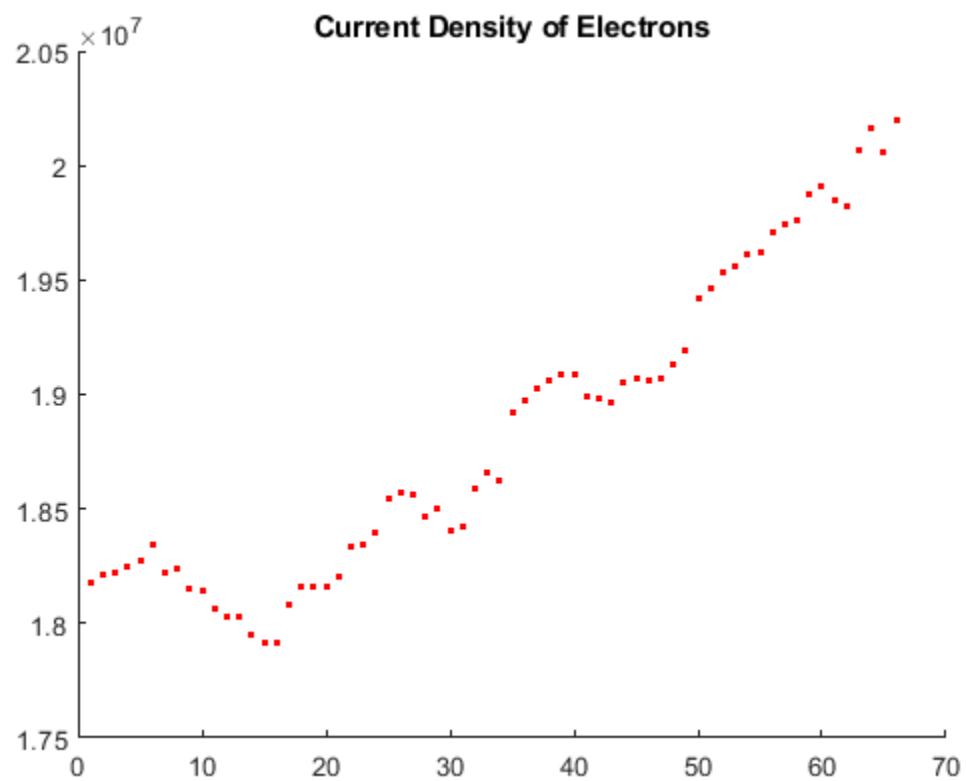
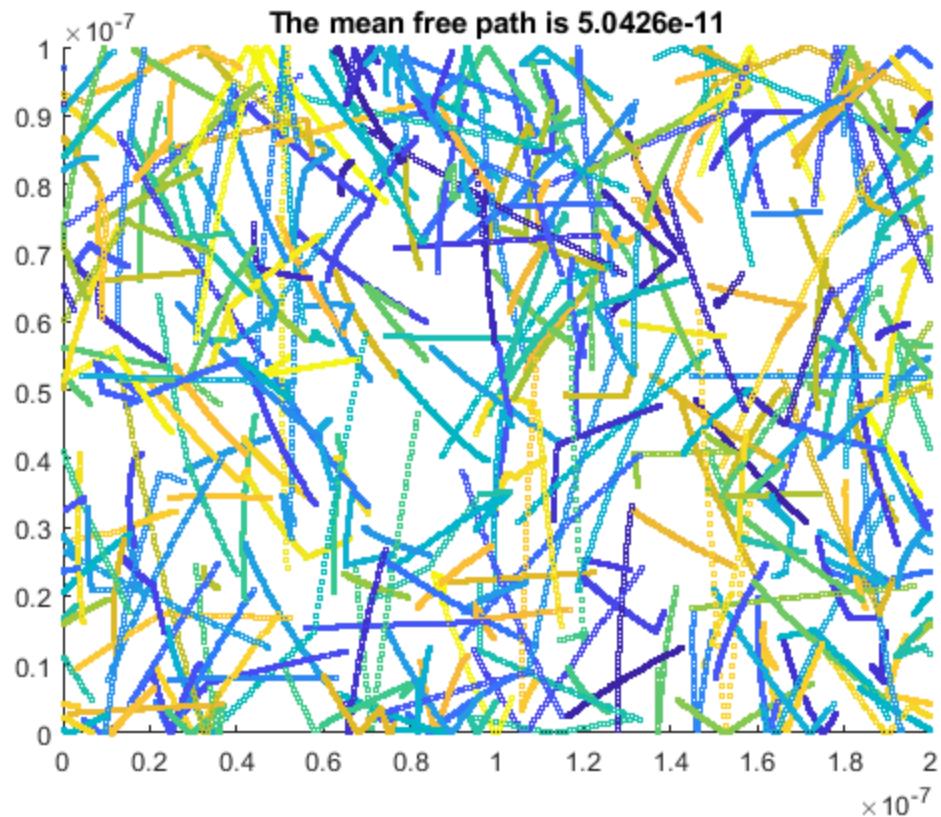


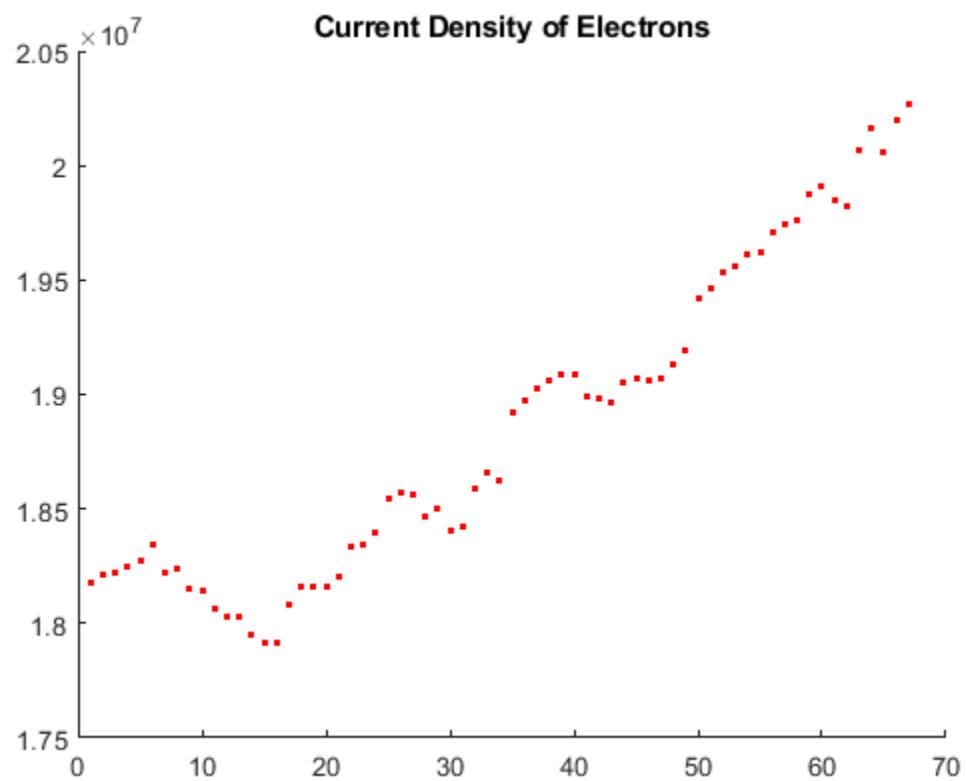
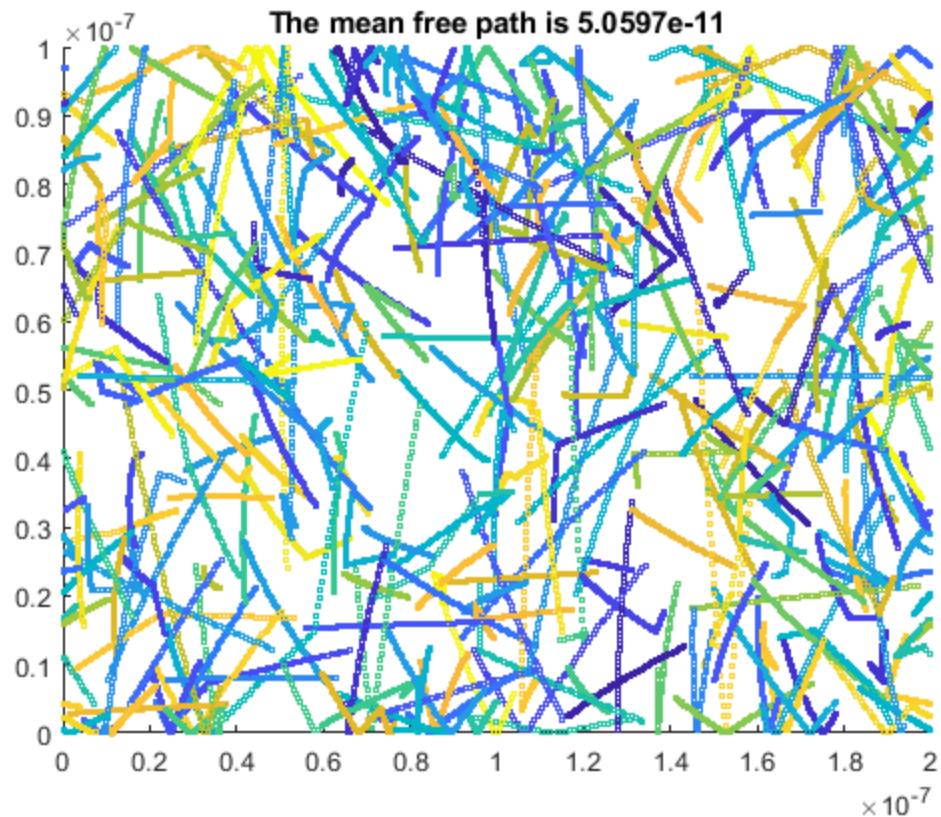


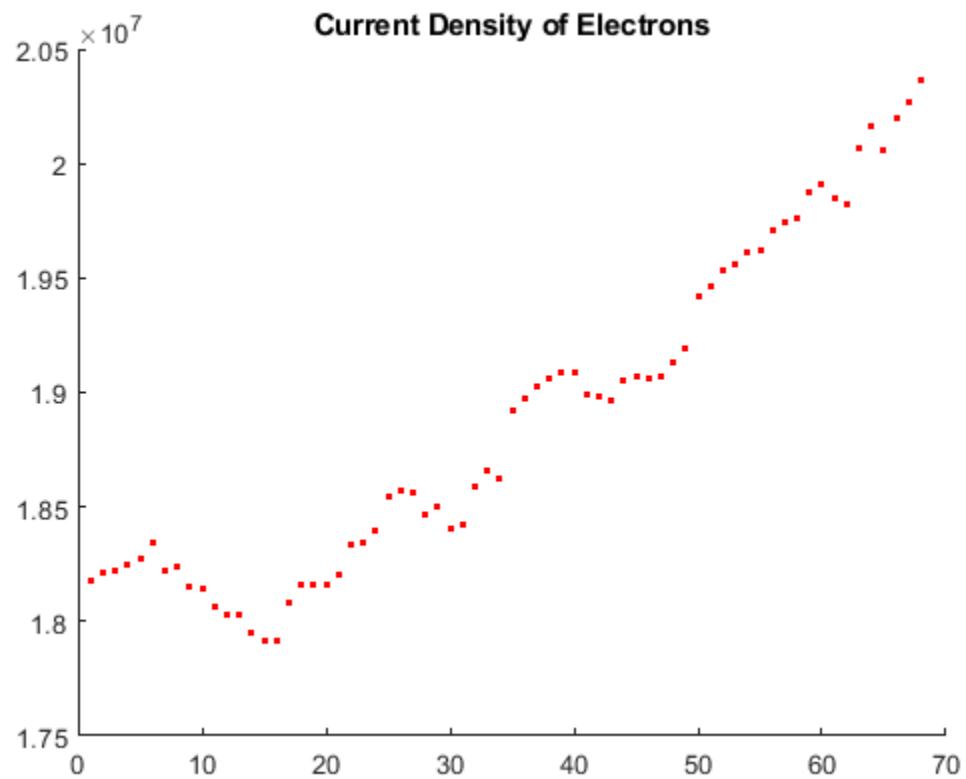
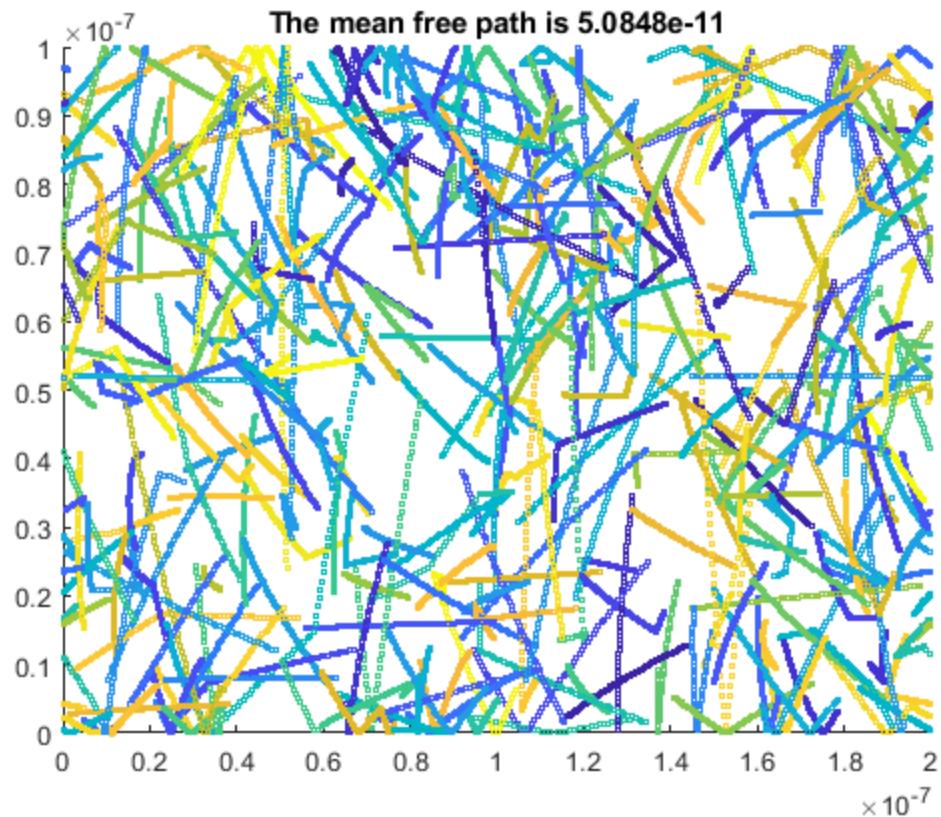


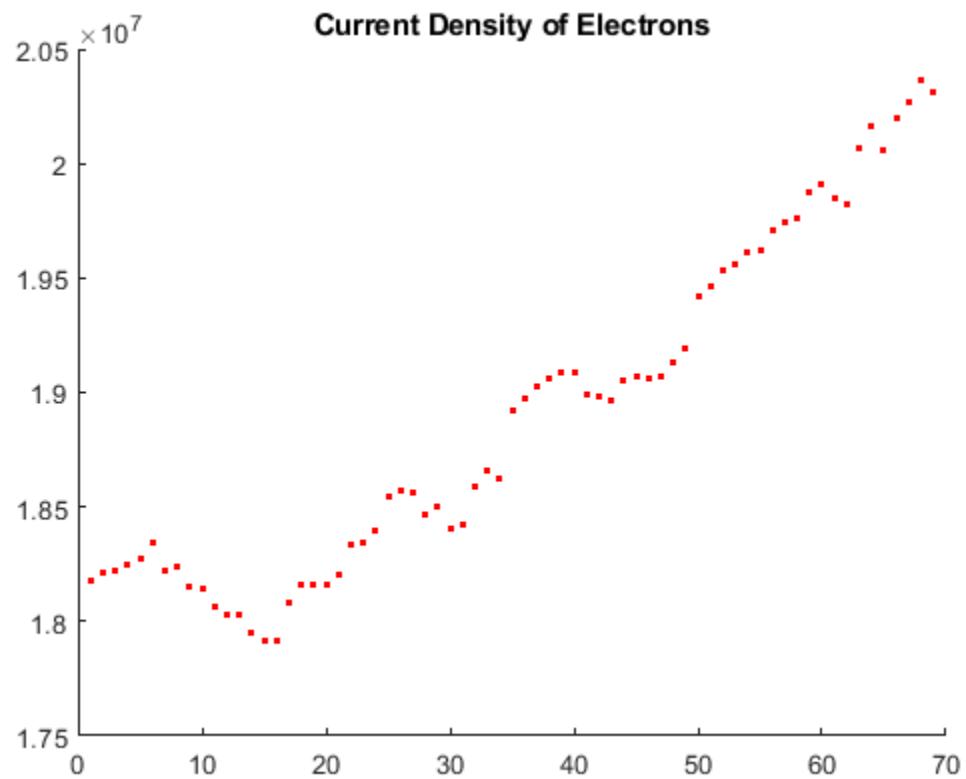
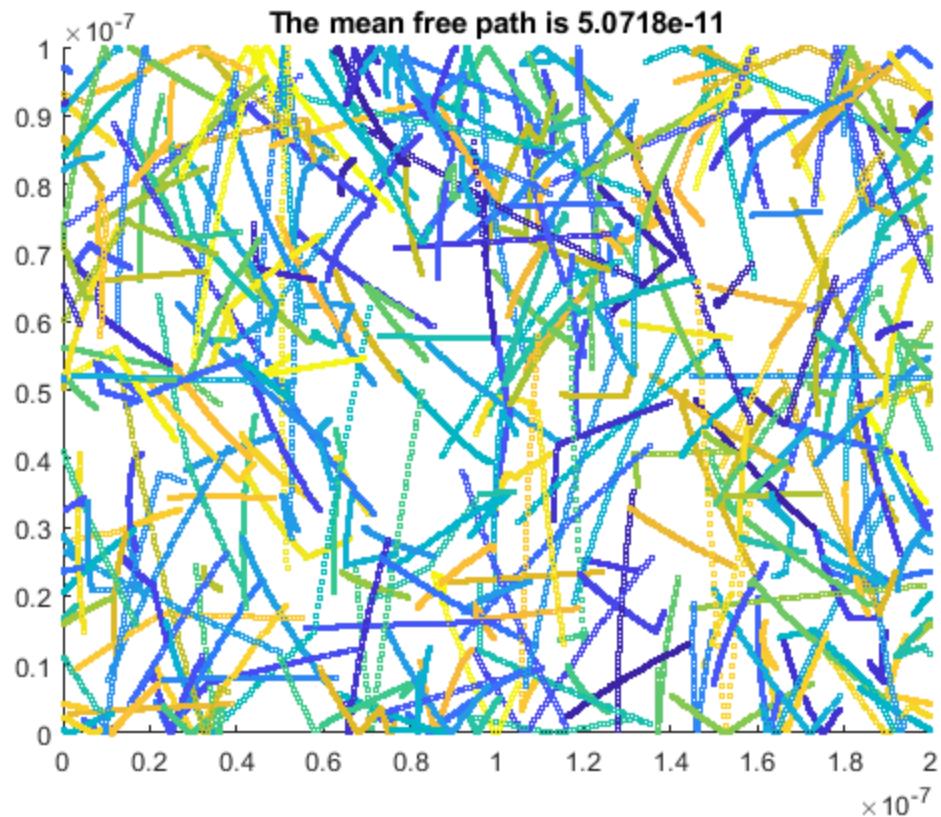


