Assignment 2 ELEC 4700
Finite Difference Method

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In this section we model two simple cases. a 1D and 2D case using Laplaces finite difference method in Matrix form as to make it easier to add boxes into the simulation. The dimmensions given in the problem states a 3/2 Length v. Width, as such I used 30 and 20 as my mesh sizes for all problems solved in the scripts below. The Voltage at the boundary conditions is set to 1V for all cases modeled below.

Part 1A

```
Assignment2_Part1(1)
```

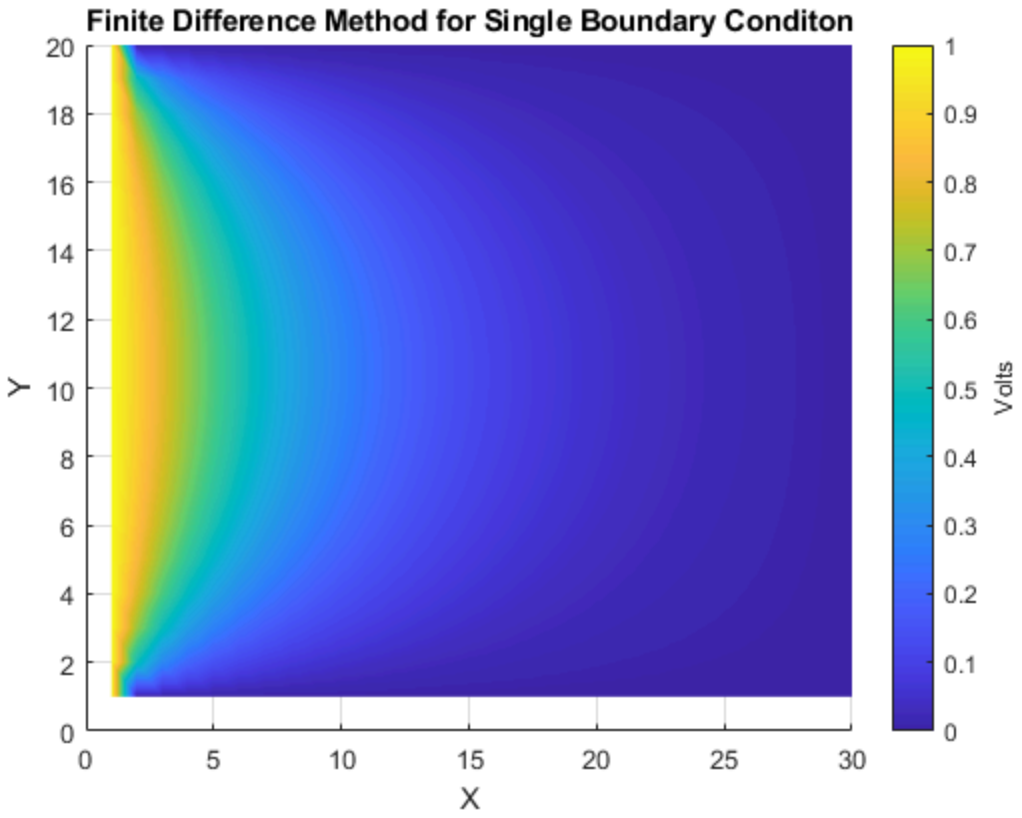
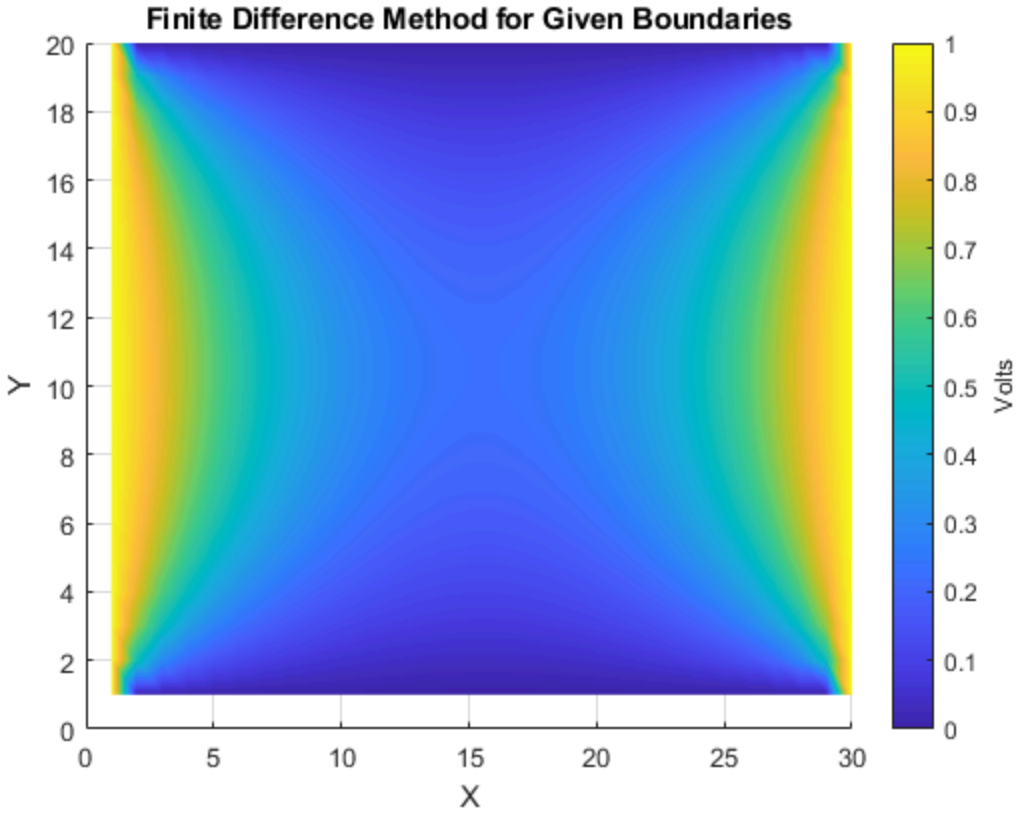


