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ELEC4700

Assignment 2

Finite Difference Method

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For the first part, the analytical solution was the better option for more simple operations but the numerical is better fit for more complex operations.

The following code was written:

```
% Hanan Alshatti 101137569
close all;
clear all;
clc;
L      =      90;
W      =      60;
V0     =      1;
x_grid =      linspace(1,L,90);
y_grid =      linspace(1,L,60);
No_of_nodes = L*W;
Mat     =      zeros(No_of_nodes,No_of_nodes);
RHS=zeros(No_of_nodes,1);
for i=1:60
    for j=1:90
        n_n=(i-1)*90+j;
        if (j==1 || j==90)
            Mat(n_n,n_n)=1;
            if(j==1)
                RHS(n_n,1)=1;
            end
        end
        if (i==1 || i==60)
            Mat(n_n,n_n)=1;
            if(i==1)
                Mat(n_n,n_n+90)=-1;
            end
            if(i==60)
                Mat(n_n,n_n-90)=-1;
            end
        end
        if(i~=1&&i~=60&&j~=1&&j~=90)
            Mat(n_n,n_n)=-4;
            Mat(n_n,n_n+1)=1;
            Mat(n_n,n_n-1)=1;
            Mat(n_n,n_n+90)=1;
            Mat(n_n,n_n-90)=1;
        end
    end
end
Mat(1,91)=0;
RHS(5311,1)=0;
V_node=Mat\RHS;
v_mat      = zeros(60,90);
for i=1:60
    for j=1:90
```

```

        v_mat(i,j)=V_node((i-1)*90+j);
    end
end
[X,Y]      = meshgrid(x_grid,y_grid);
figure;
plot(x_grid,v_mat(12,:))

%%%%%%%%%Question 2%%%%%%%%%
Mat      =      zeros(No_of_nodes,No_of_nodes);
RHS=zeros(No_of_nodes,1);
for i=1:60
    for j=1:90
        n_n=(i-1)*90+j;
        if(i~=1&&i~=60&&j~=1&&j~=90)
            Mat(n_n,n_n)=-4;
            Mat(n_n,n_n+1)=1;
            Mat(n_n,n_n-1)=1;
            Mat(n_n,n_n+90)=1;
            Mat(n_n,n_n-90)=1;
        end
        if(i==1 || i==60 || j==1 || j==90)
            Mat(n_n,n_n)=1;
        end
        if(j==1 || j==90)
            RHS(n_n,1)=1;
        end
    end
end
V_node_new=Mat\RHS;
v_mat      = zeros(60,90);
for i=1:60
    for j=1:90
        v_mat(i,j)=V_node_new((i-1)*90+j);
    end
end
[X,Y]      = meshgrid(x_grid,y_grid);
figure;
surf(X,Y,v_mat);

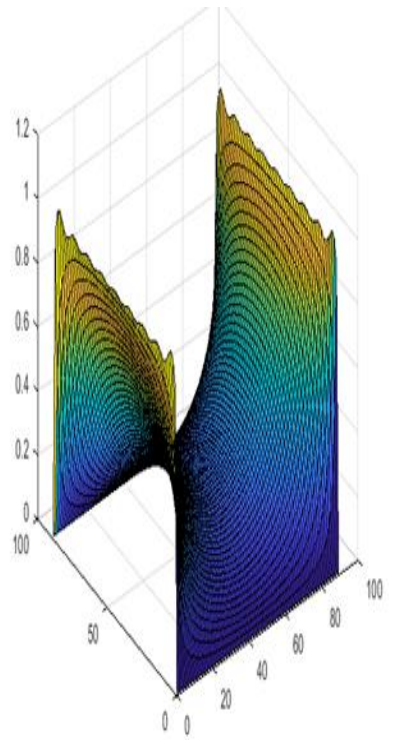
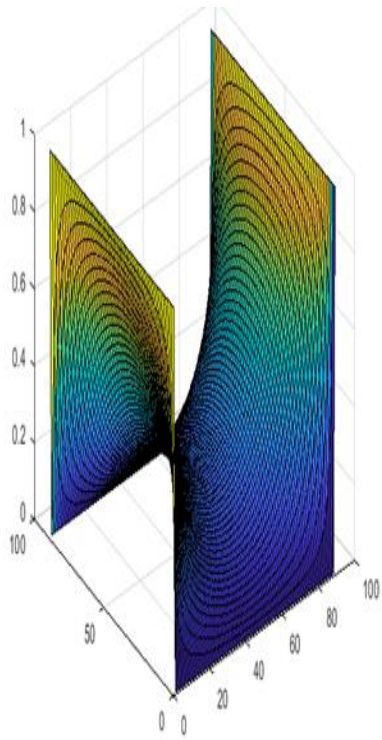
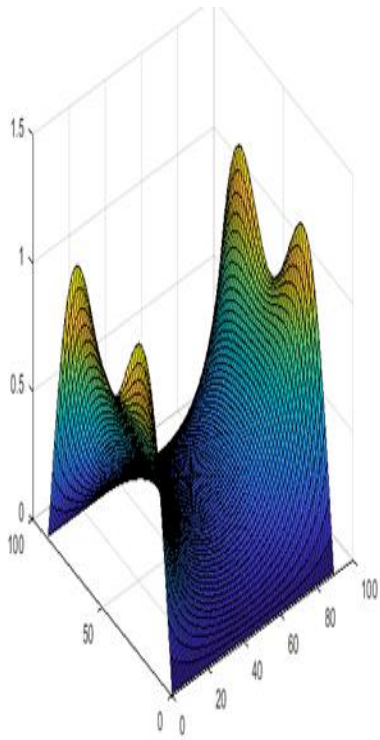
%%%%%%%%%Analytical Solution%%%%%%%%%
figure;
psum=zeros(60,90);
v_analy=zeros(60,90);
x=linspace(-45,45,90);
y=linspace(0,60,60);
for n=1:2:100
    for i=1:60
        for j=1:90
            s1=cosh(n*pi*x(j)/60)/(n*cosh(n*pi*45/60));
            s2=sin(n*pi*y(i)/60);
            psum(i,j)=s1*s2;
        end
    end
end
v_analy=v_analy+(4/pi)*psum;