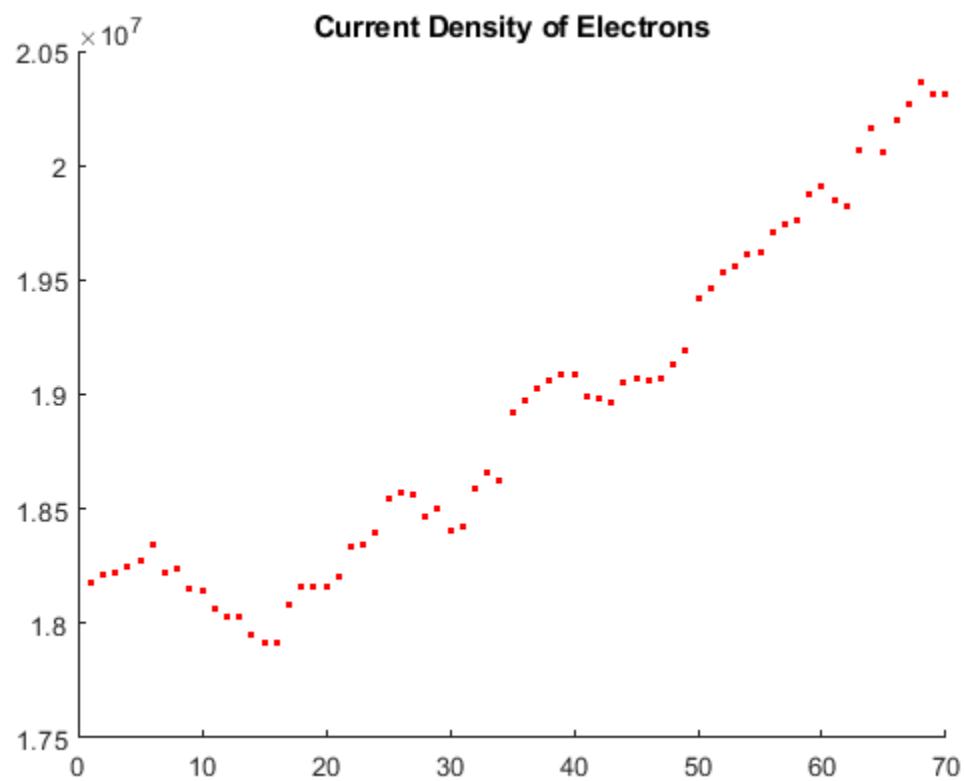
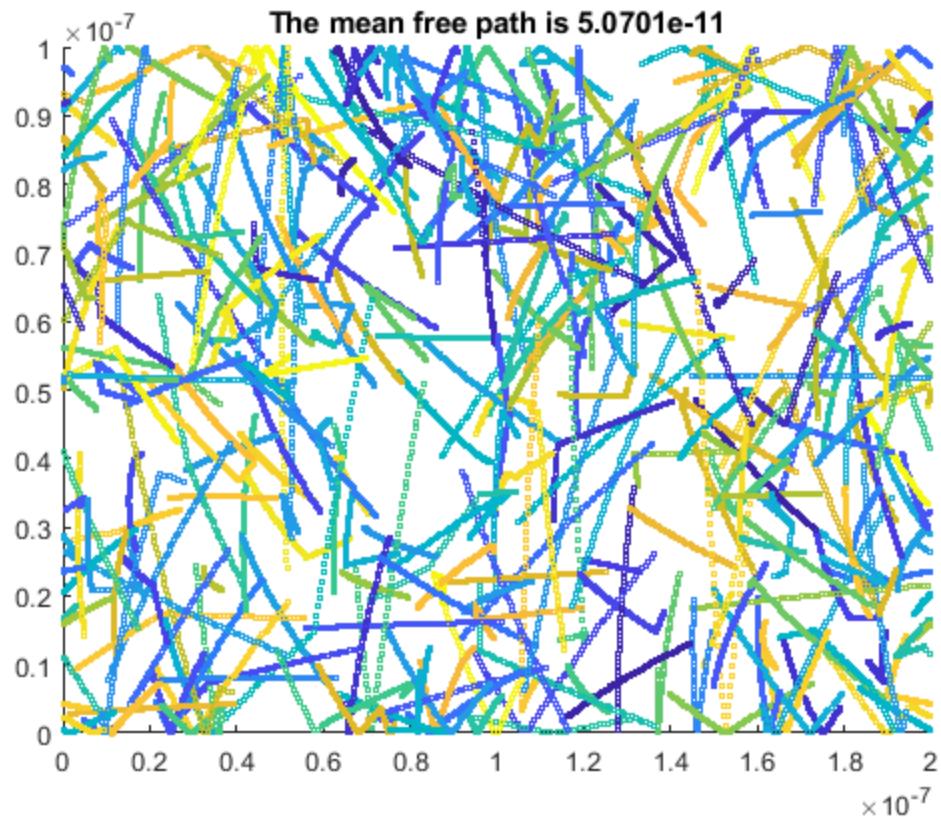


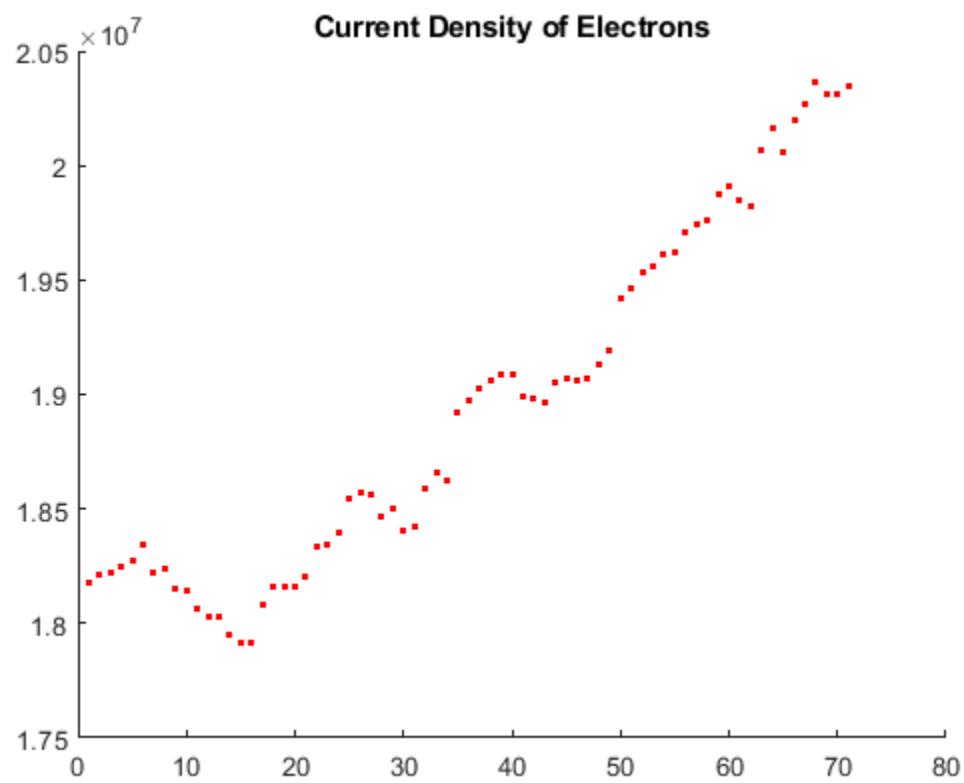
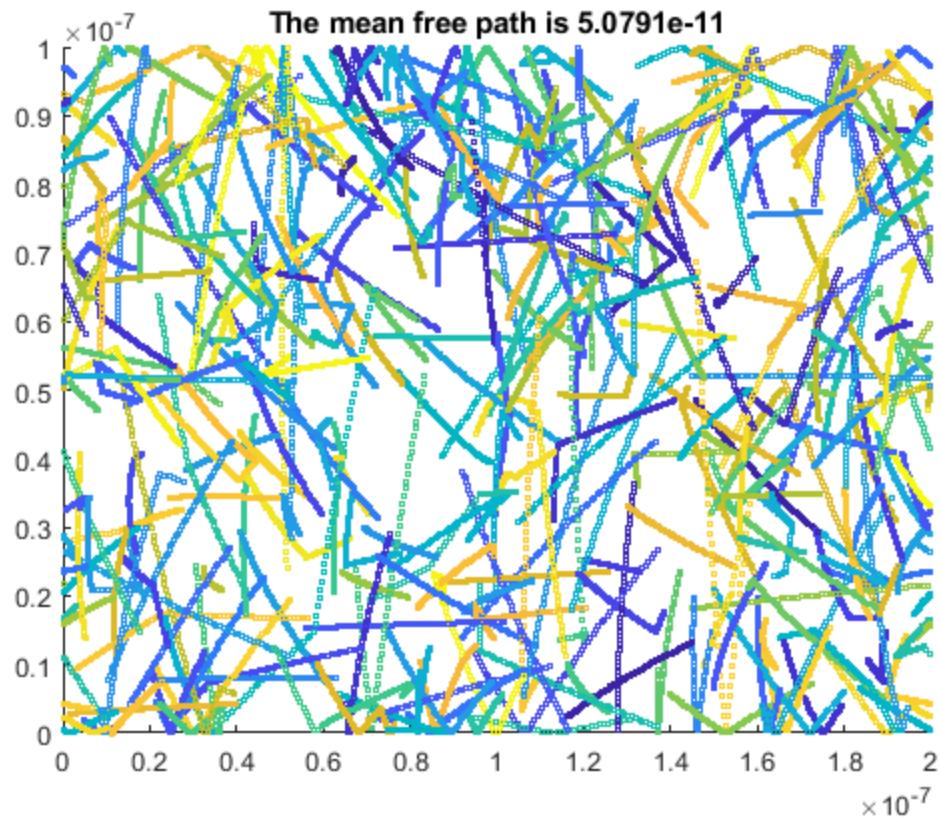


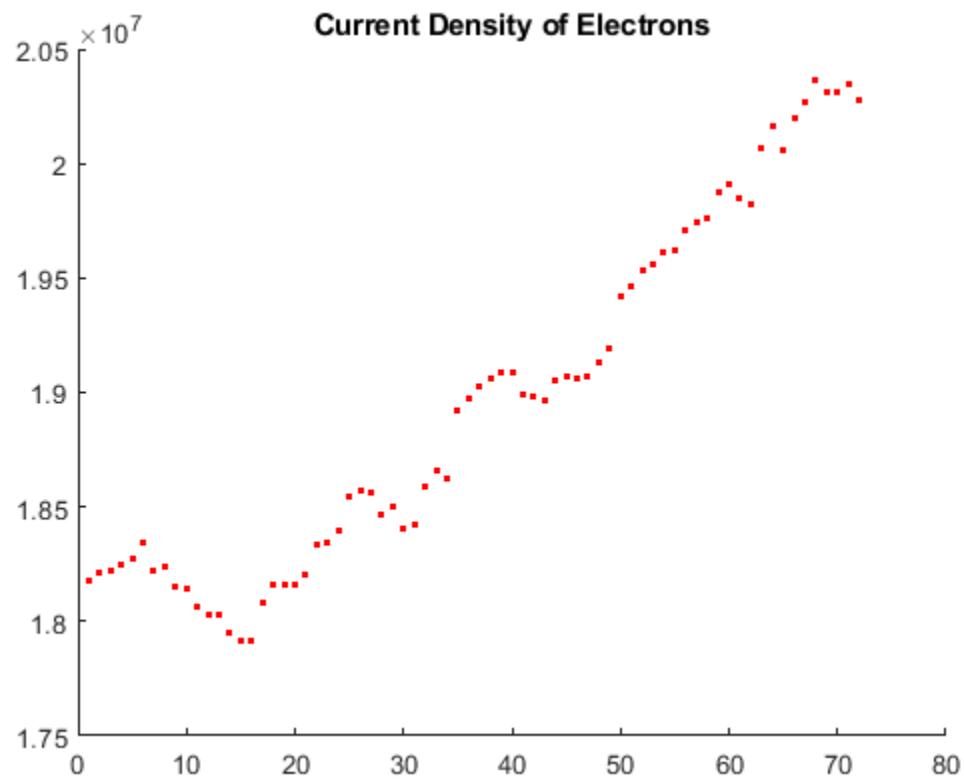
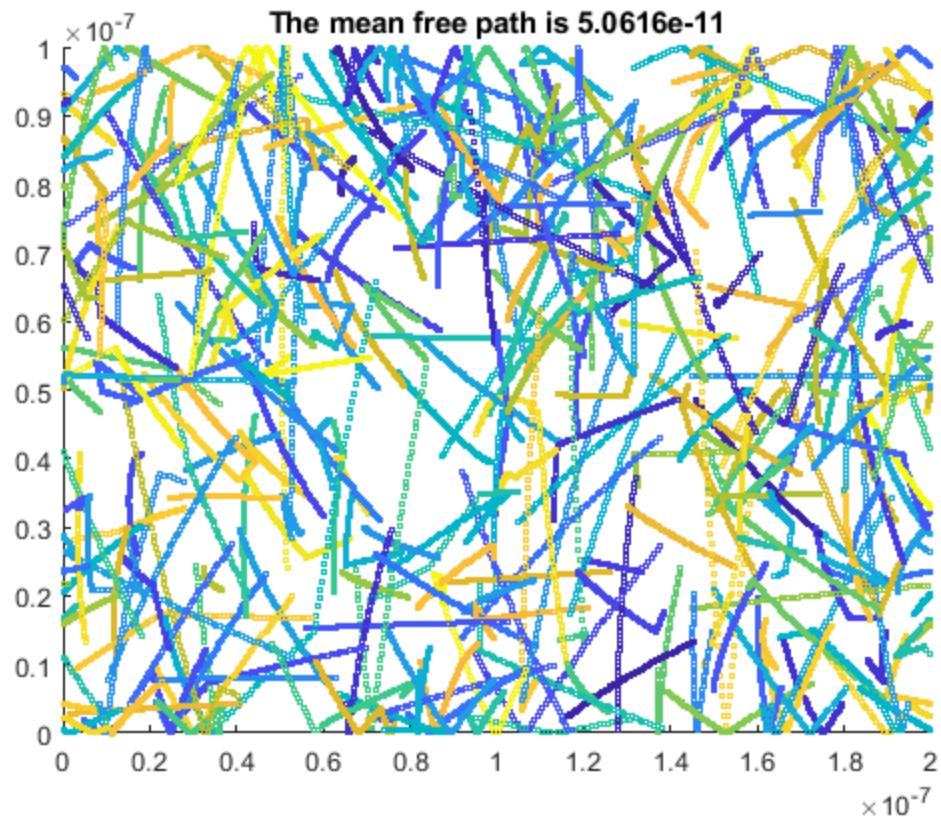


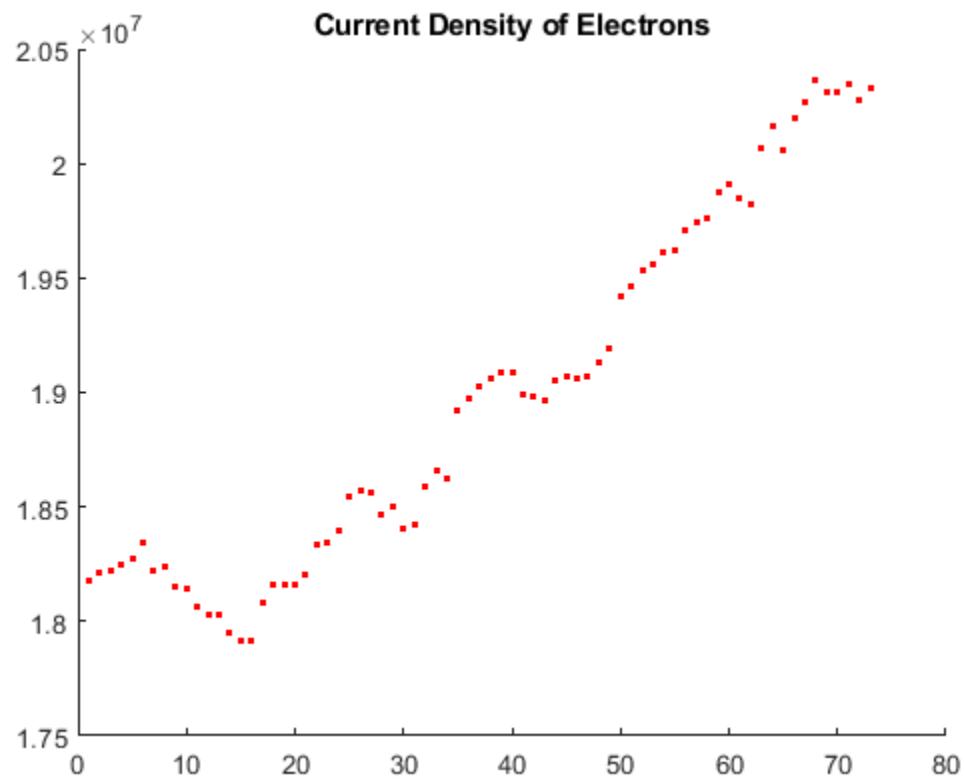
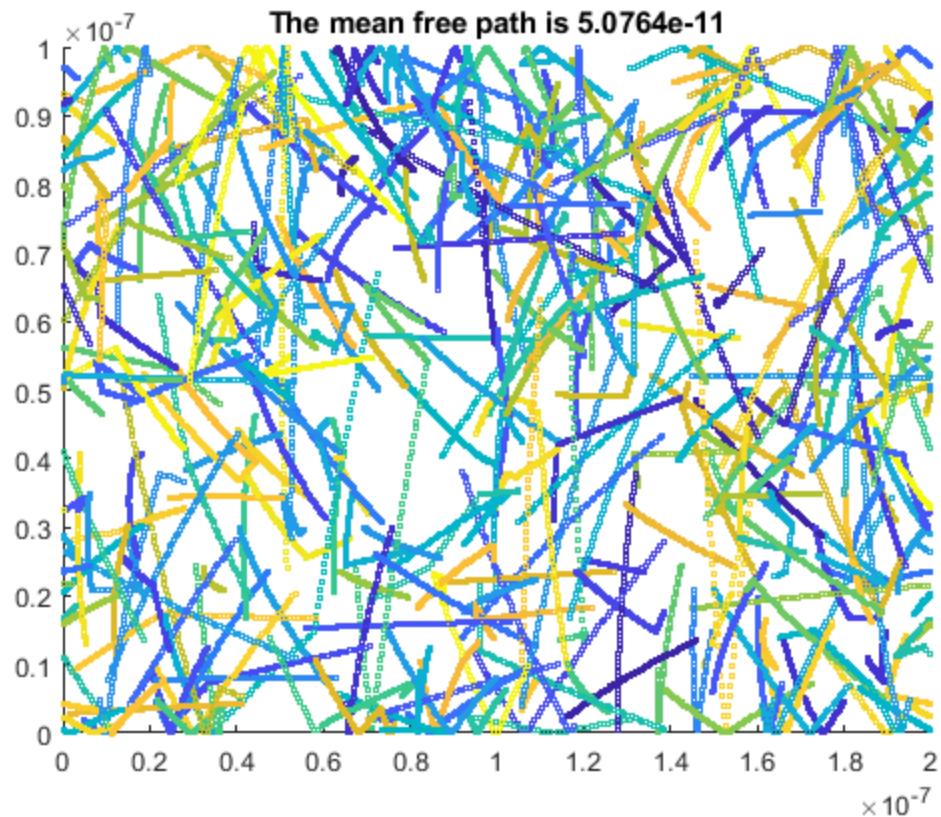


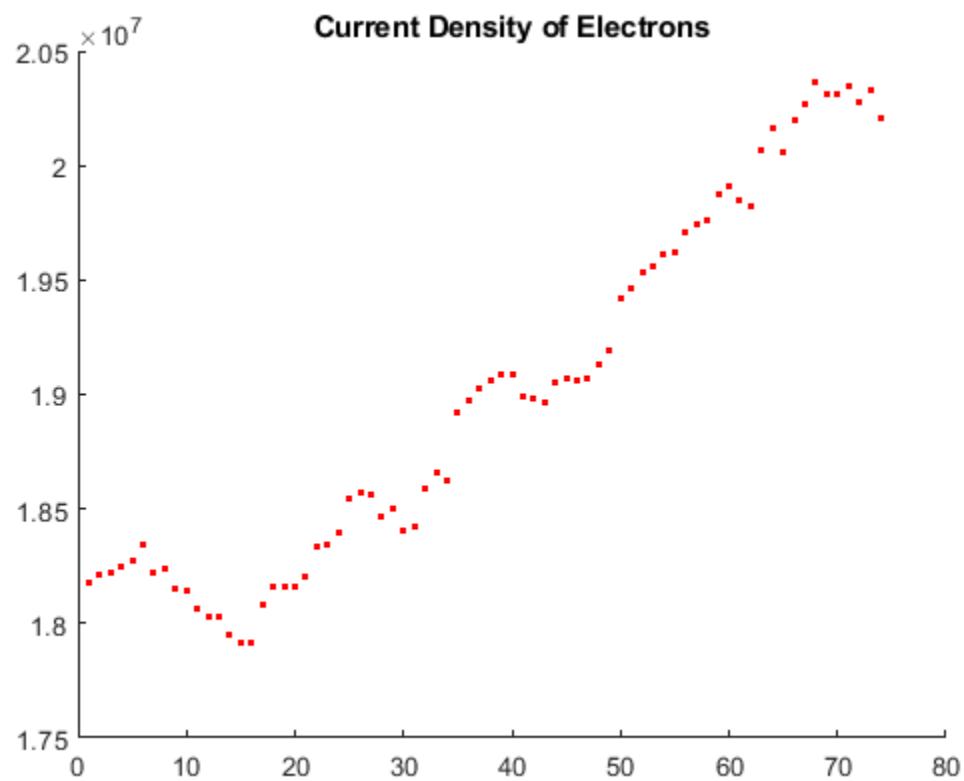
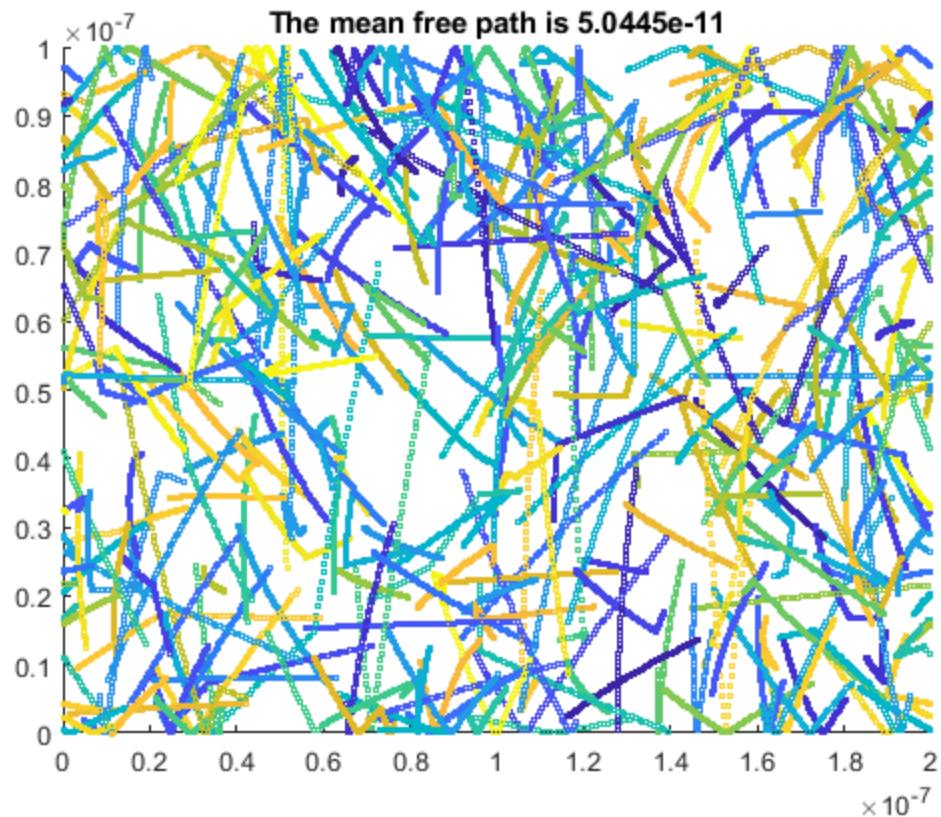