Figure 1 Above shows the 1D potential case where $X = V_0$ while $X = 0$ and the potential as we approach all 3 other sides goes to 0. That is $X = 0$ at $X = length$, $Y = 0$ while $Y = 0$ and $Y = Width$. In this case the voltage is constant in the Y direction at 0V and rises linearly to 1V at between $X = 0$ and $X = length$

Part 1B

```
Assignment2_Part1(2)
```


Finite Difference Method for Given Boundaries
Y
X
Volts
0
2
4
6
8
10
12
14
16
18
20
0
5
10
15
20
25
30
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

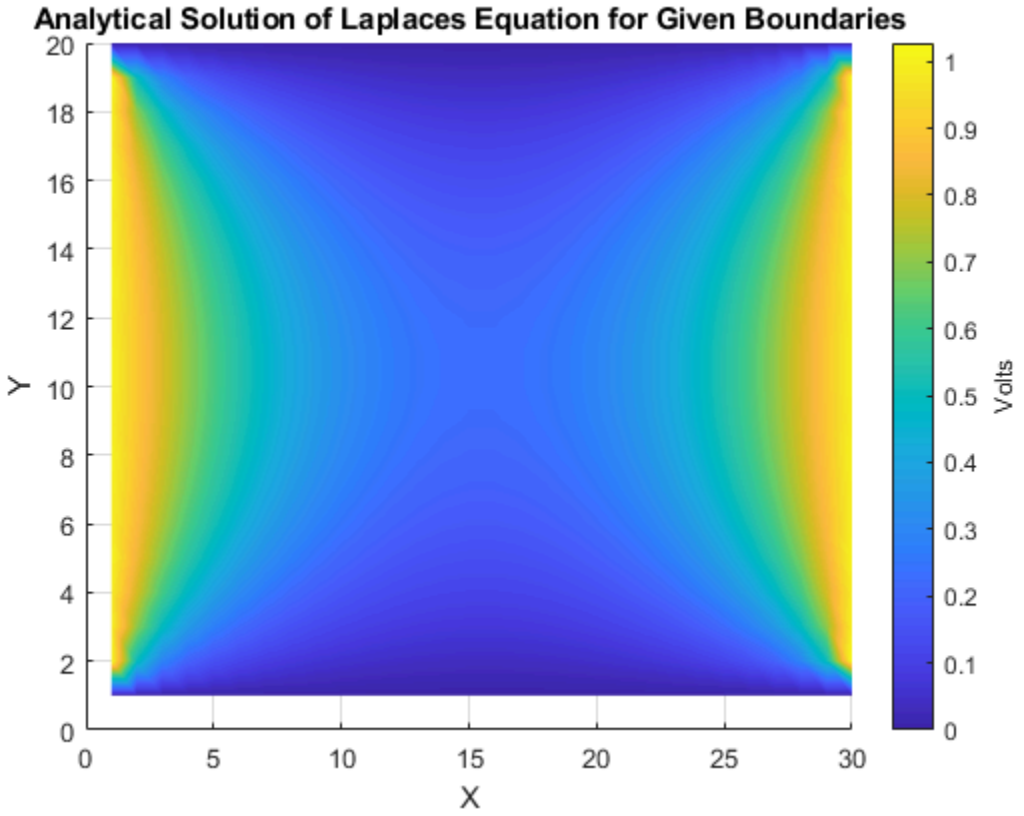
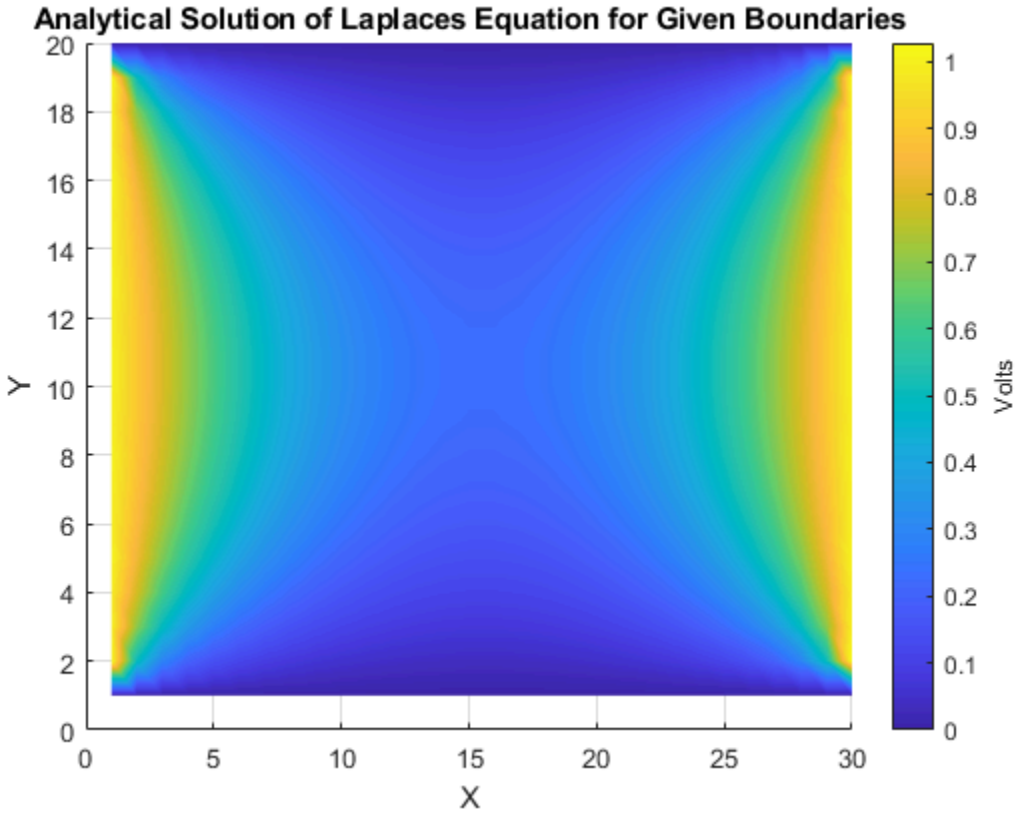
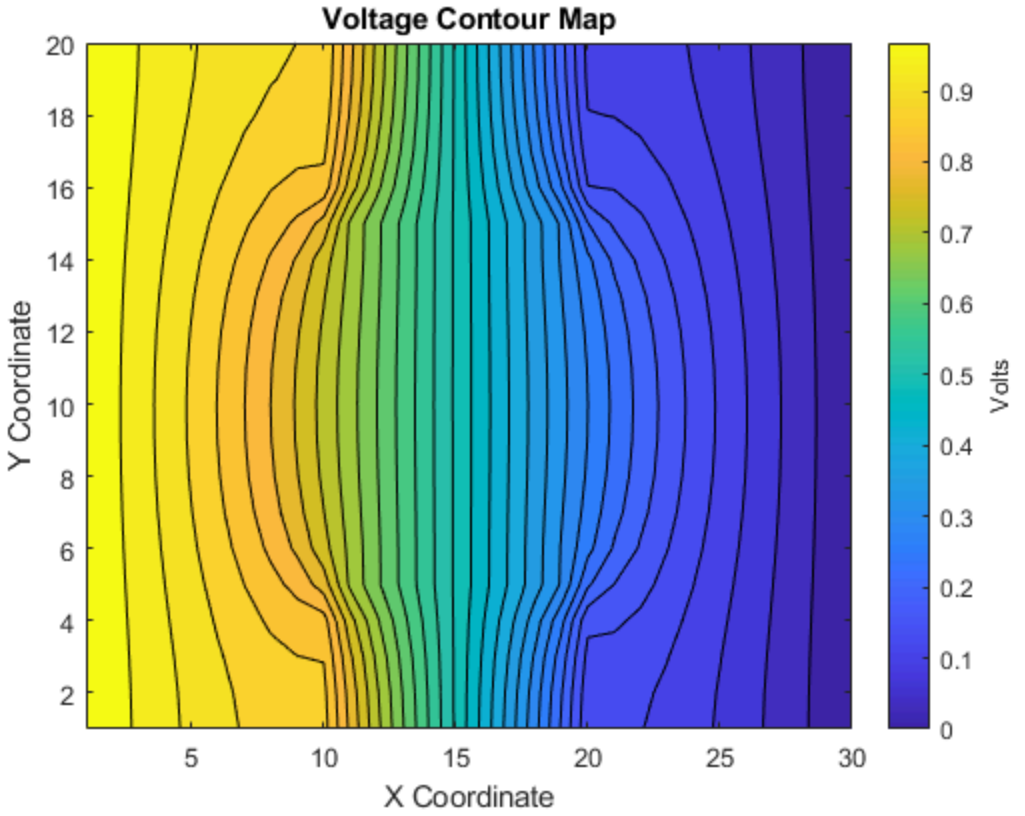