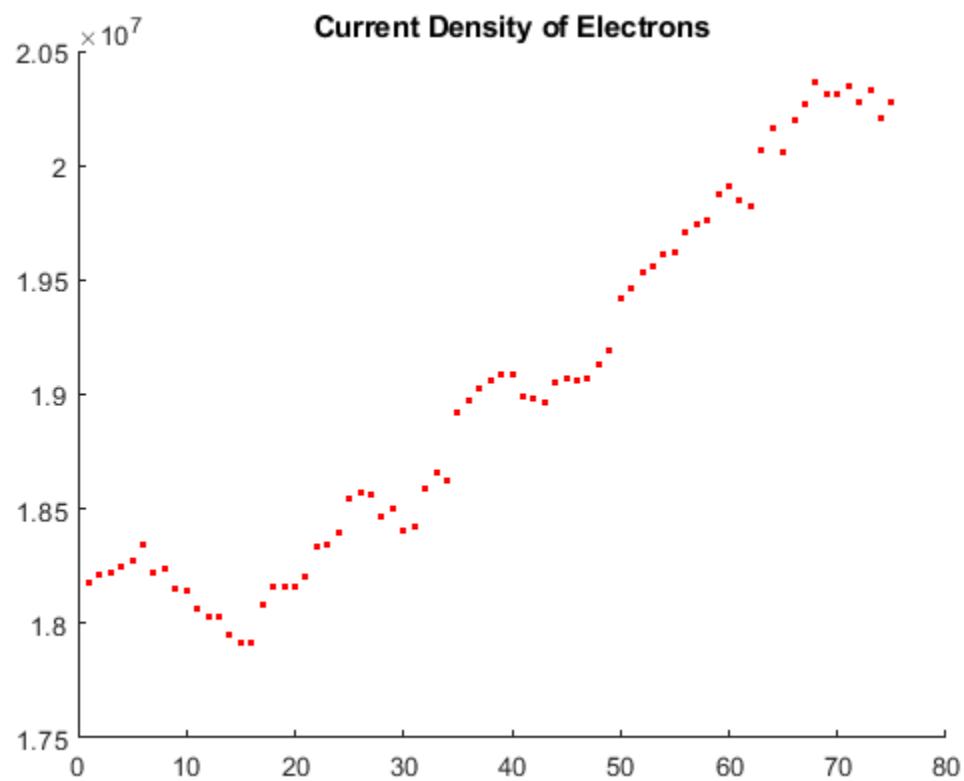
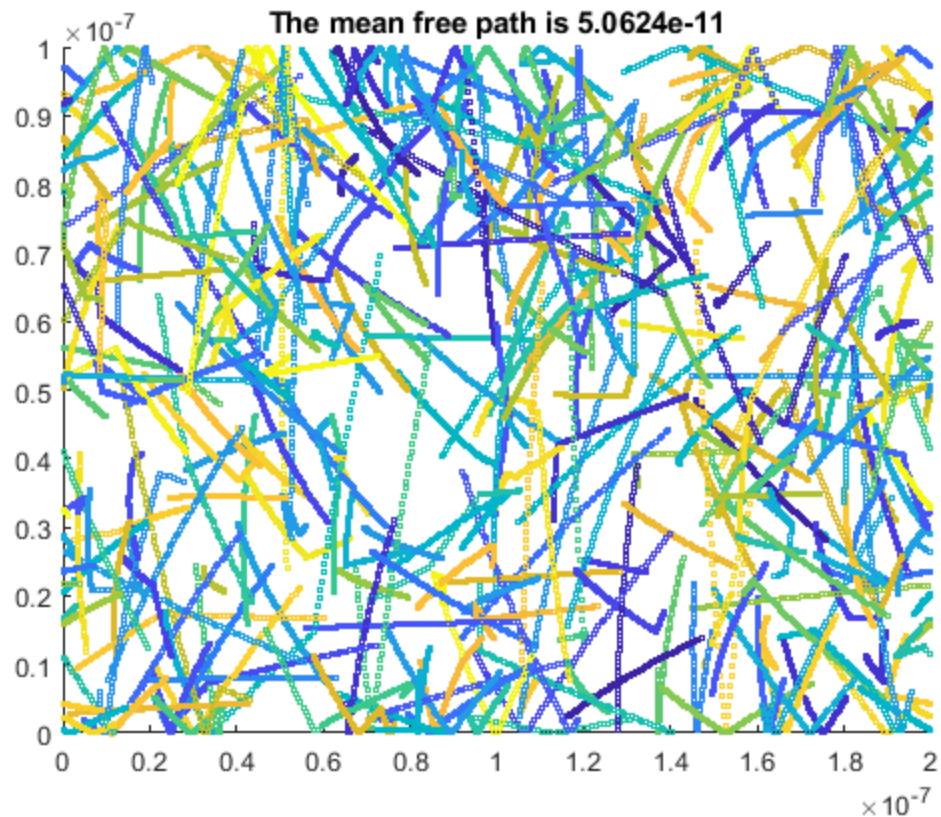


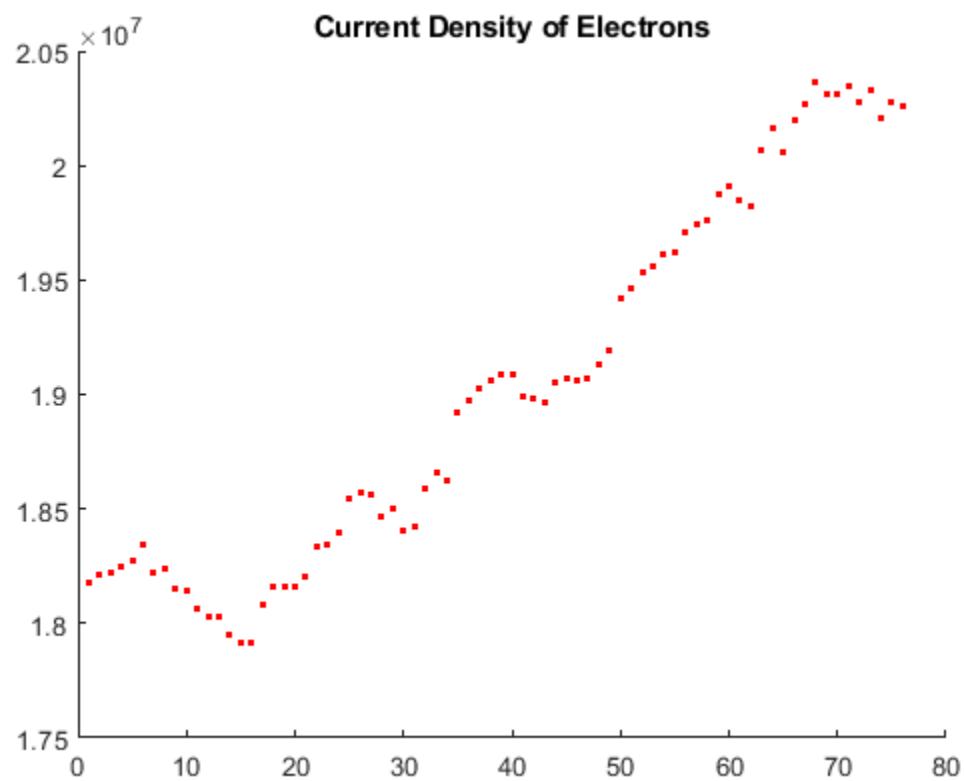
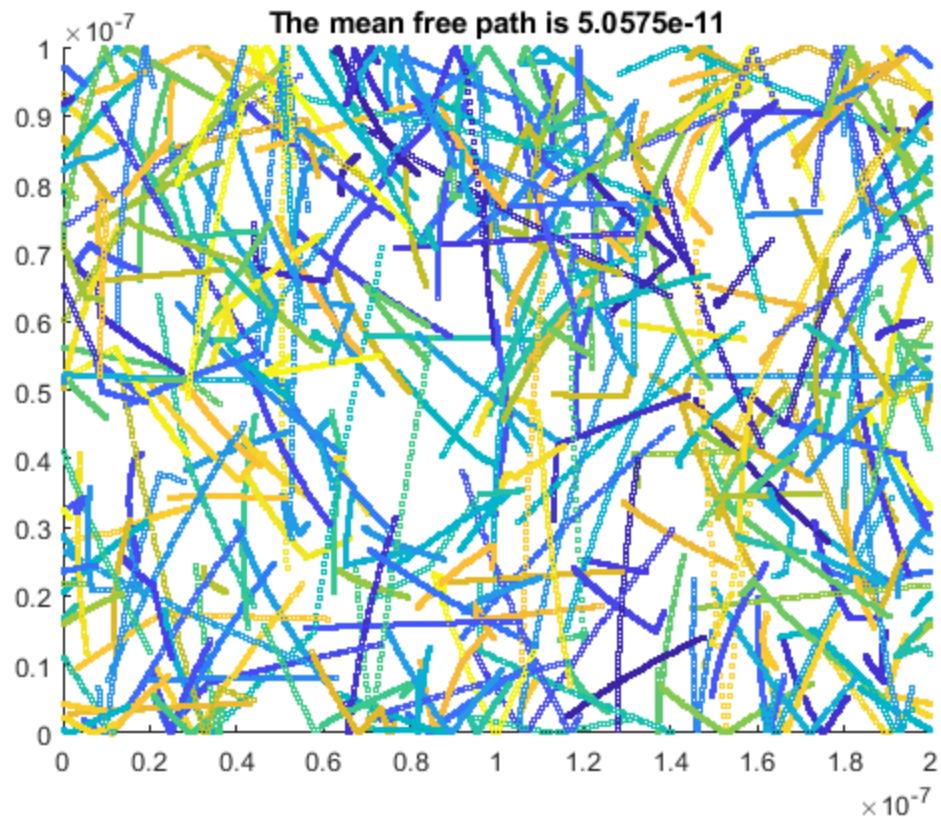


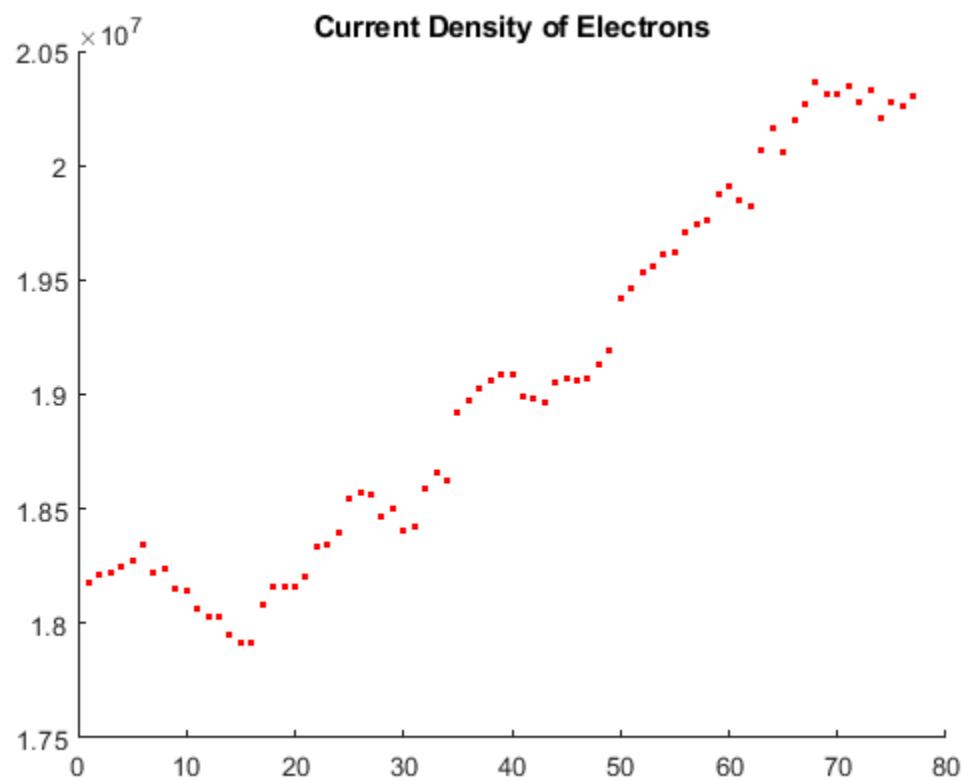
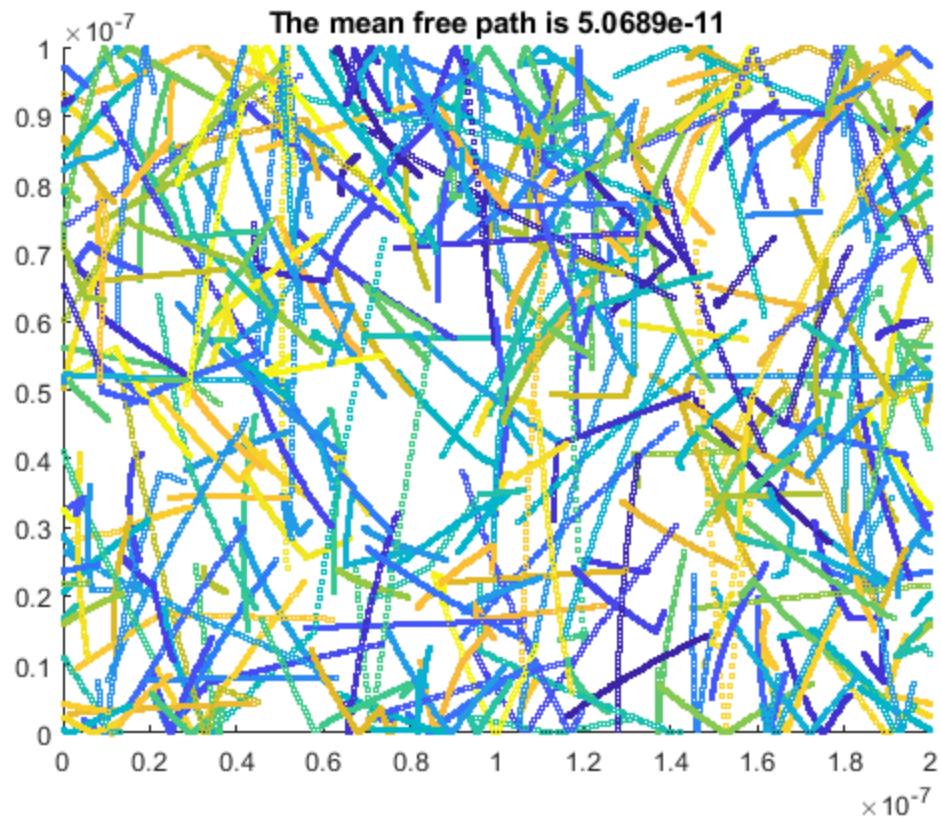


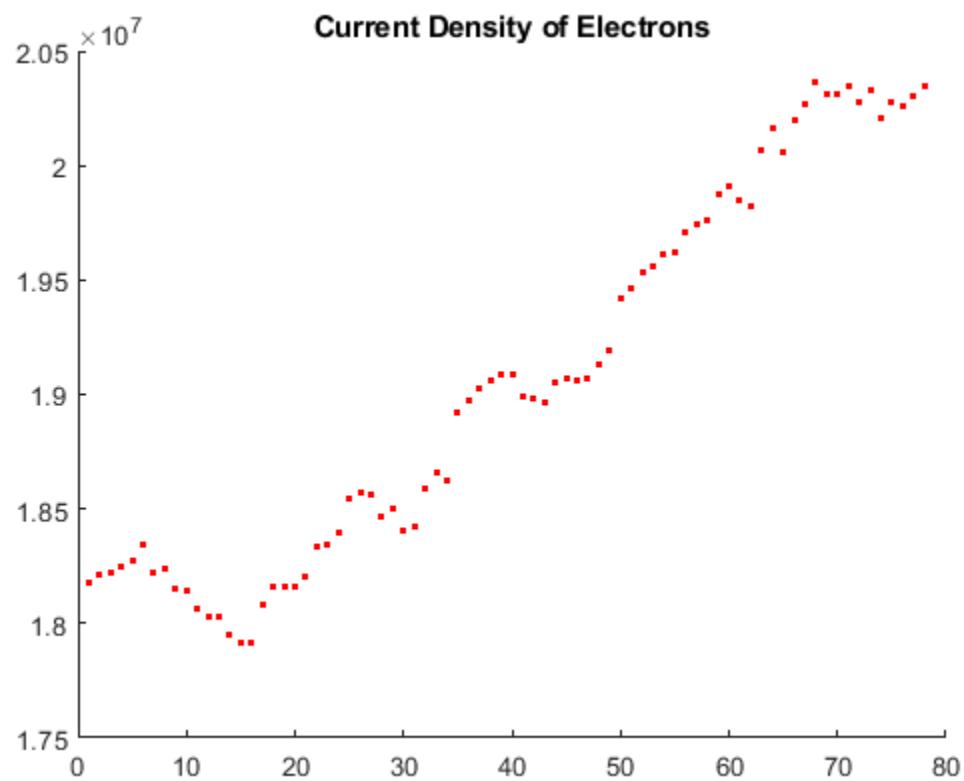
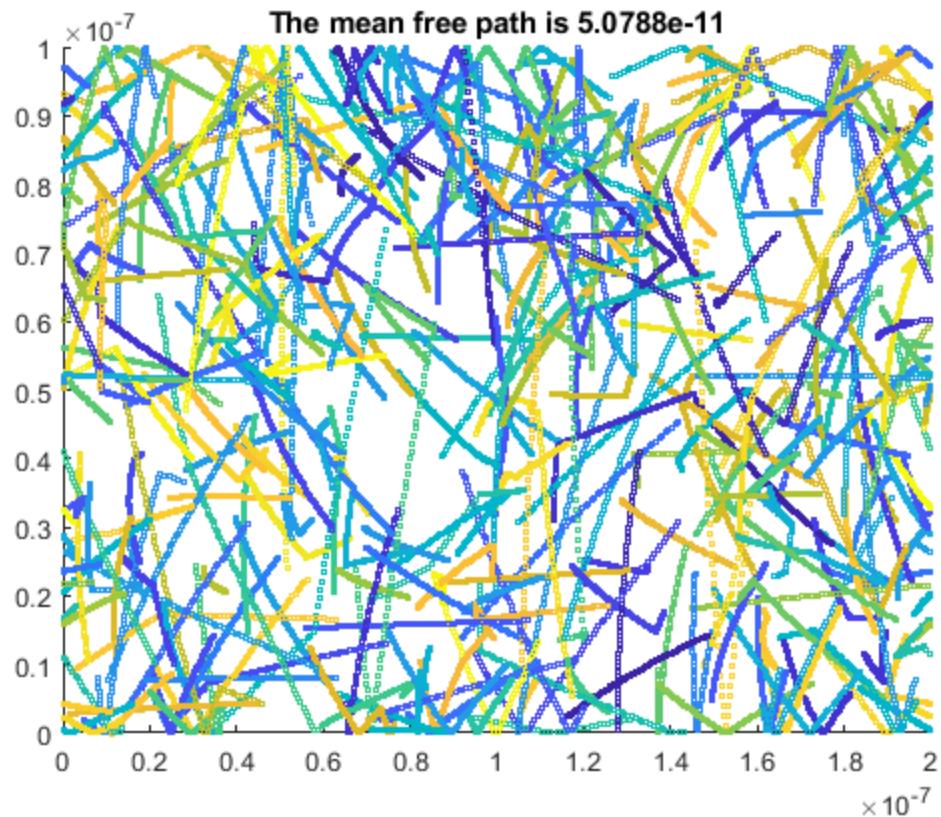


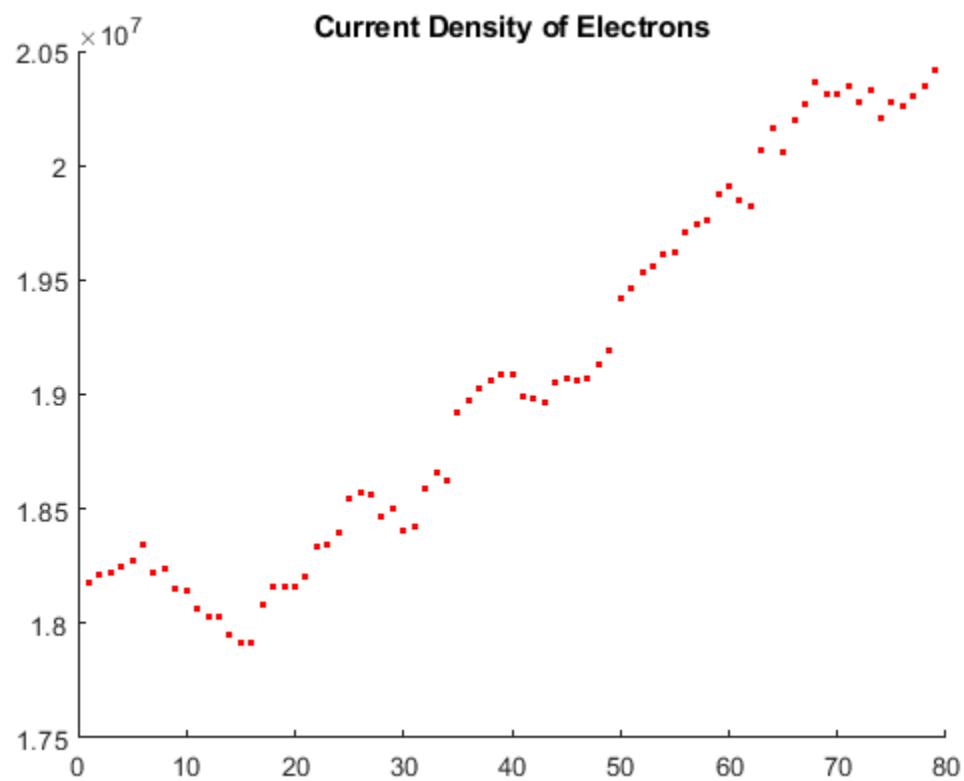
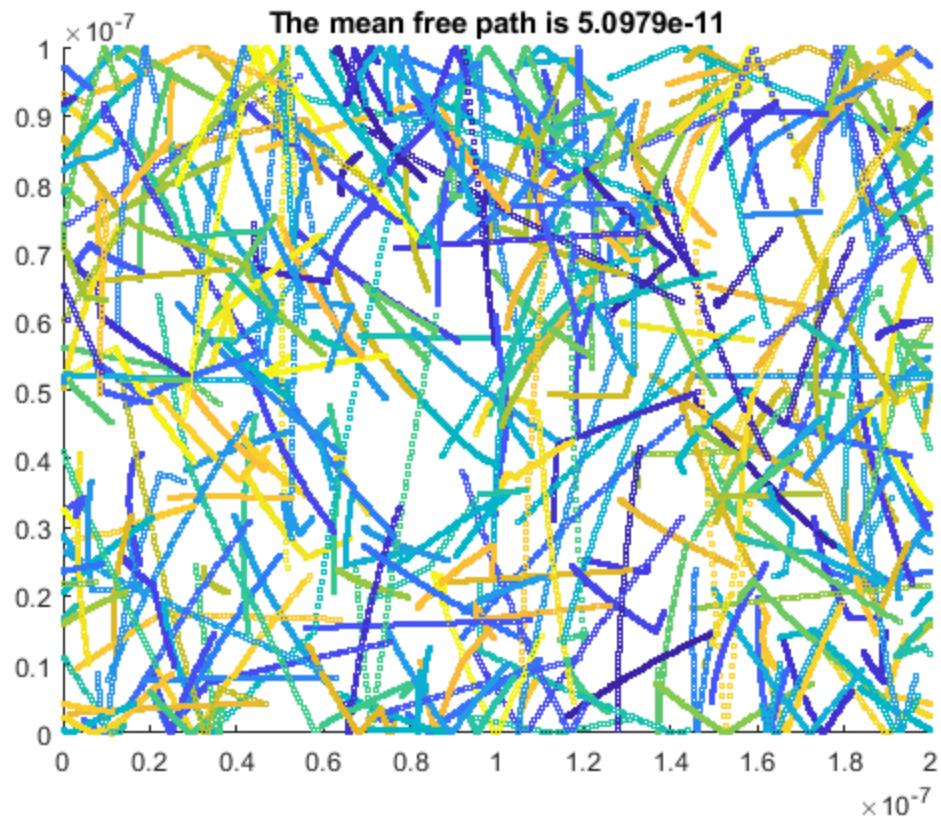


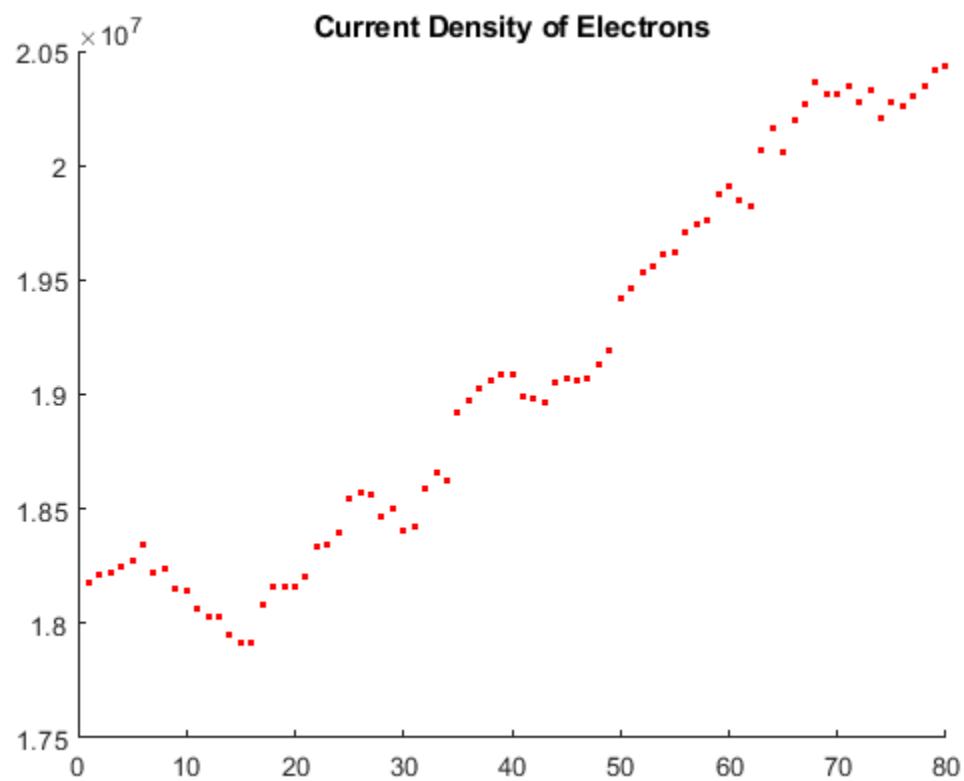
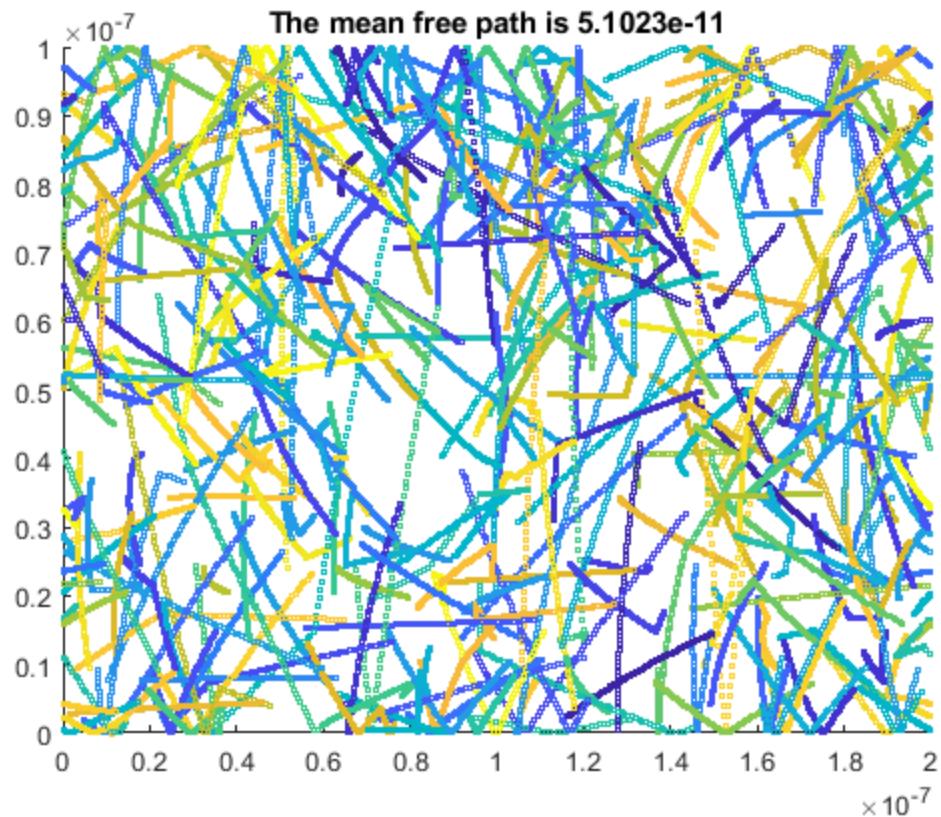


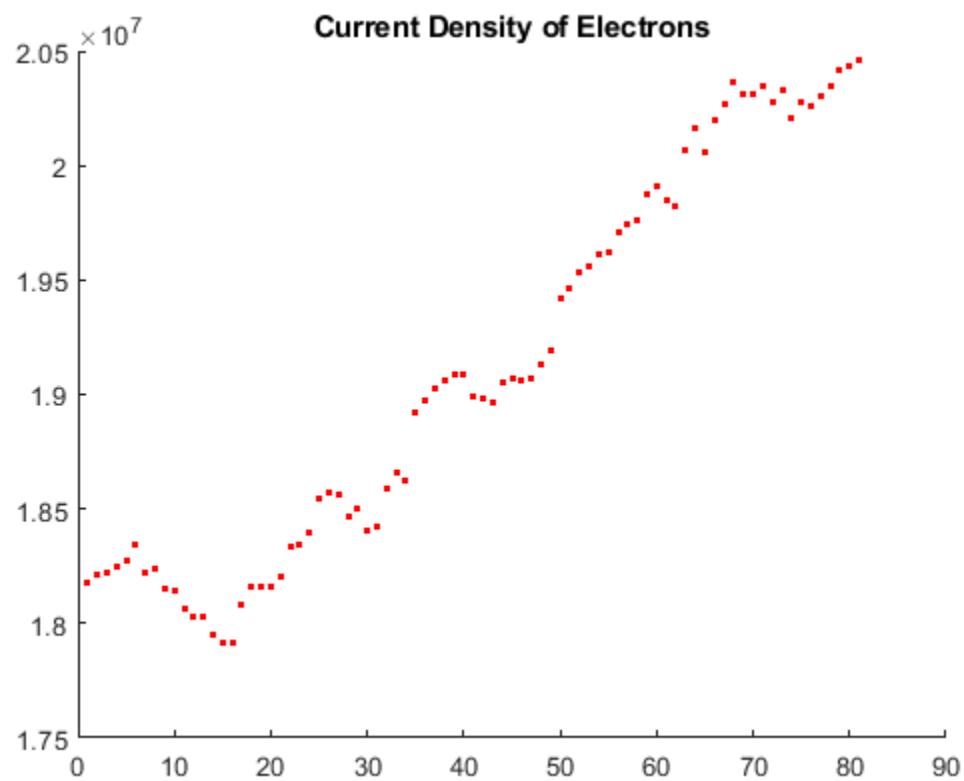
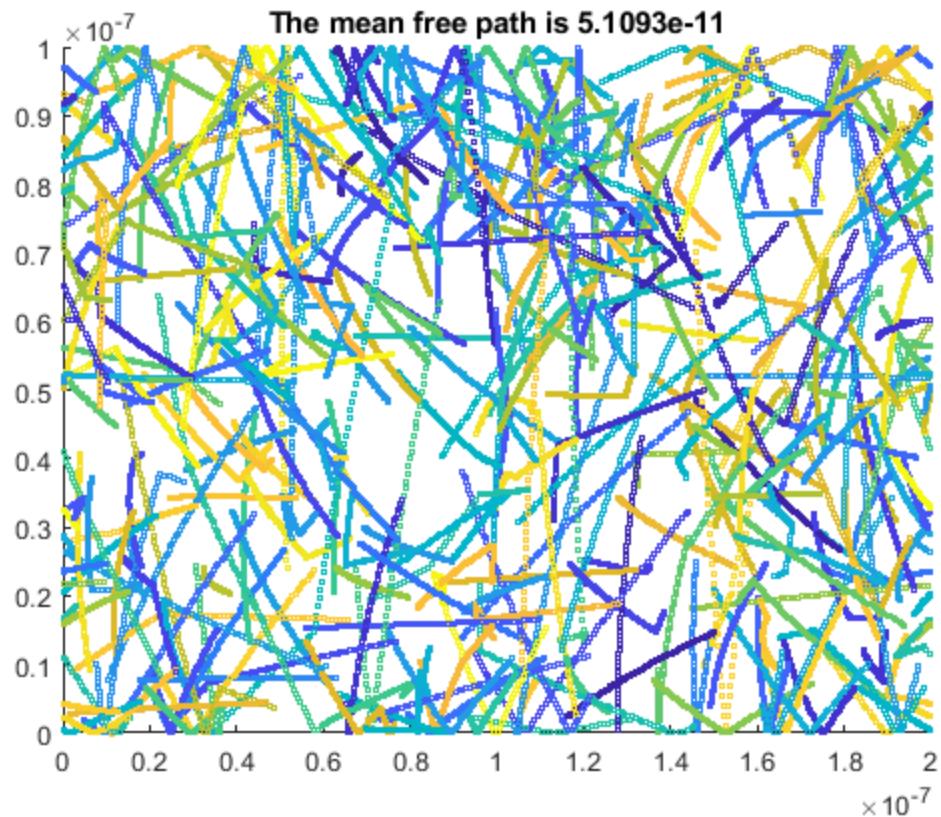


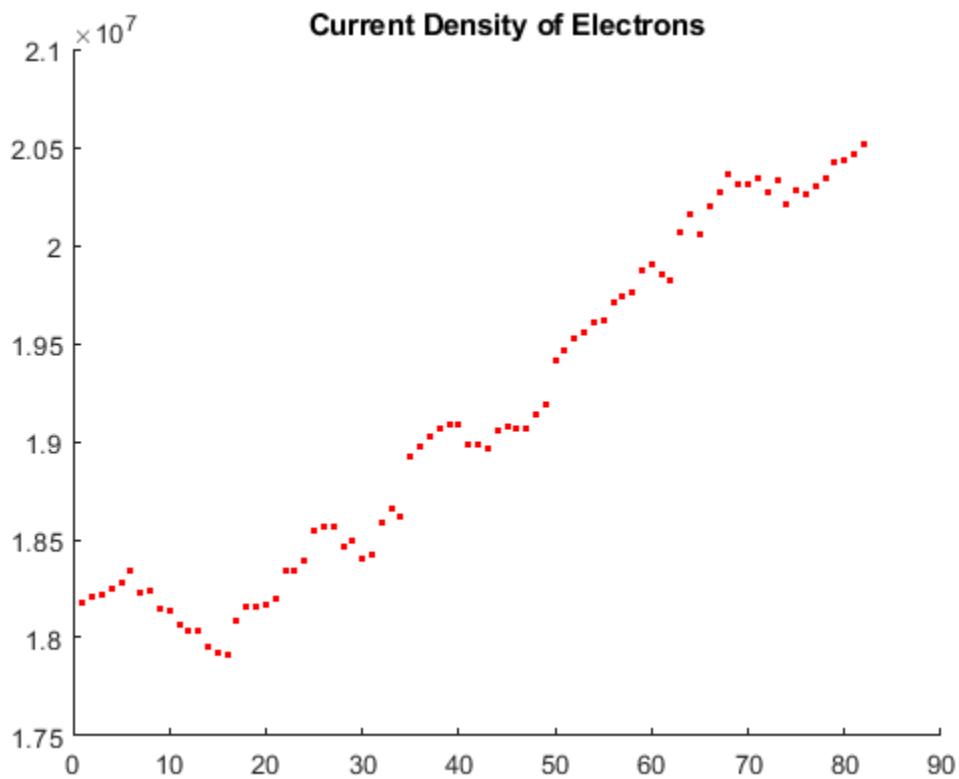
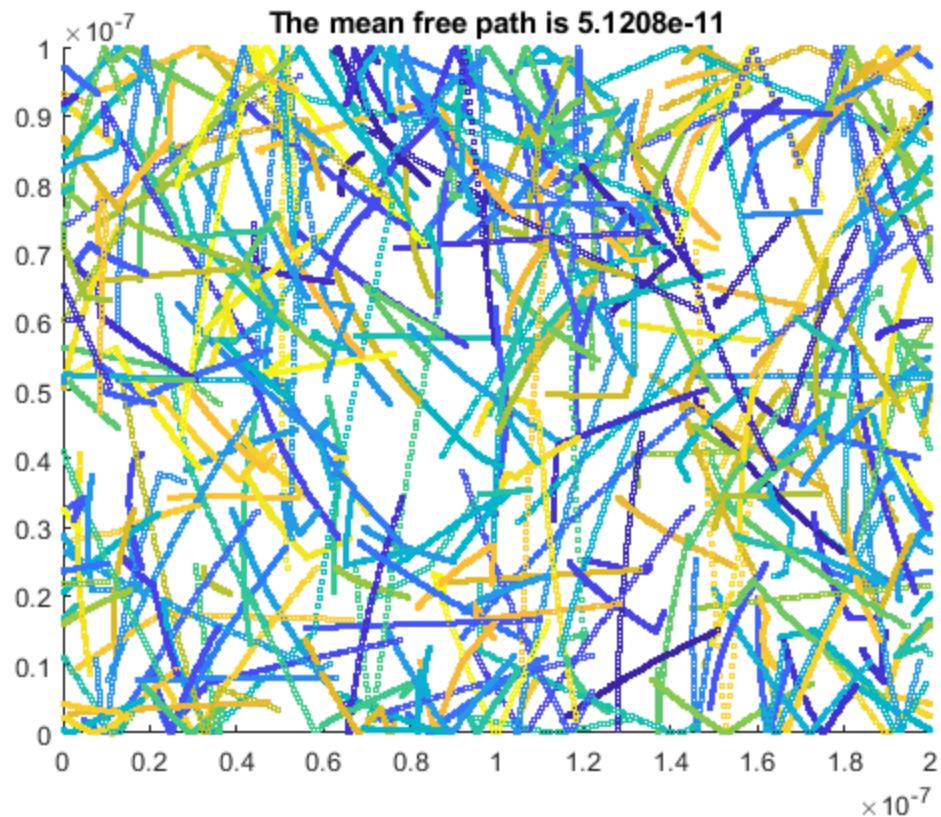


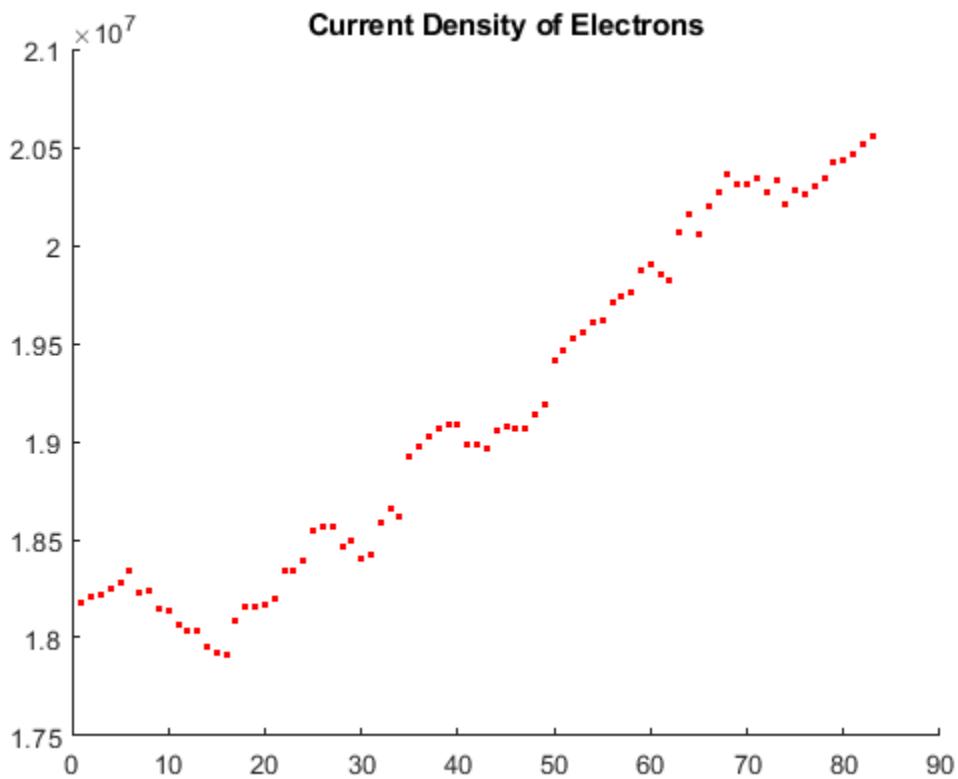
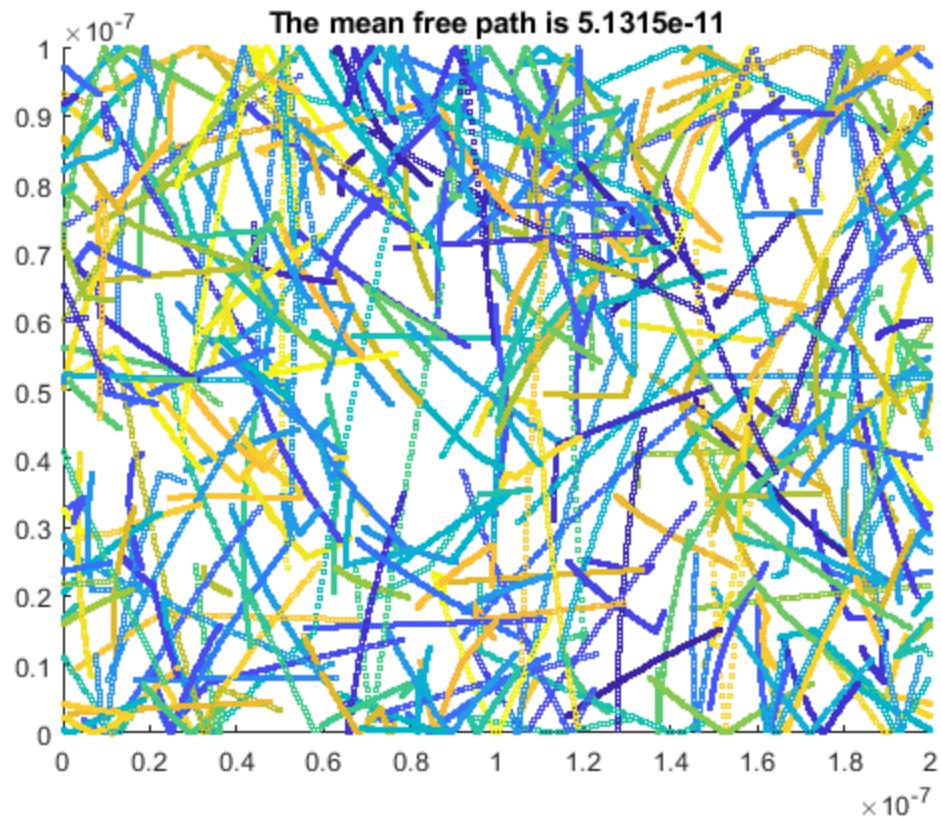