Analytical Solution of Laplaces Equation for Given Boundaries
Y
X
Volts
0
2
4
6
8
10
12
14
16
18
20
0
5
10
15
20
25
30
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

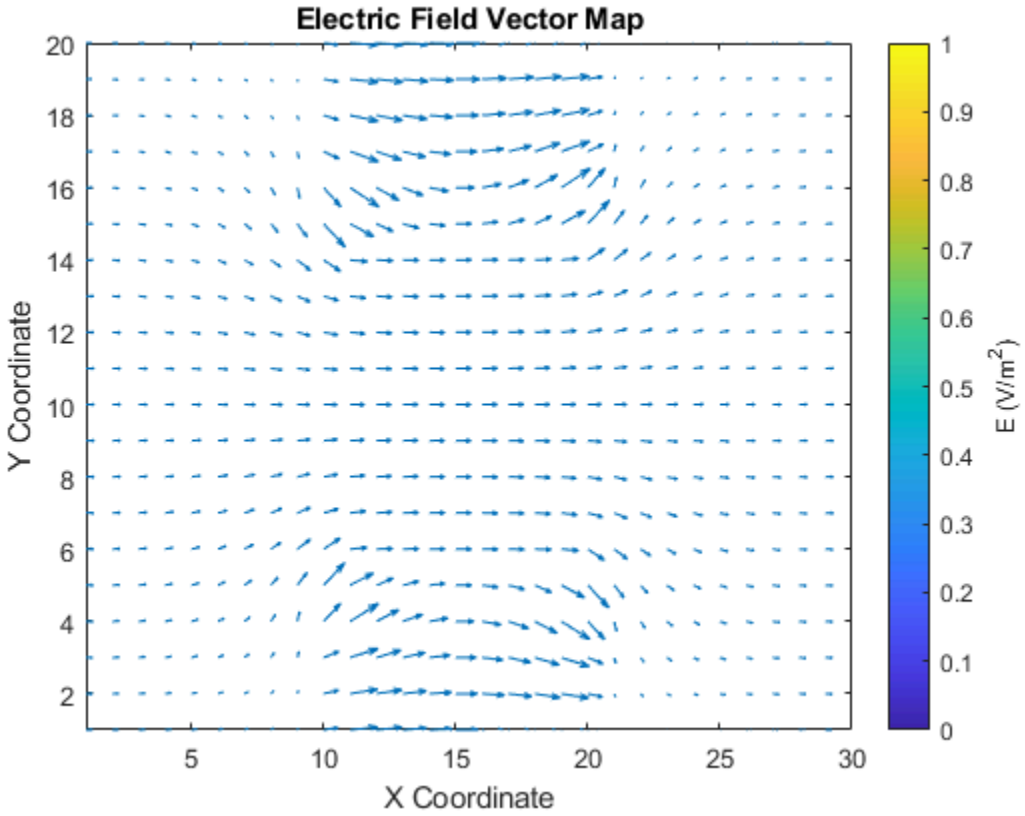
Figure 2 and 3 Above shows the 1D potential case where $X = V_0$ while $X = 0$ and the potential as we approach all 3 other sides goes to 0. That is $X = 0$ at $X = length$, $Y = 0$ while $Y = 0$ and $Y = Width$. In this case the voltage is constant in the Y direction at 0V and rises linearly to 1V at between $X = 0$ and $X = length$