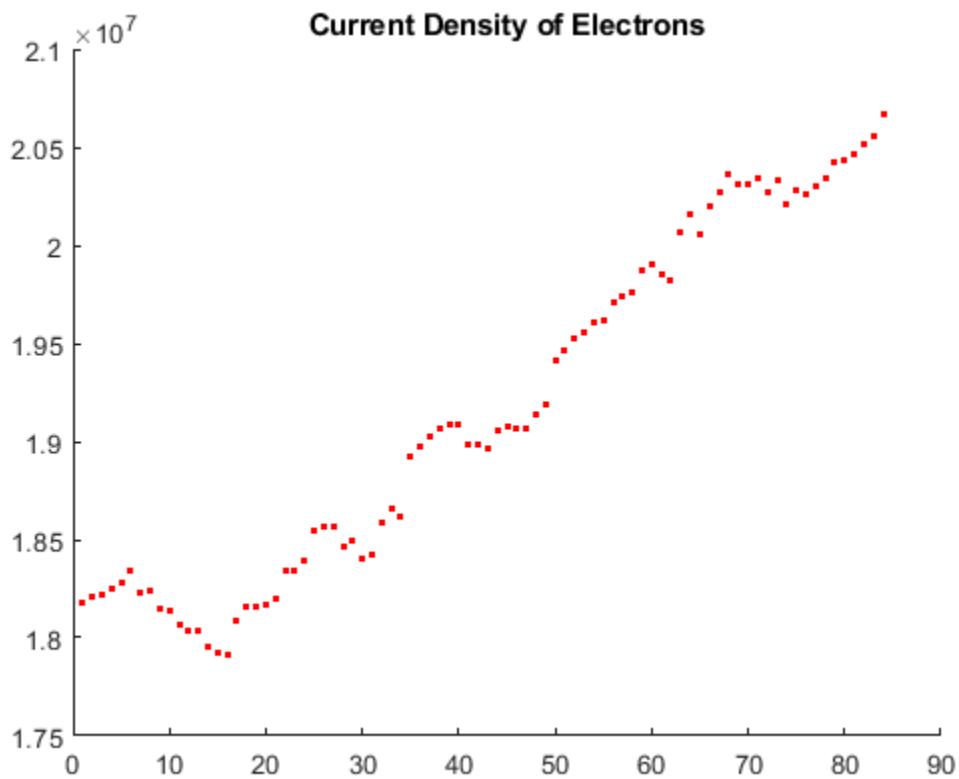
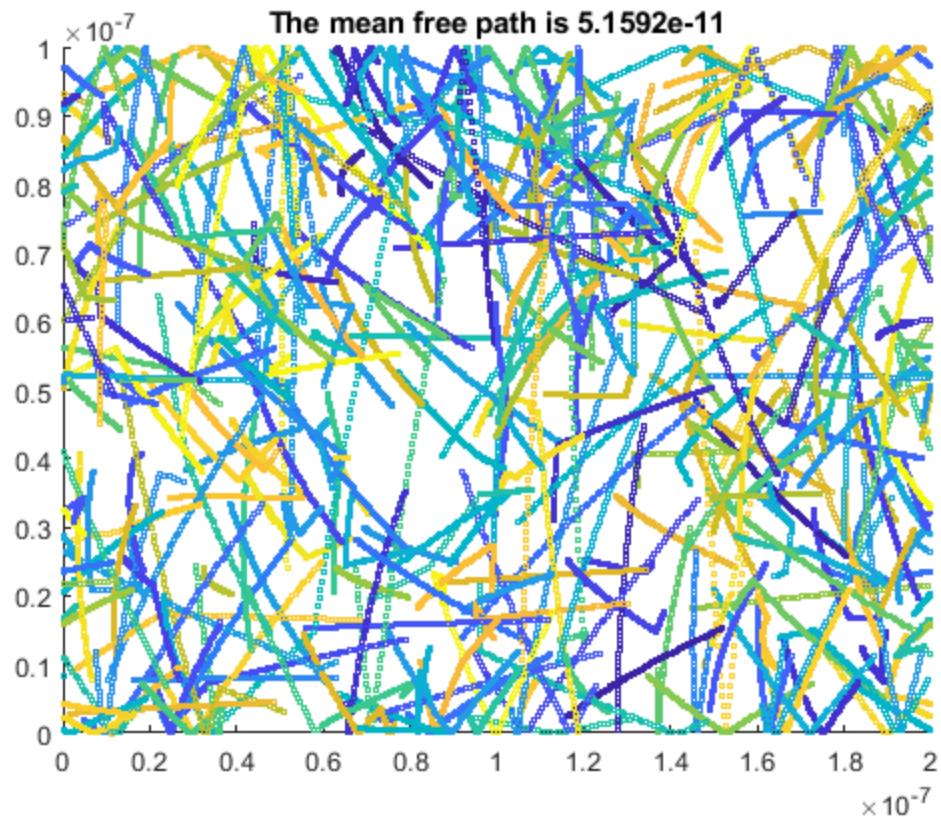


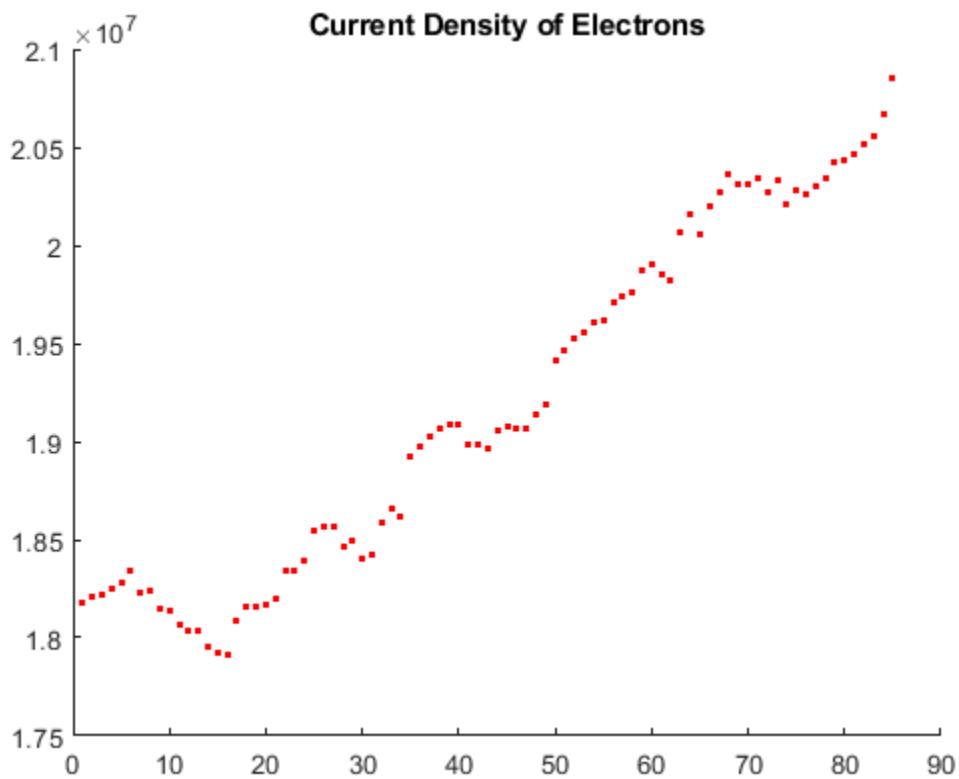
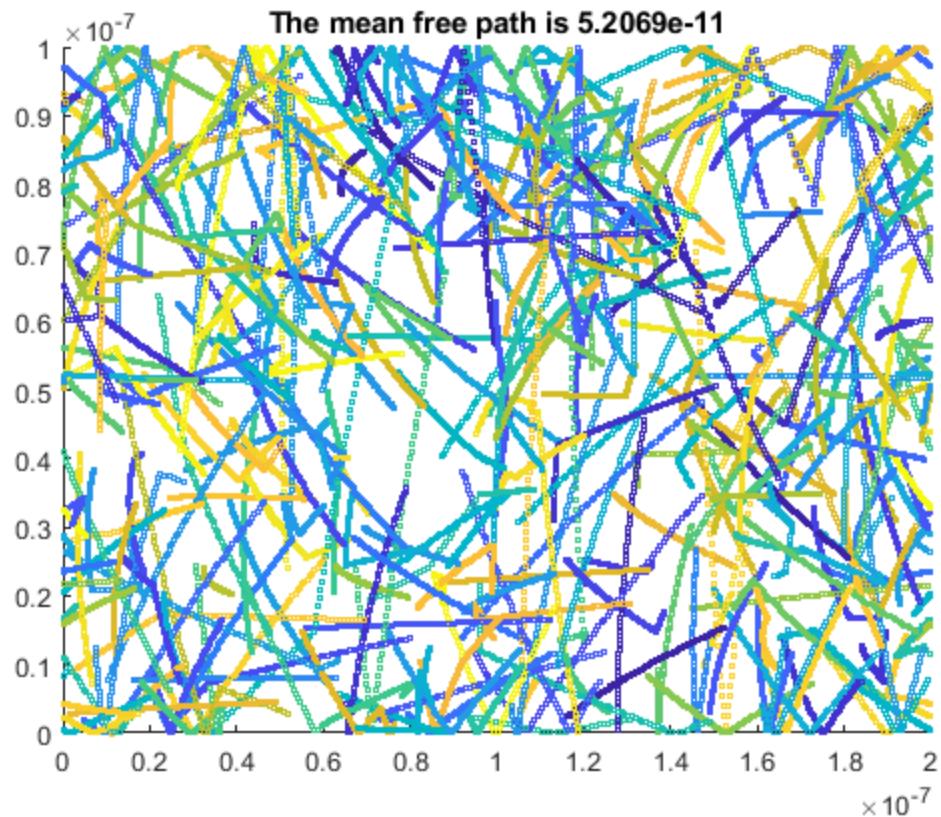


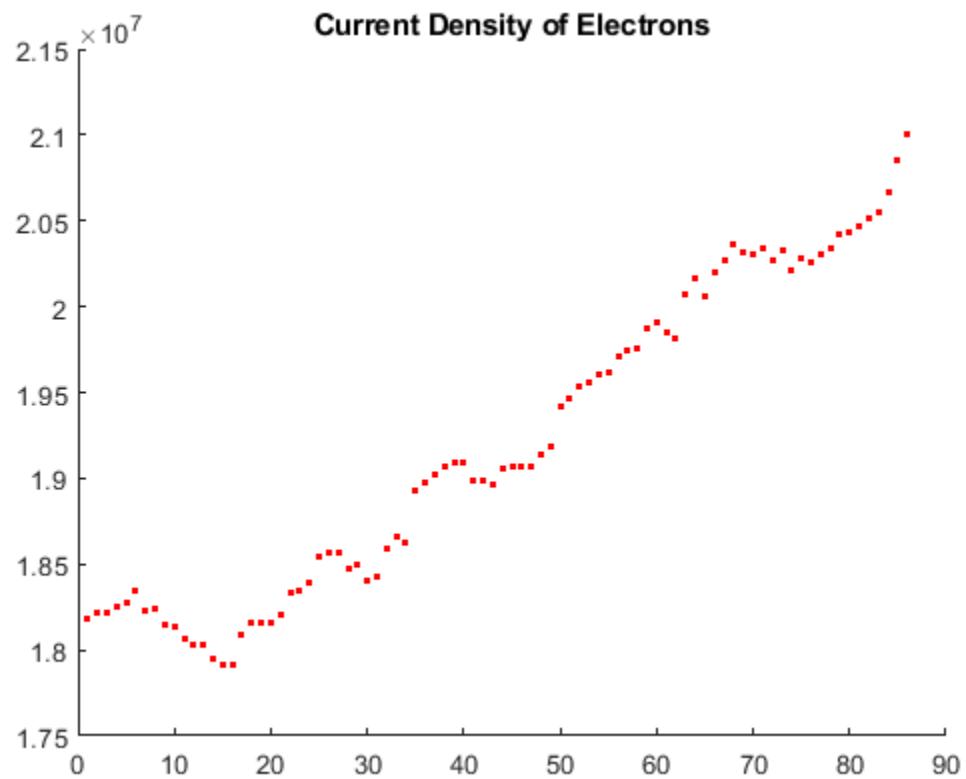
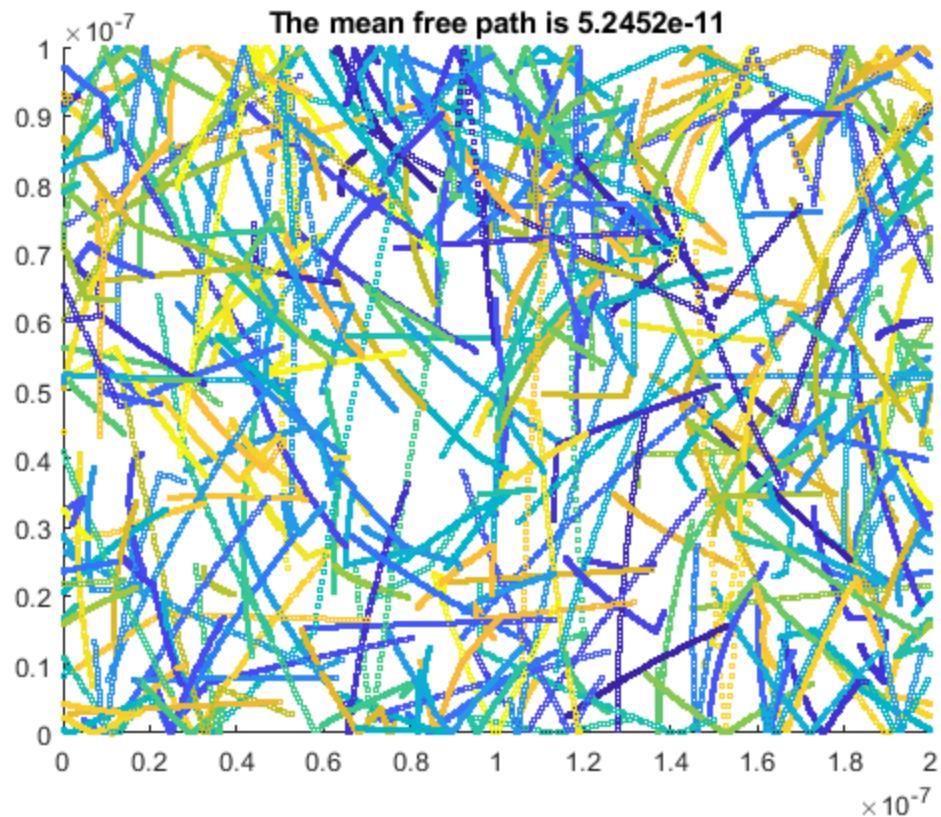


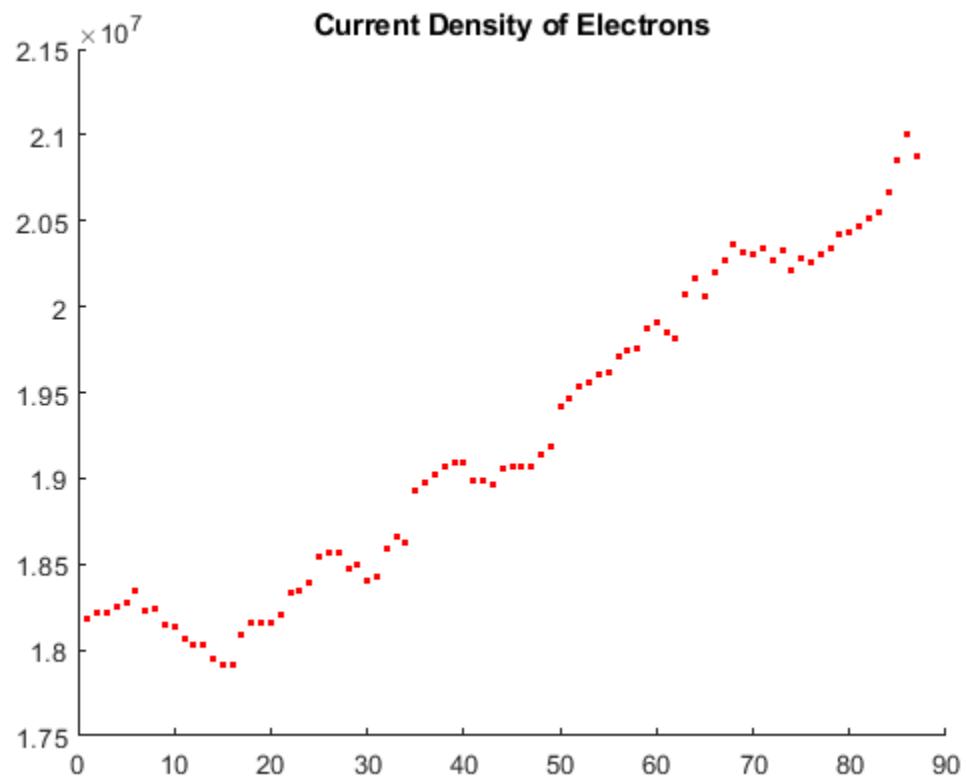
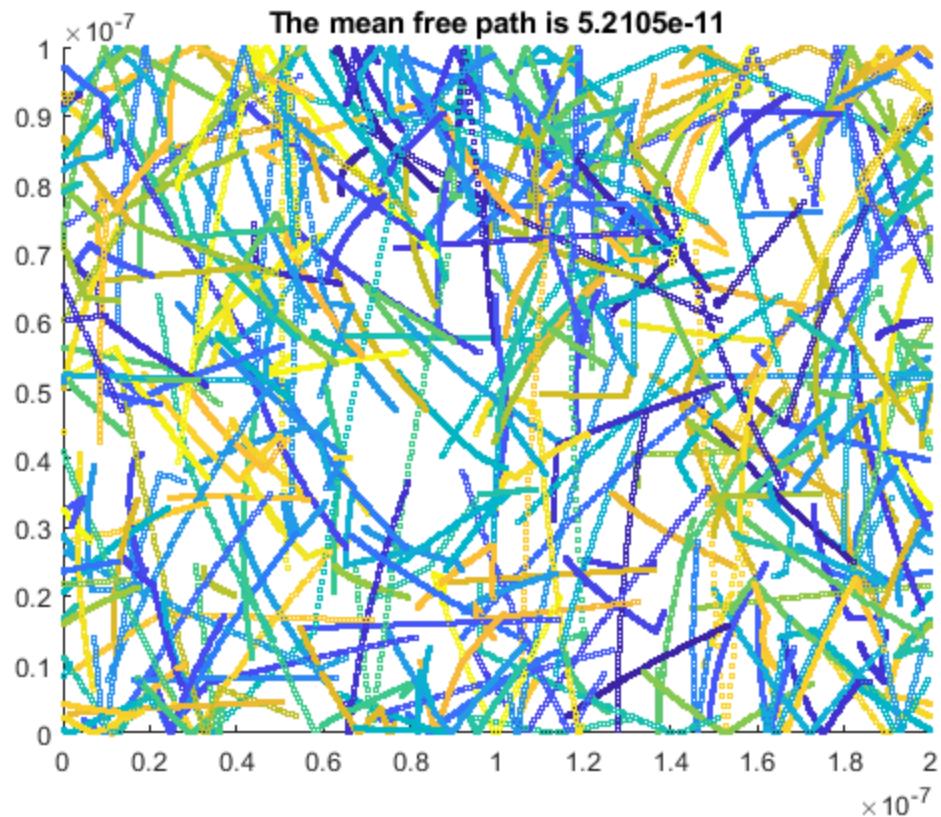


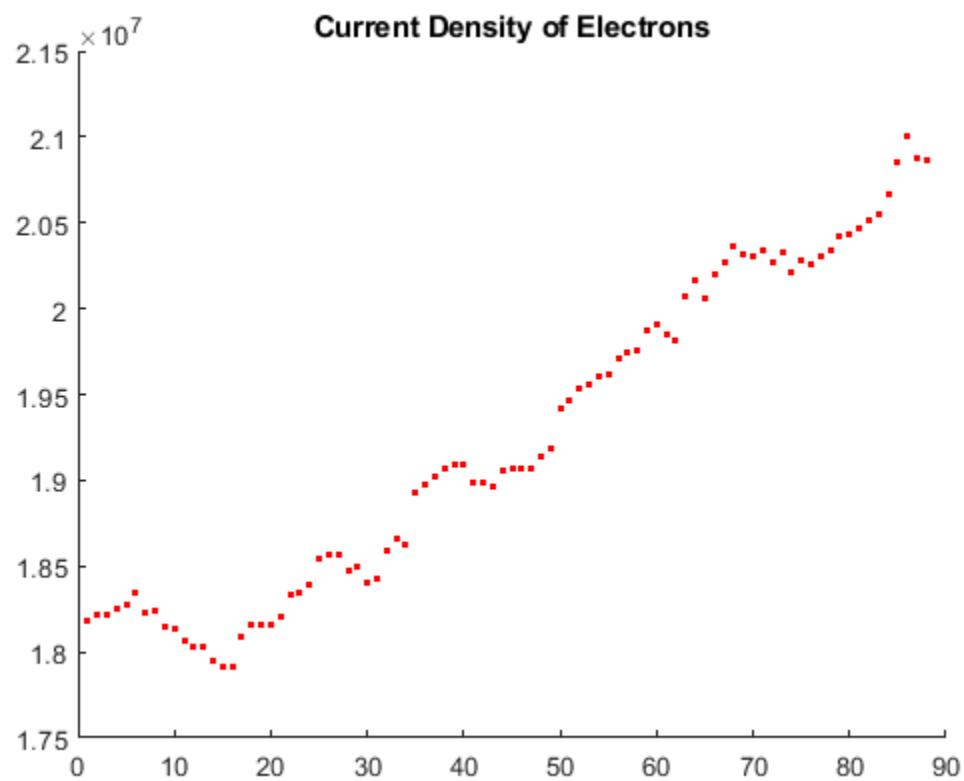
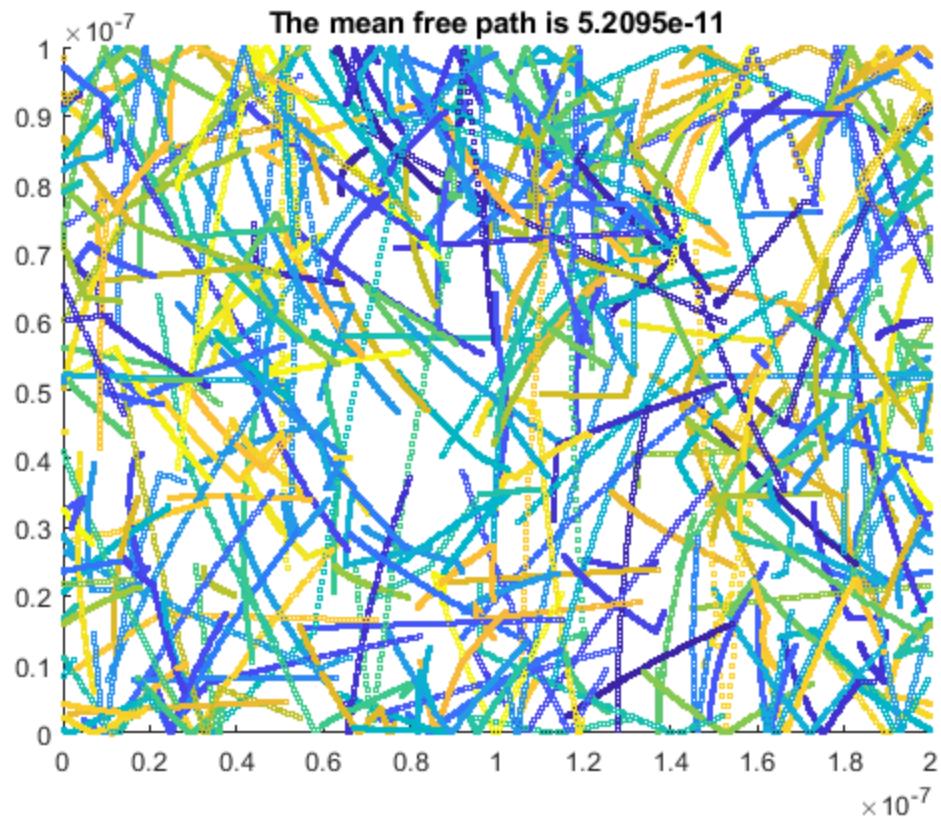


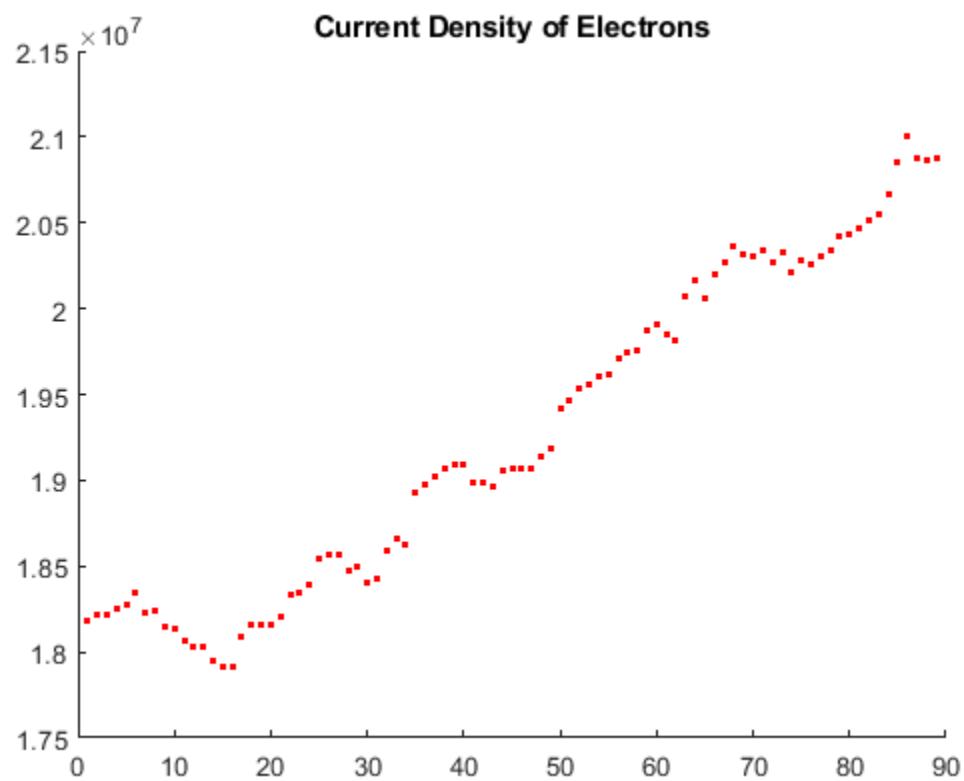
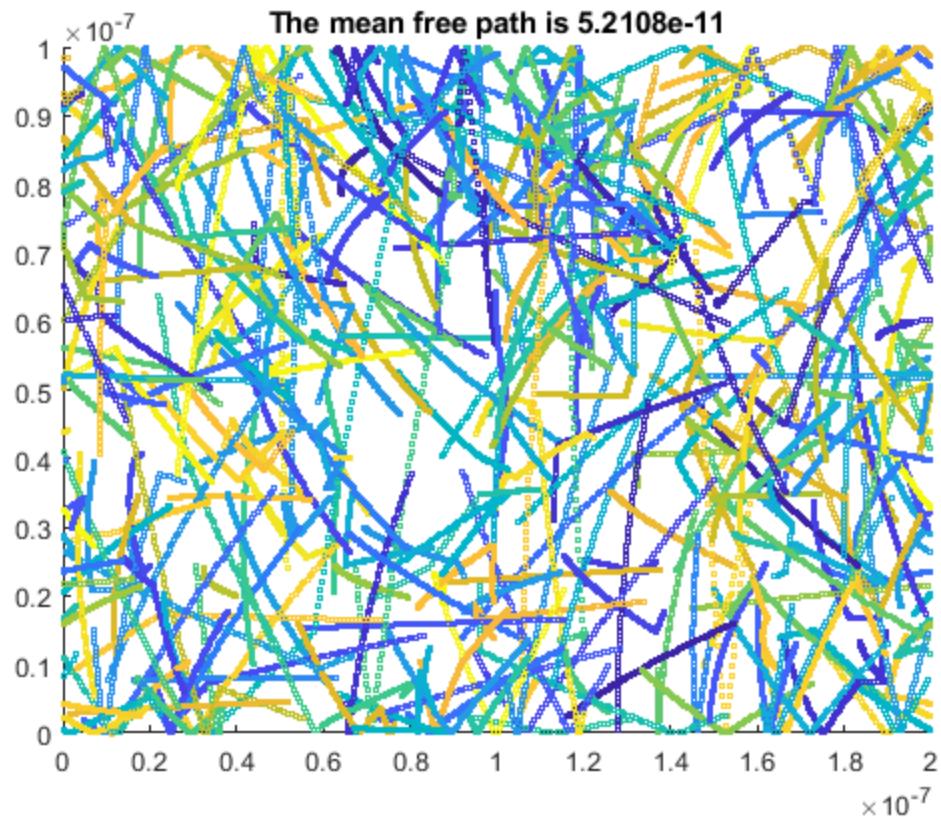


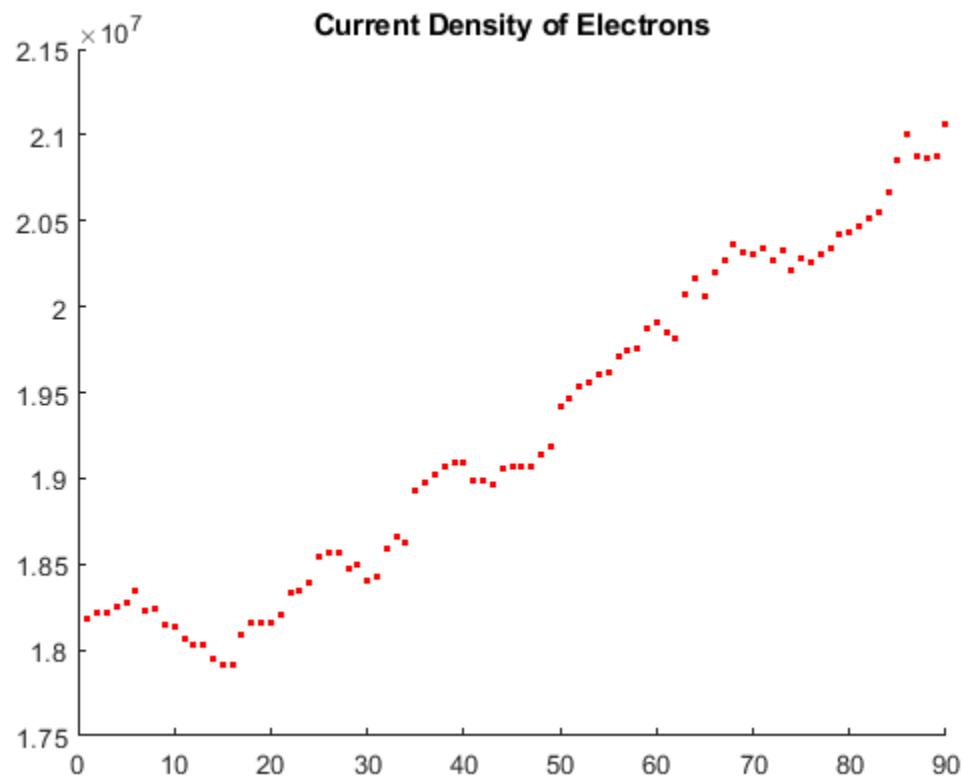
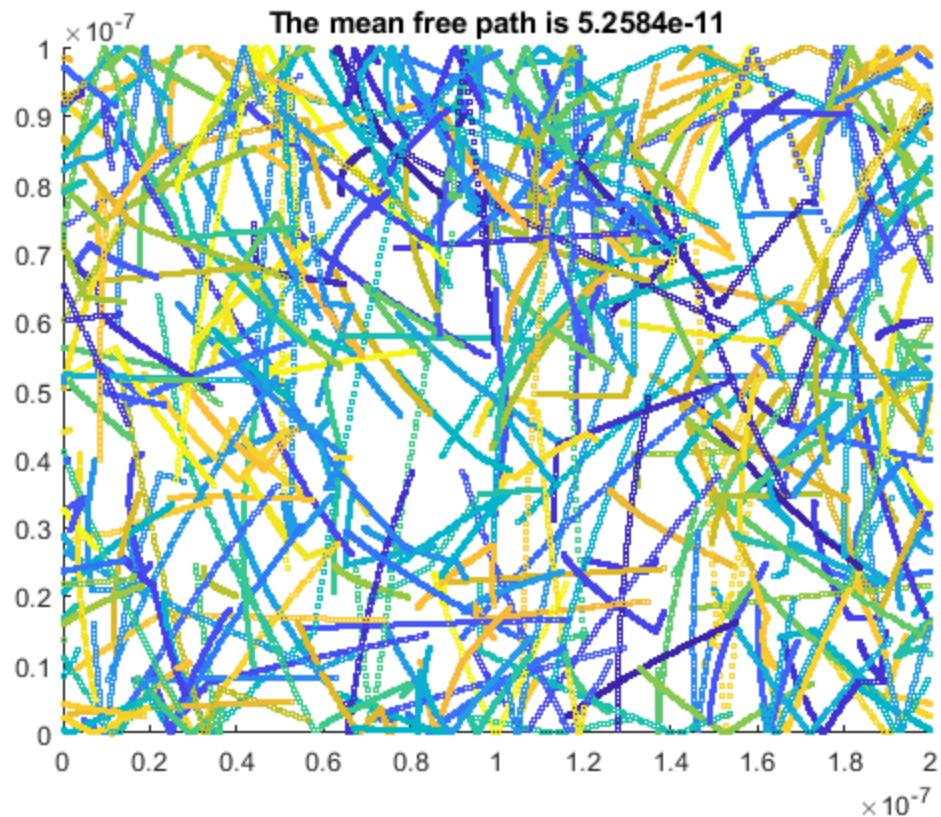


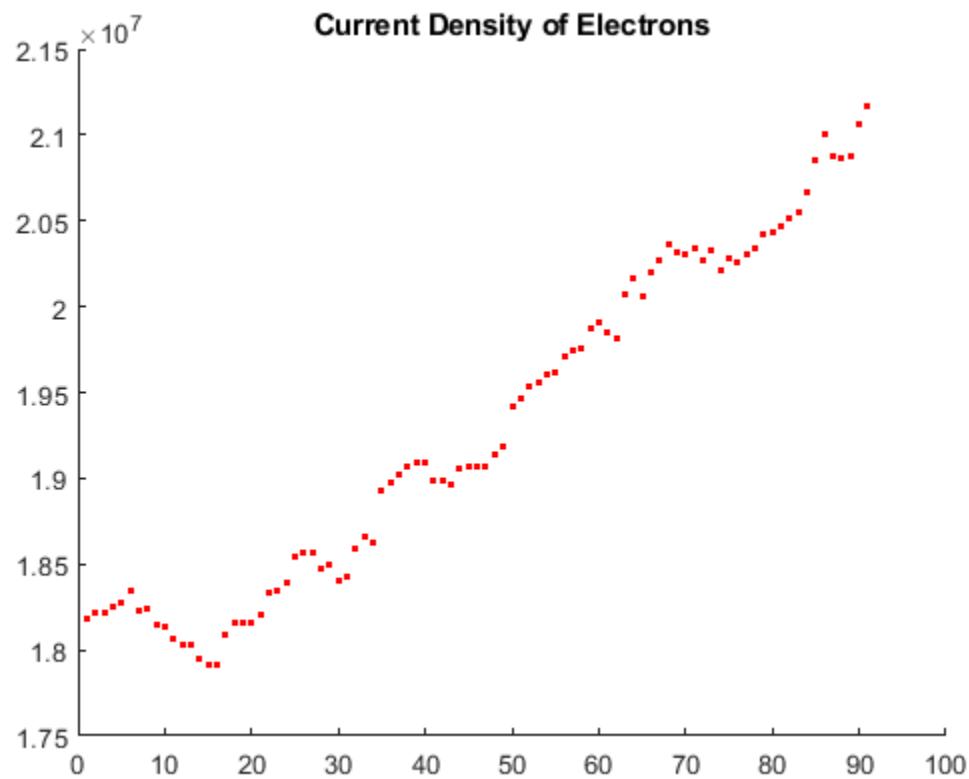
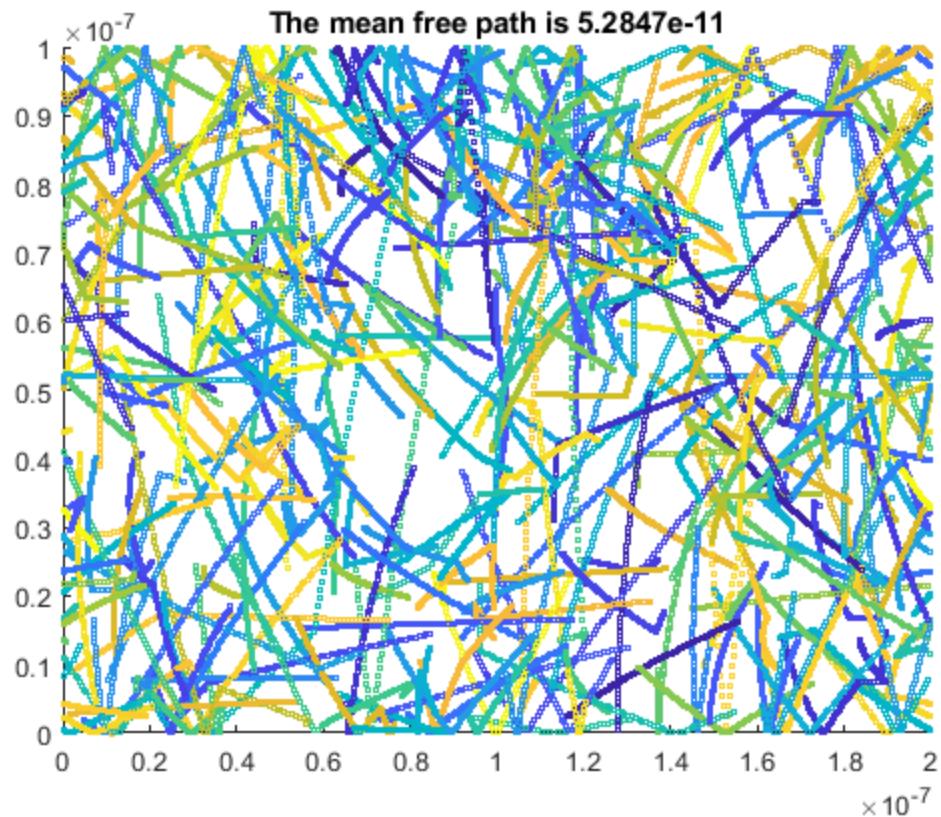