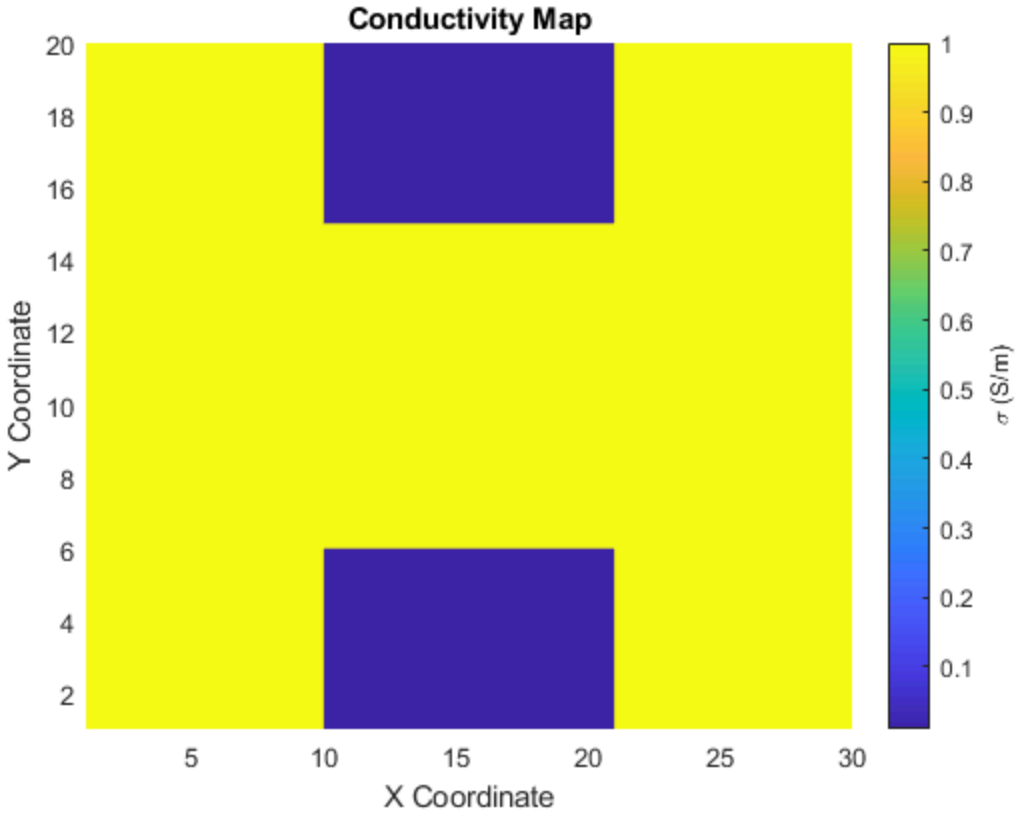
Part 2A

`Assignment2_Part2(1)`




Voltage Contour Map
Y Coordinate
X Coordinate
Volts
20
18
16
14
12
10
8
6
4
2
5
10
15
20
25
30
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


Electric Field Vector Map
Y Coordinate
X Coordinate
E (V/m^2)
20
18
16
14
12
10
8
6
4
2
5
10
15
20
25
30
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


Conductivity Map
Y Coordinate
X Coordinate
σ (S/m)
20
18
16
14
12
10
8
6
4
2
5
10
15
20
25
30
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

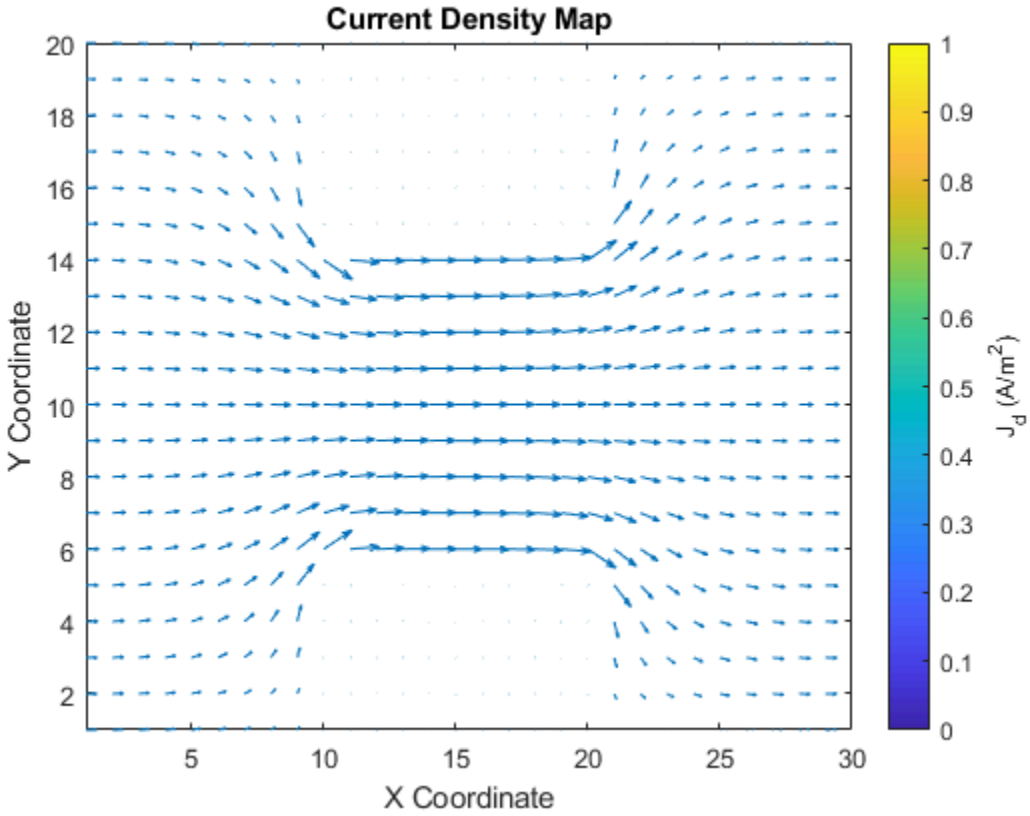

Current Density Map
Y Coordinate
X Coordinate
J_d (A/m^2)
20
18
16
14
12
10
8
6
4
2
5
10
15
20
25
30
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