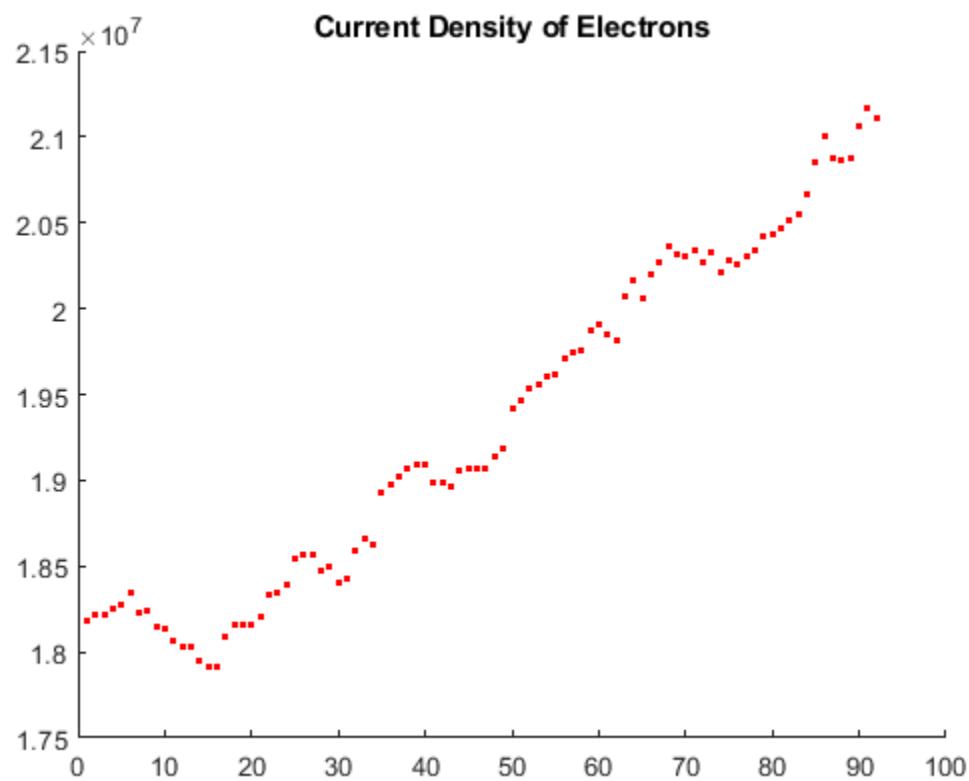
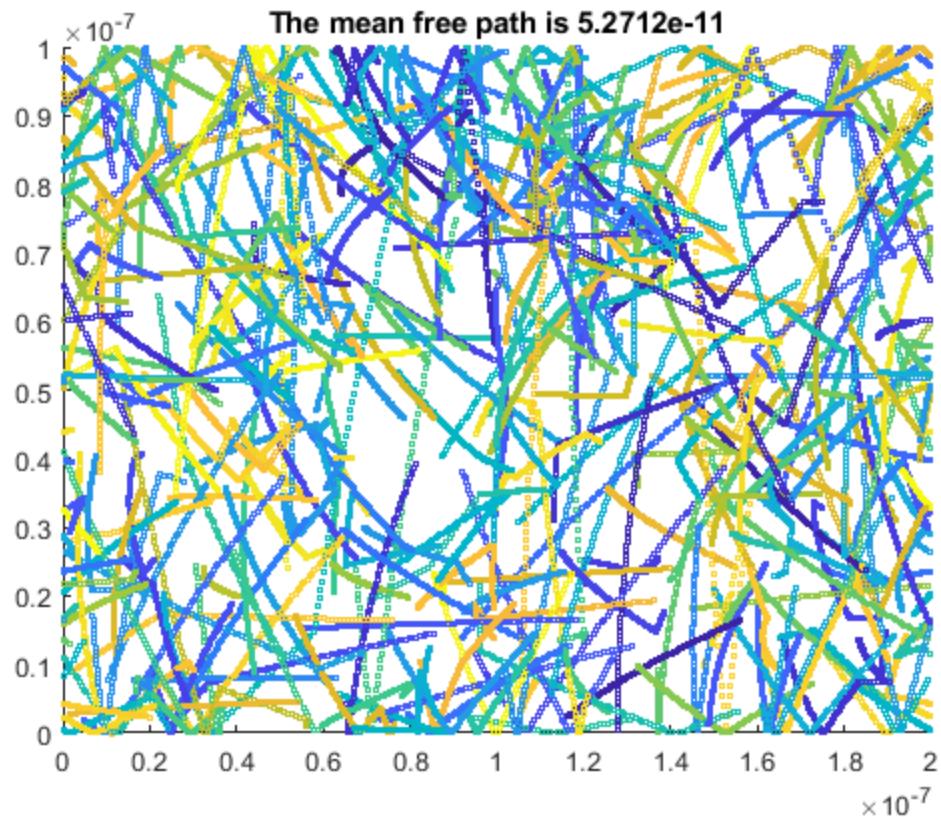


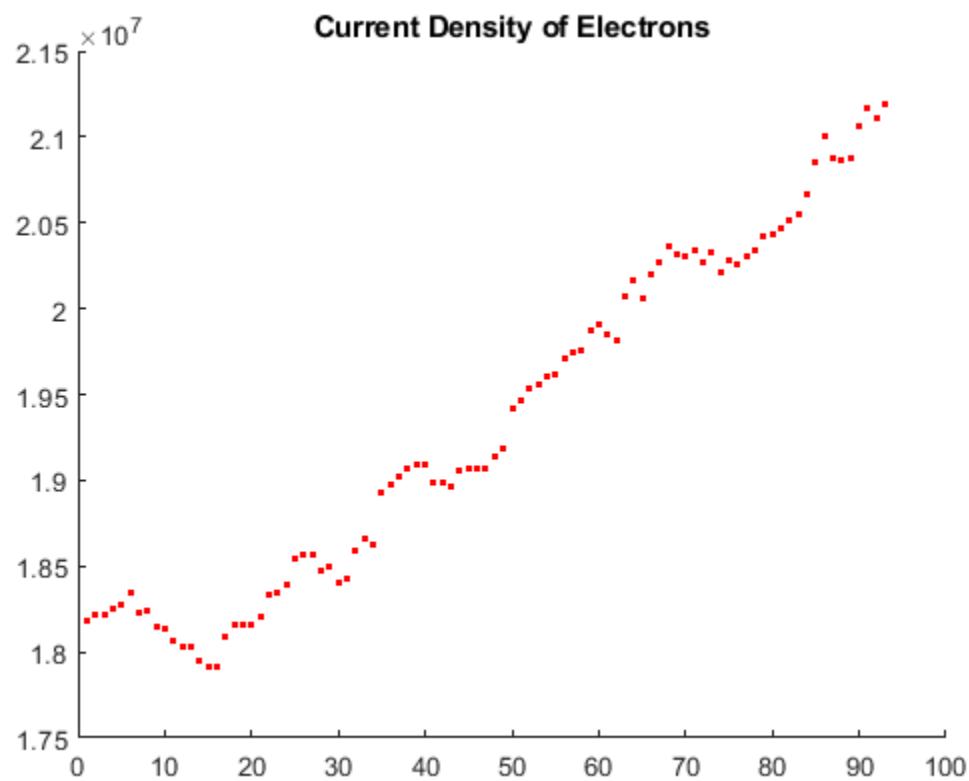
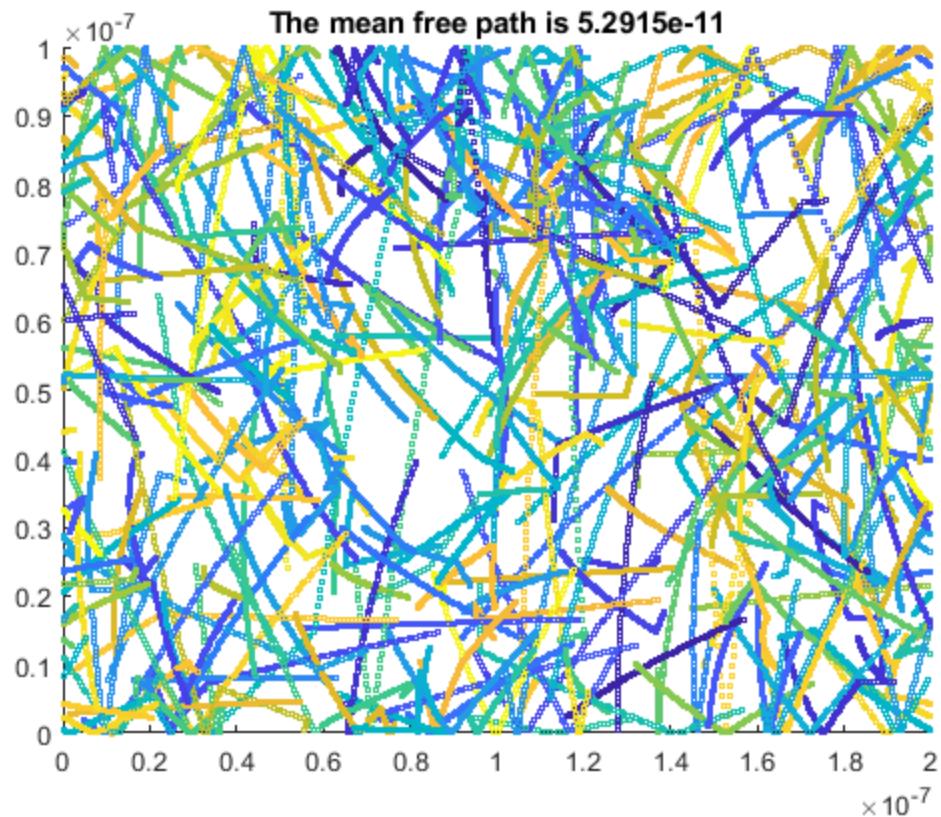


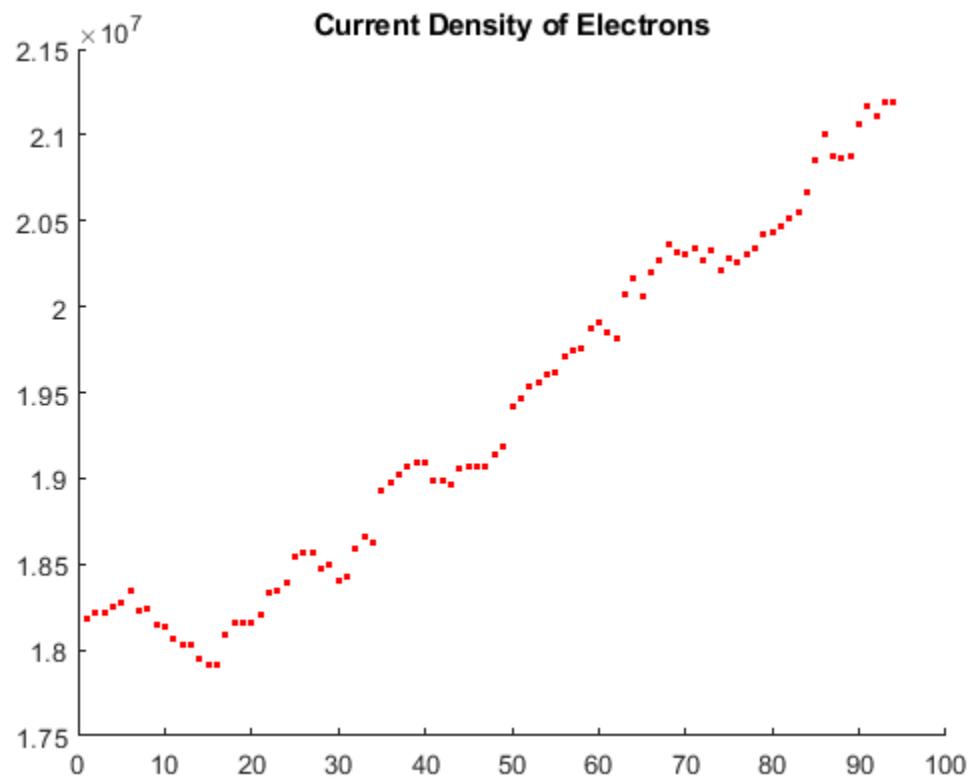
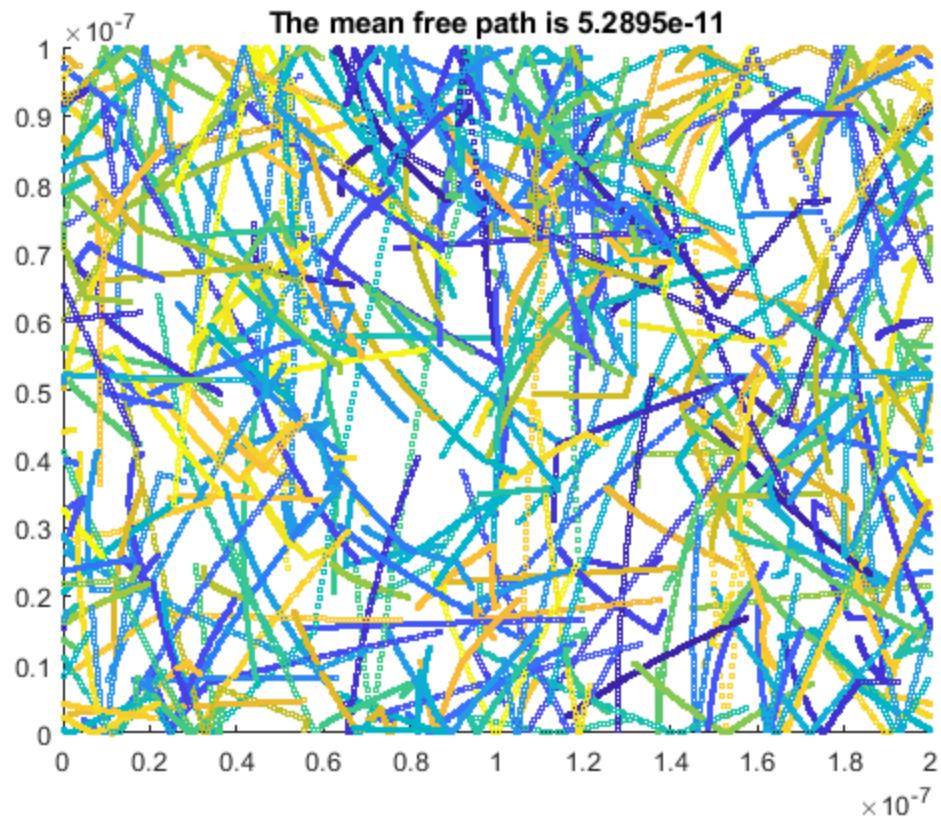


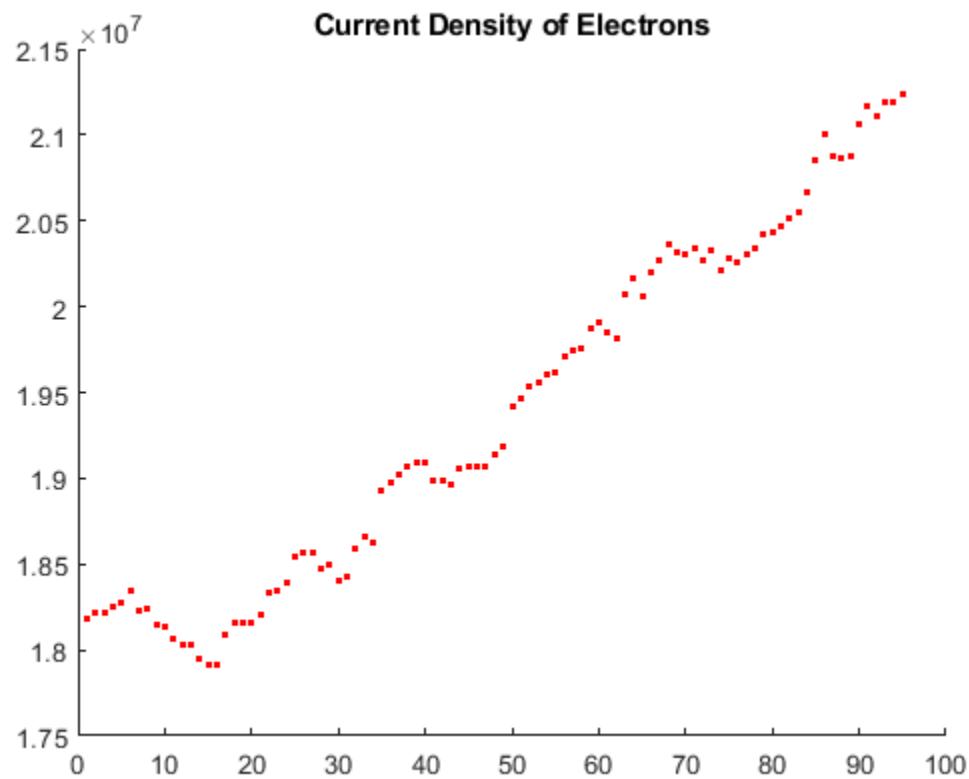
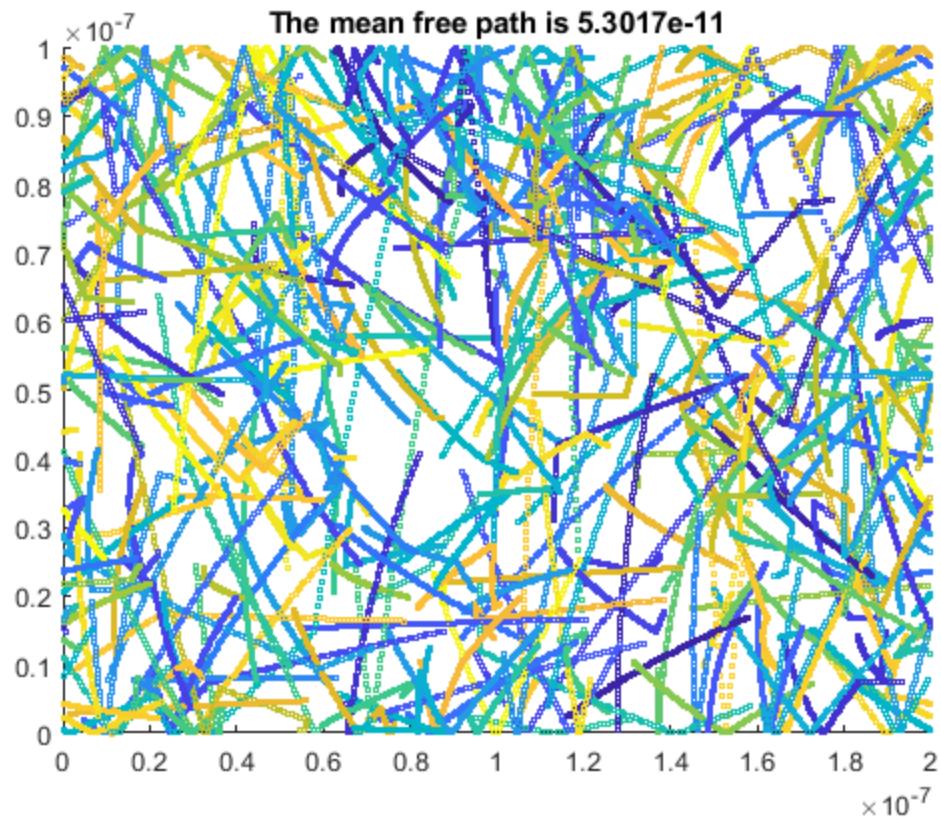


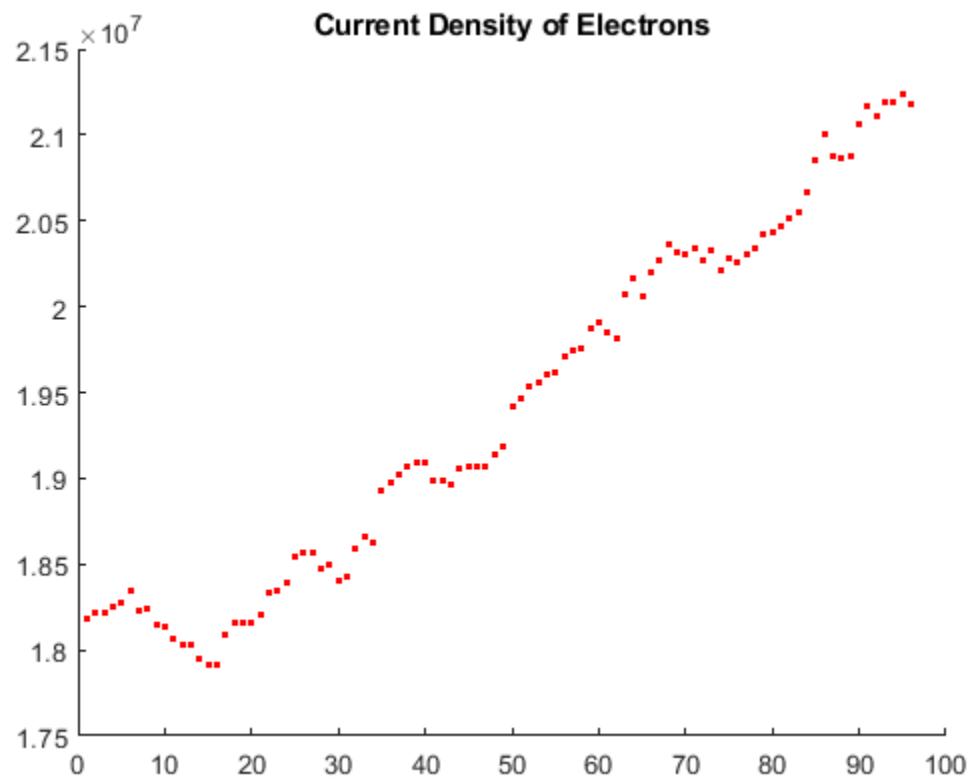
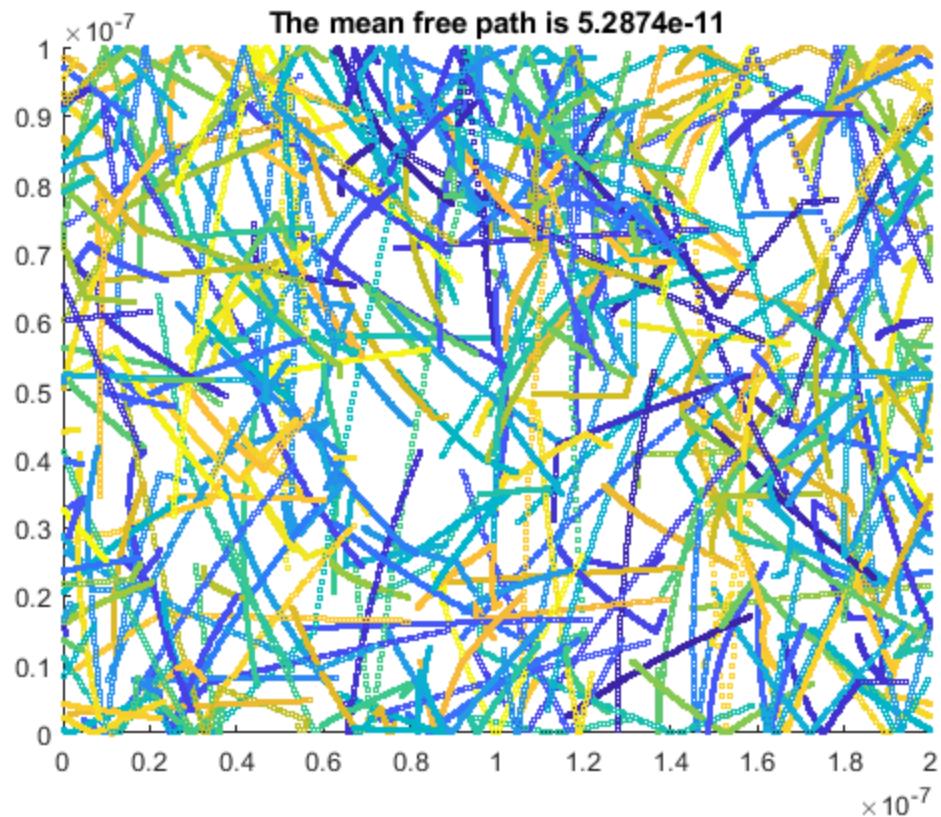