Figure 4,5,6,7

Part 2B Varrying mesh sizes

```
Assignment2_Part2(2)
```

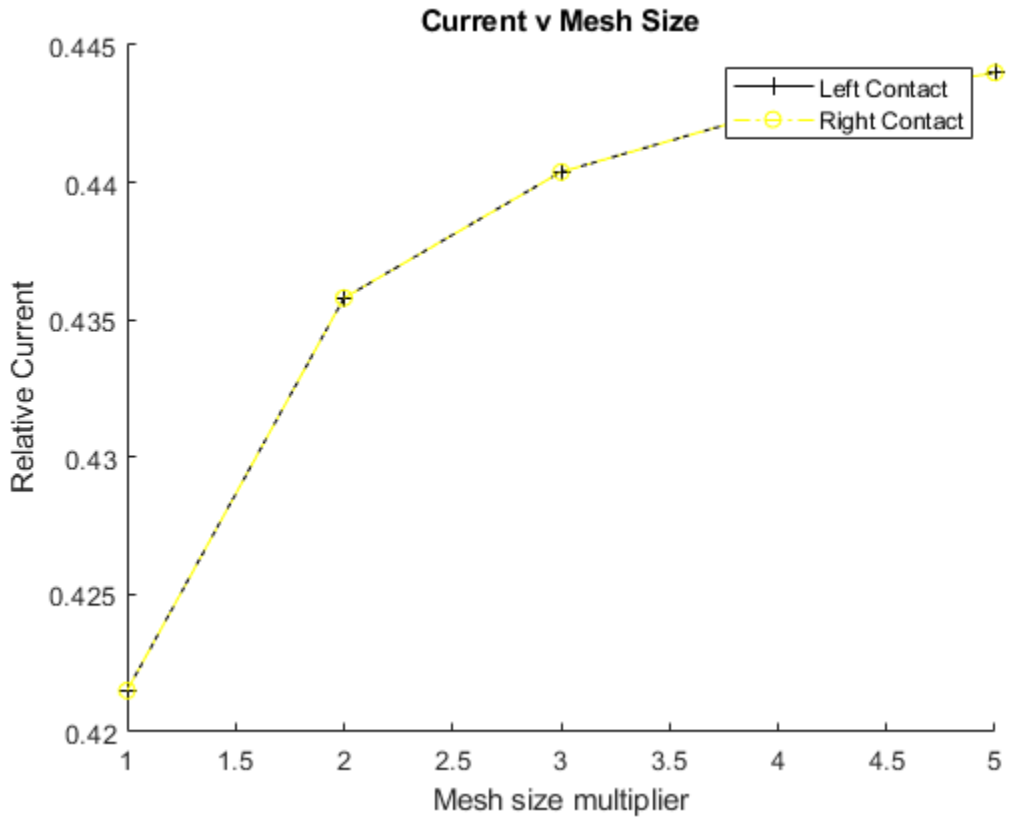


Figure 8

Part 2C-1 Varrying Box Width

```
Assignment2_Part2(3)
```

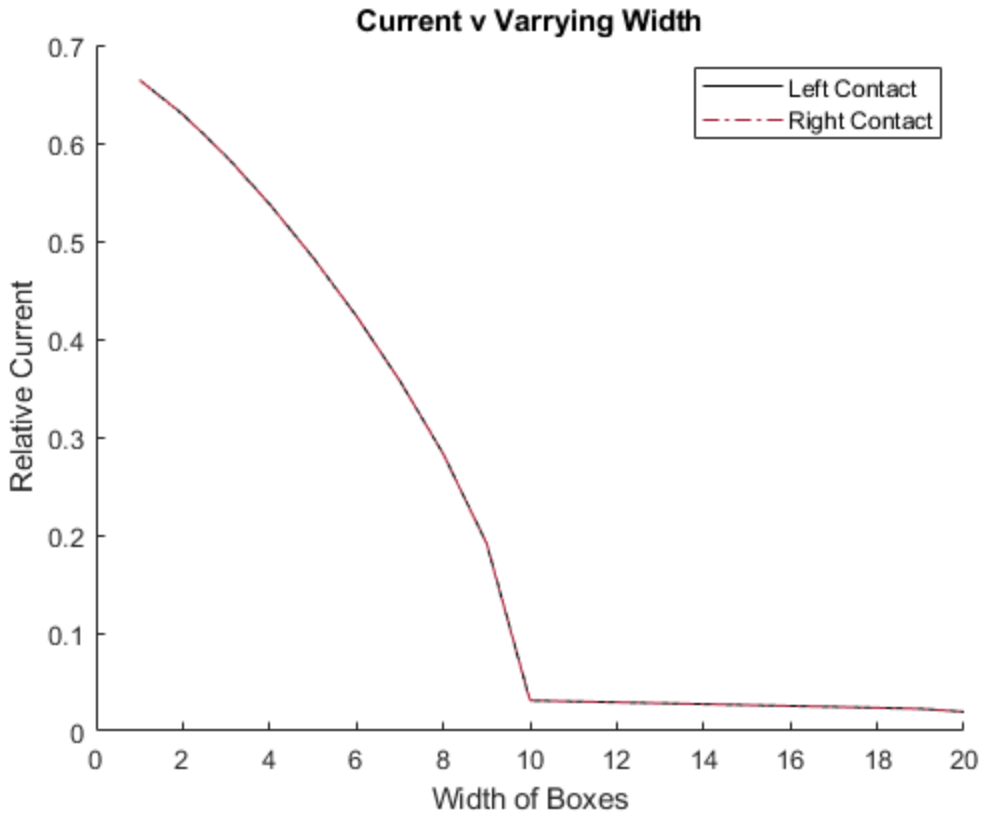


Figure 9

Part 2C-2 Varrying Box Height

```
Assignment2_Part2(4)
```

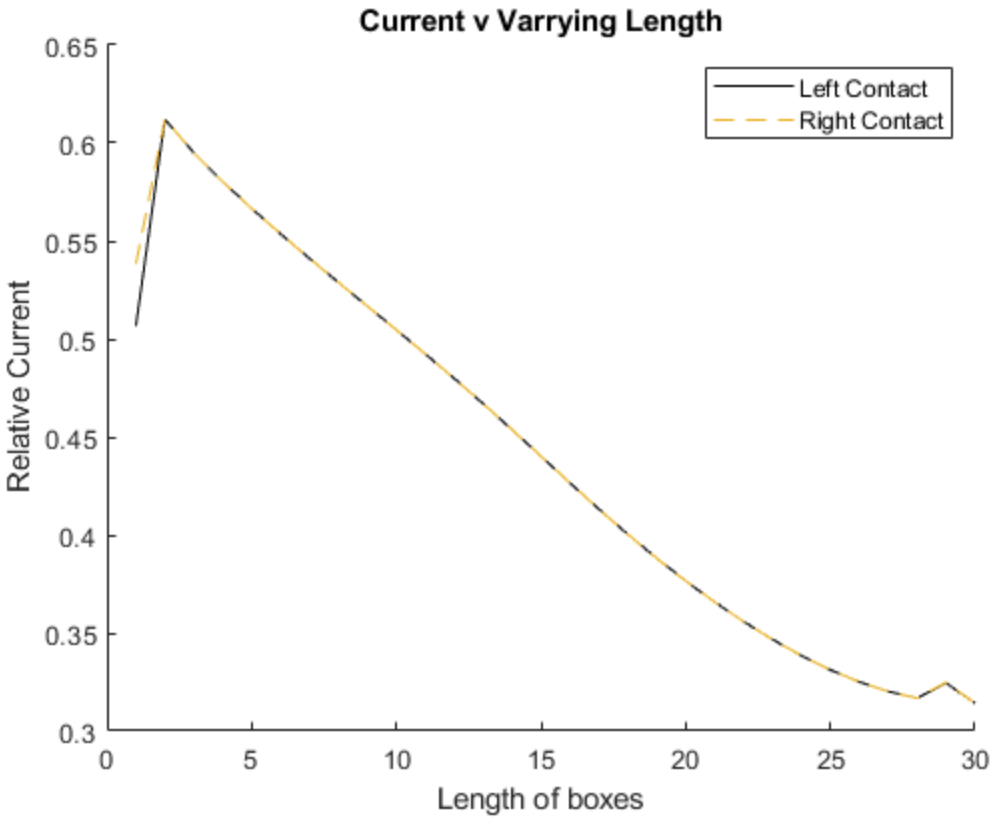


Figure 10

Part 2D Varrying the conductivity density map

```
Assignment2_Part2(5)
```

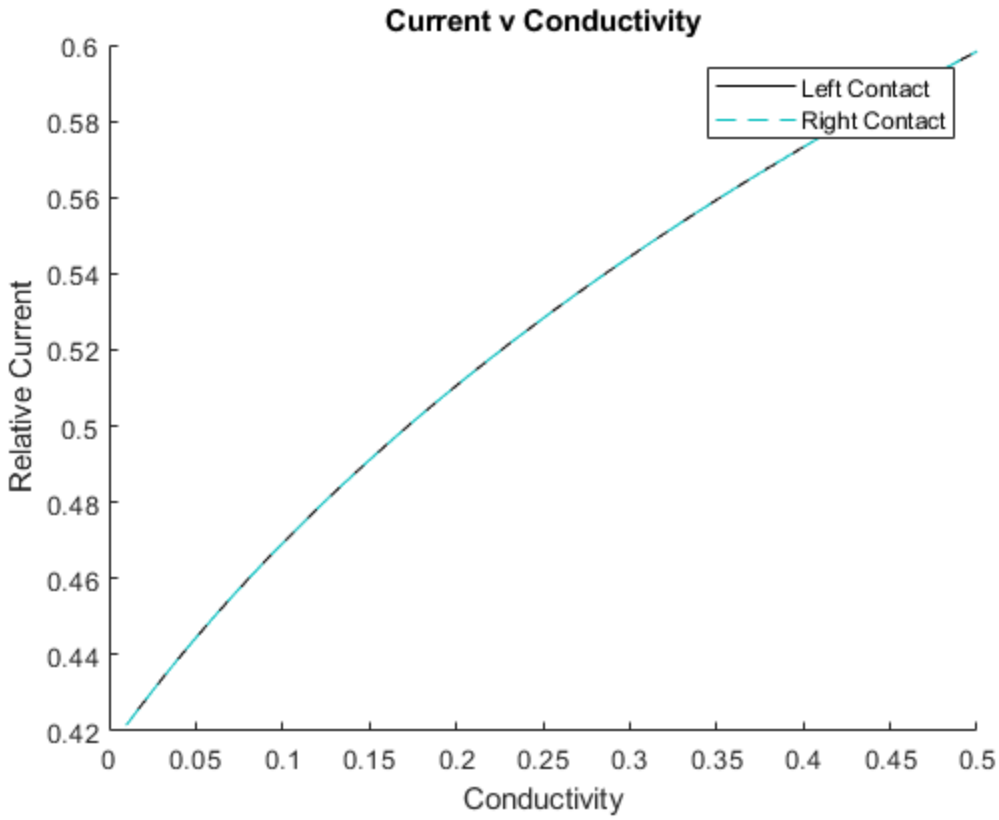


Figure 11

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