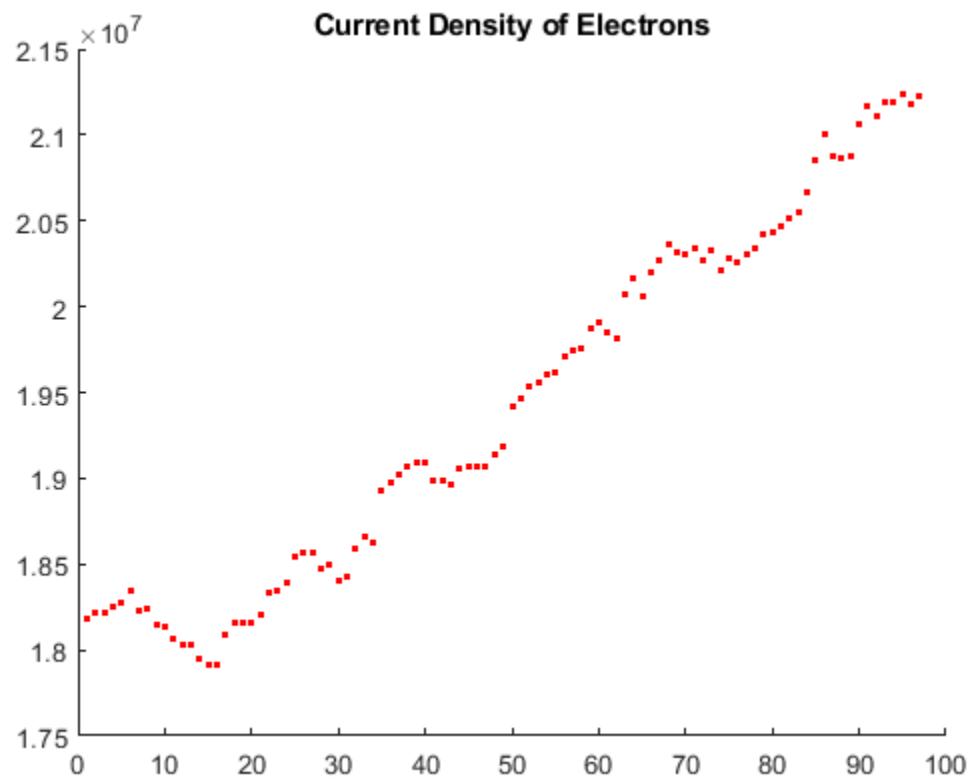
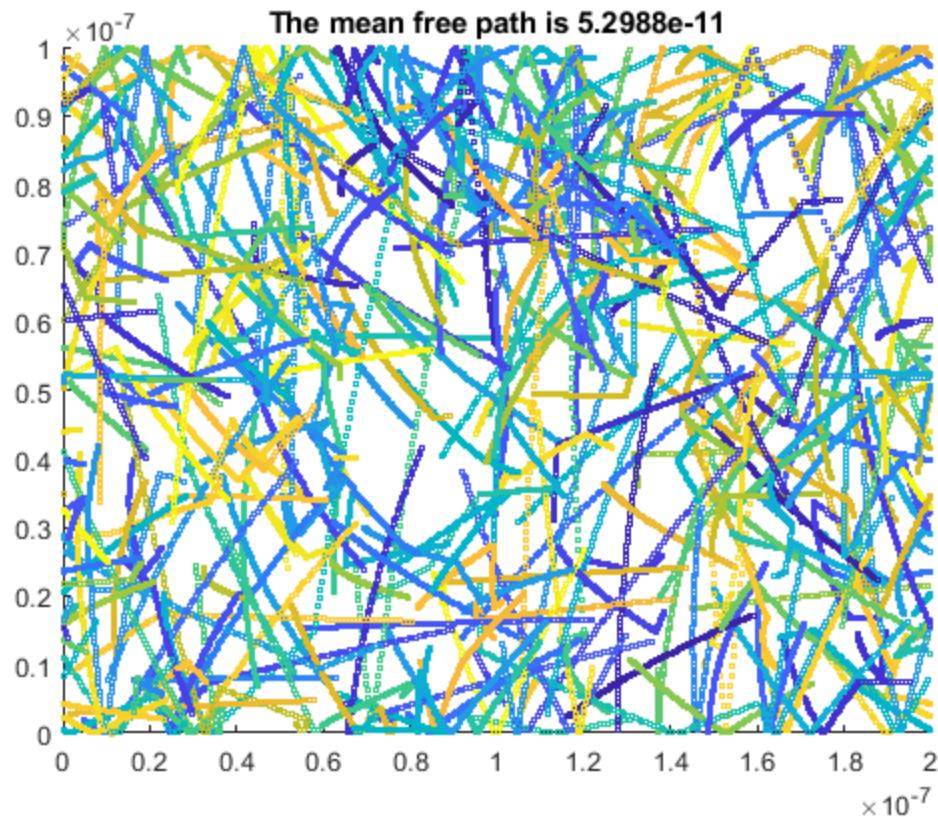


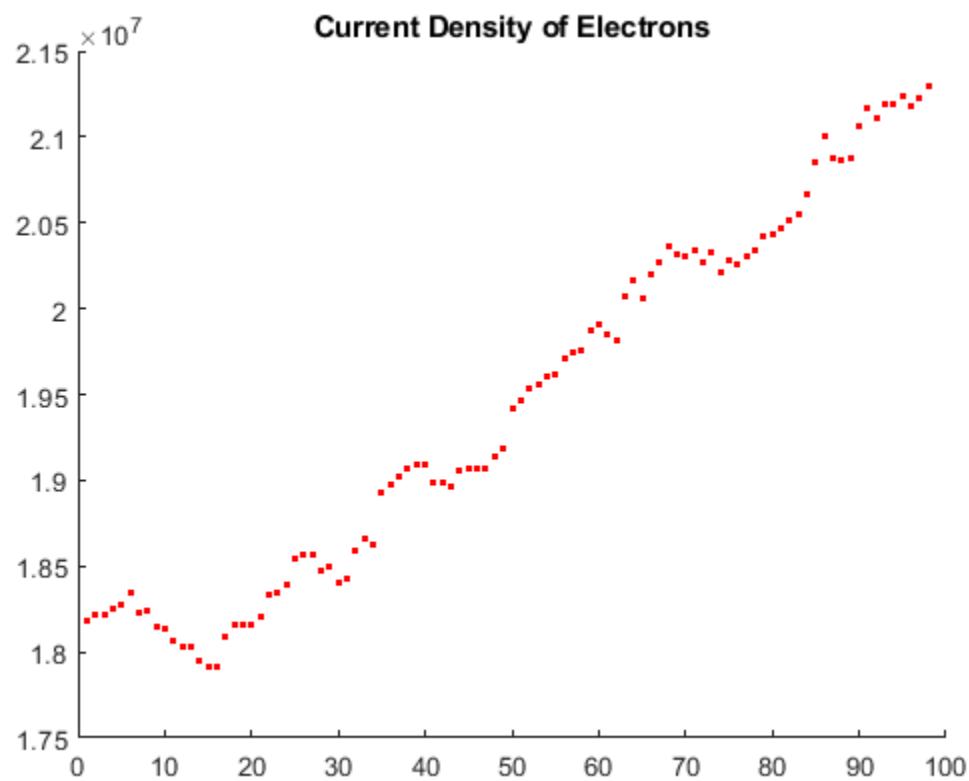
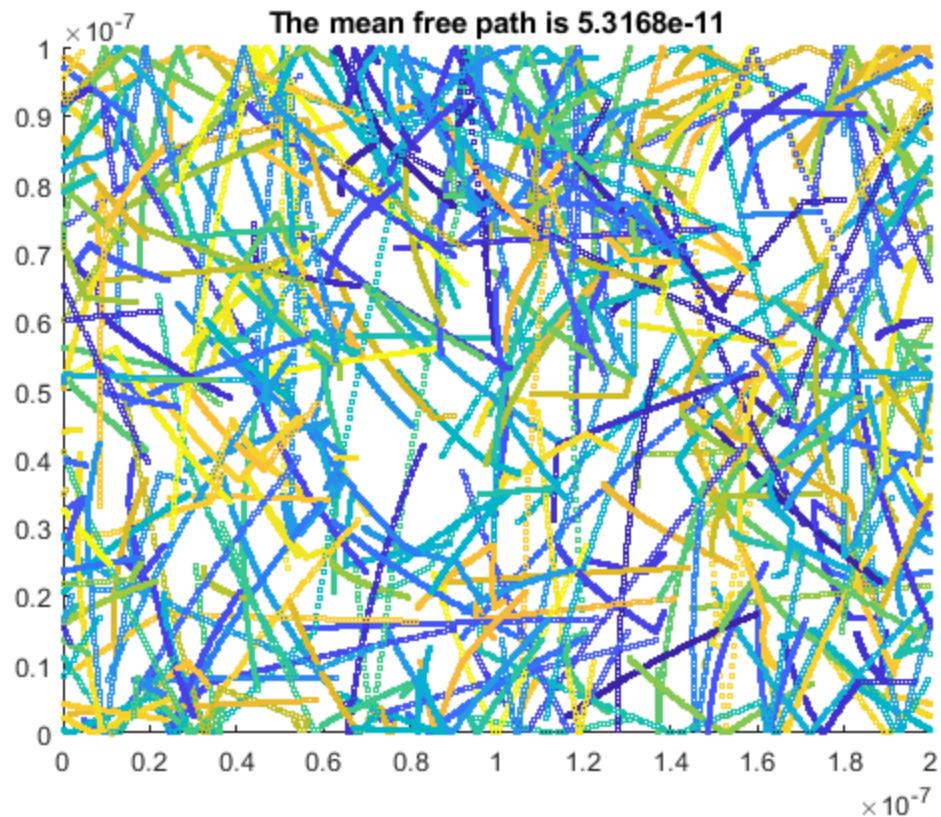


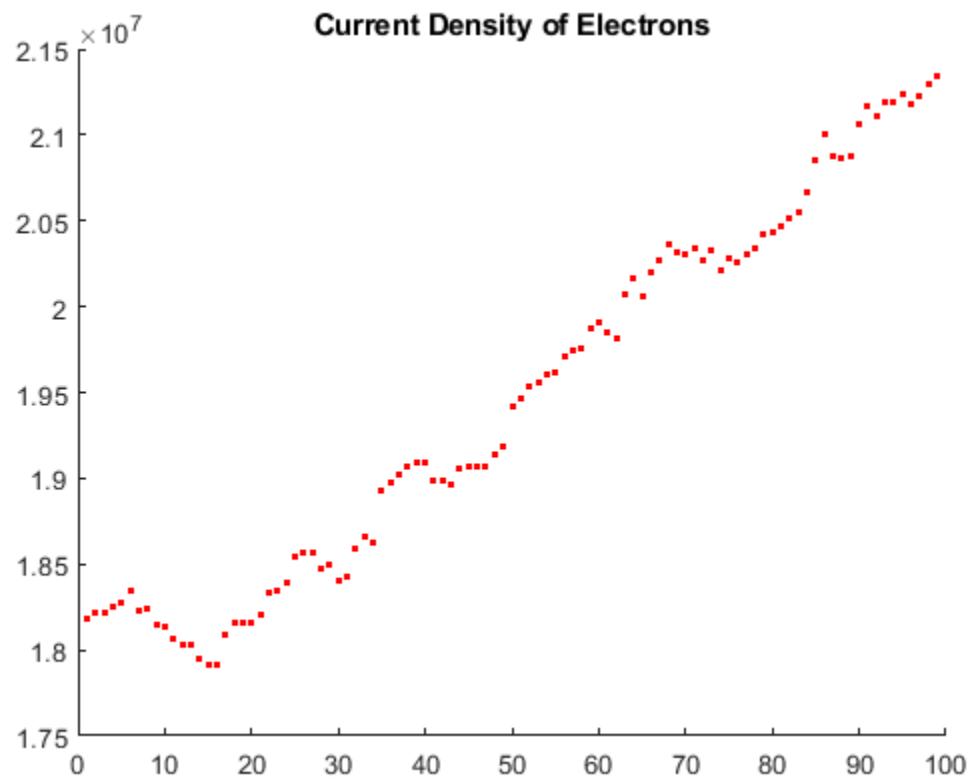
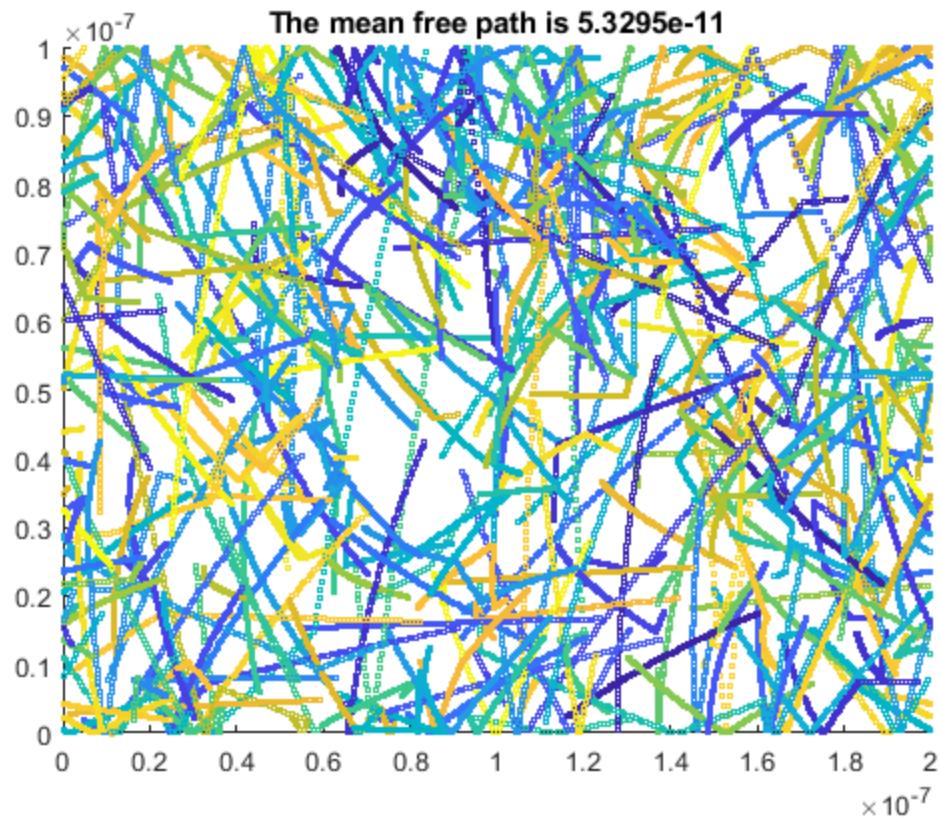


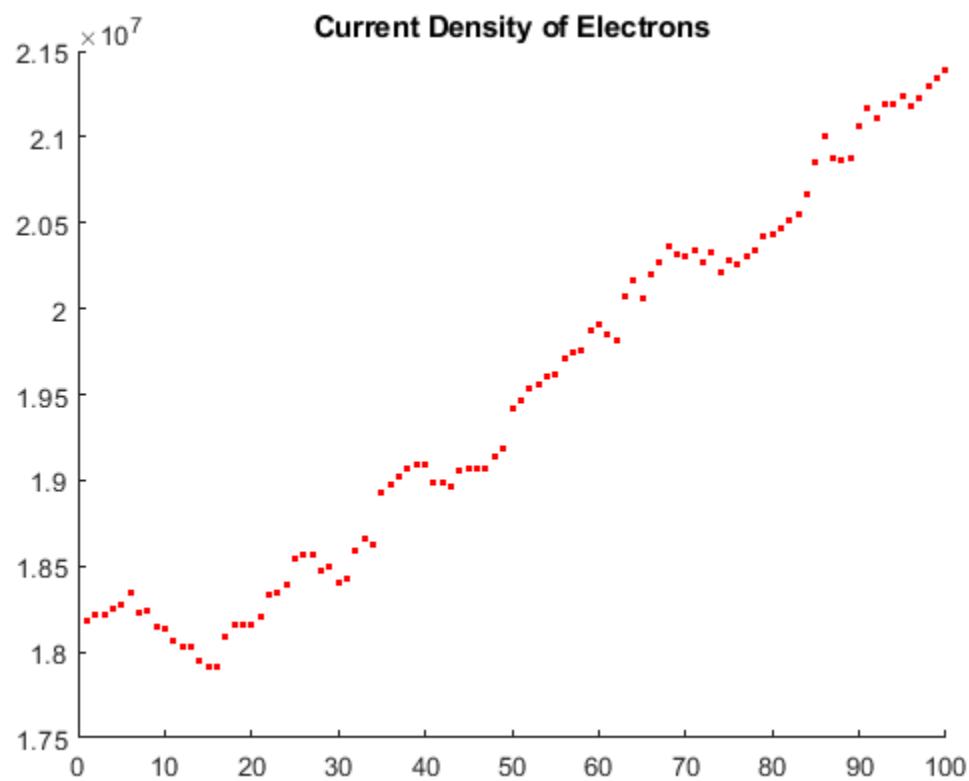
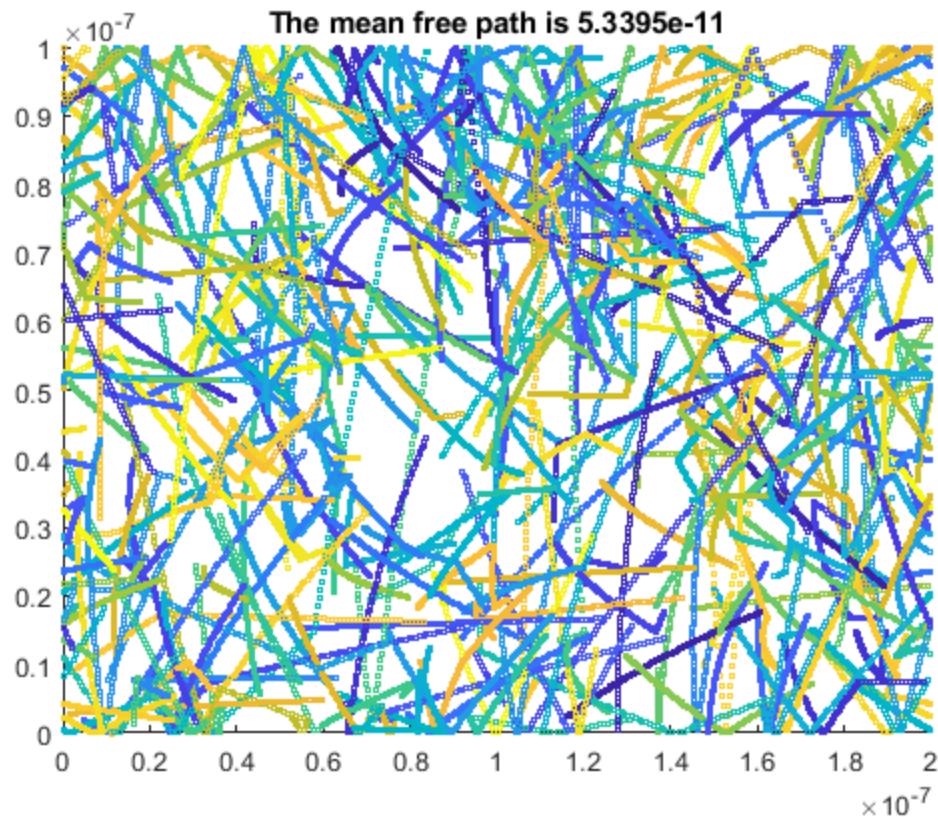












---

# As you can see from the plot, as time goes on, the current density in the electrons increase

```
hold on  
end  
  
% Part E - Desnity and Temp Map  
  
figure(3)  
hist3([Pos_x Pos_y], 'CdataMode', 'auto', 'Nbins', [20 20]);  
title('Electron Density Map of Final Positions')  
colorbar  
view(2)  
  
% Still havent figured out the temp map :)  
  
Part a) The value of the electric field on the electrons is 5.000000e  
+05  
Part b) The value of force on each electron is 8.010883e-14  
Part c) The value of acceletation on each electron is  
338234525008850432
```

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