```

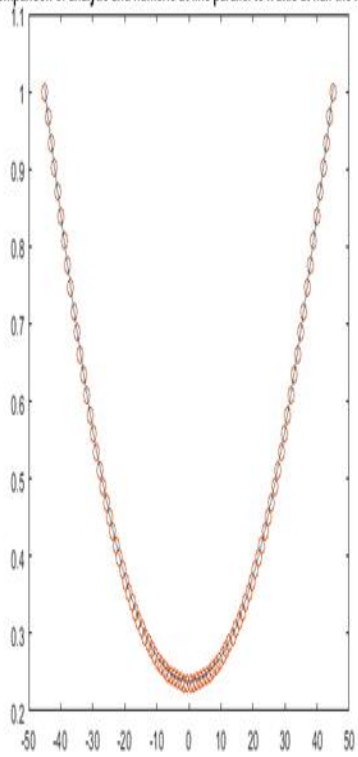
```
    surf(X,Y,v_analy);  
    pause(1)  
end  
figure;  
plot(x,v_analy(30,:));  
hold on;  
plot(x,v_mat(30,:), 'o');  
title('comparison of analytic and numeric at line parallel to x axis at half the  
height');
```

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The following plots were created:

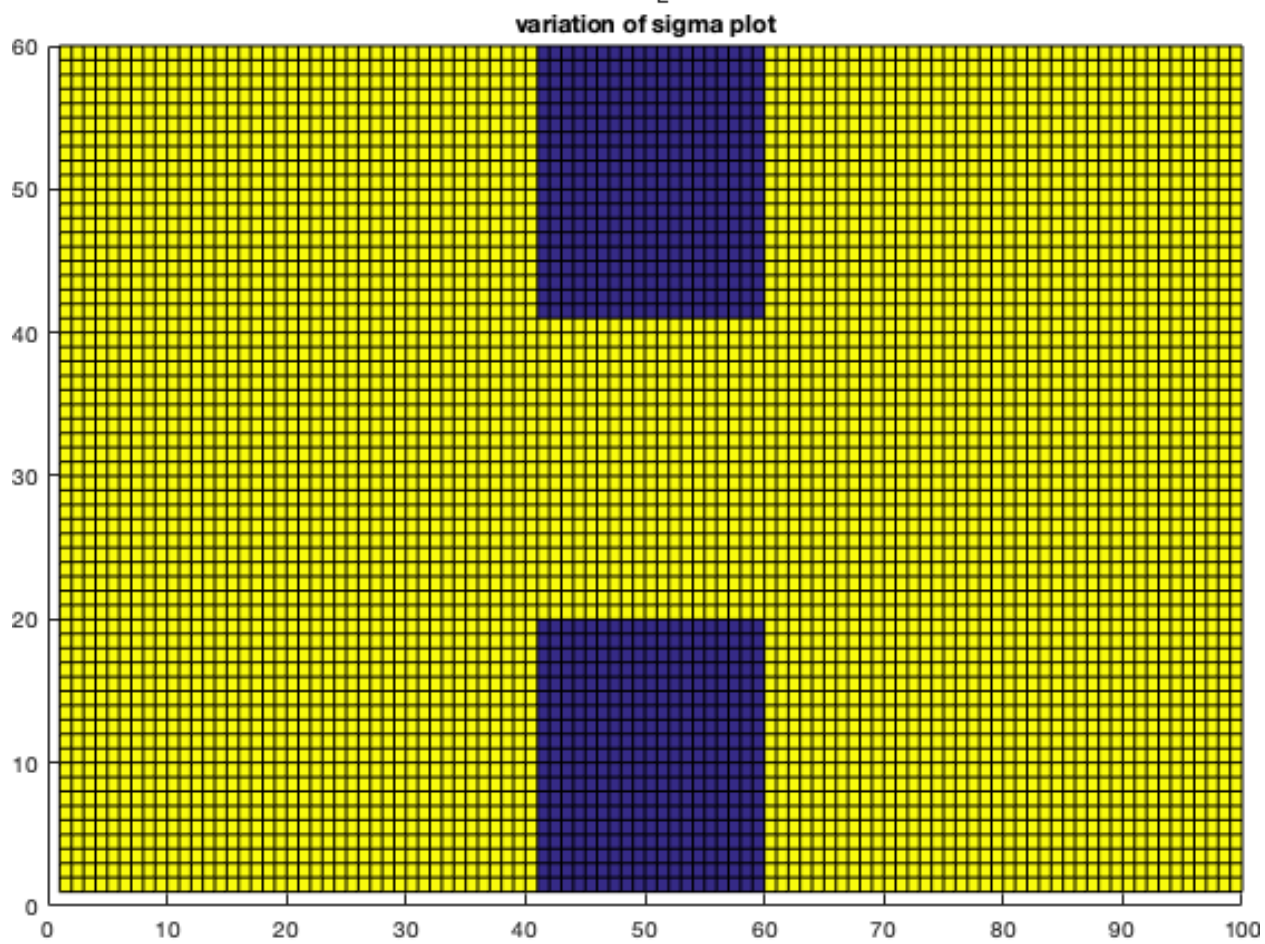
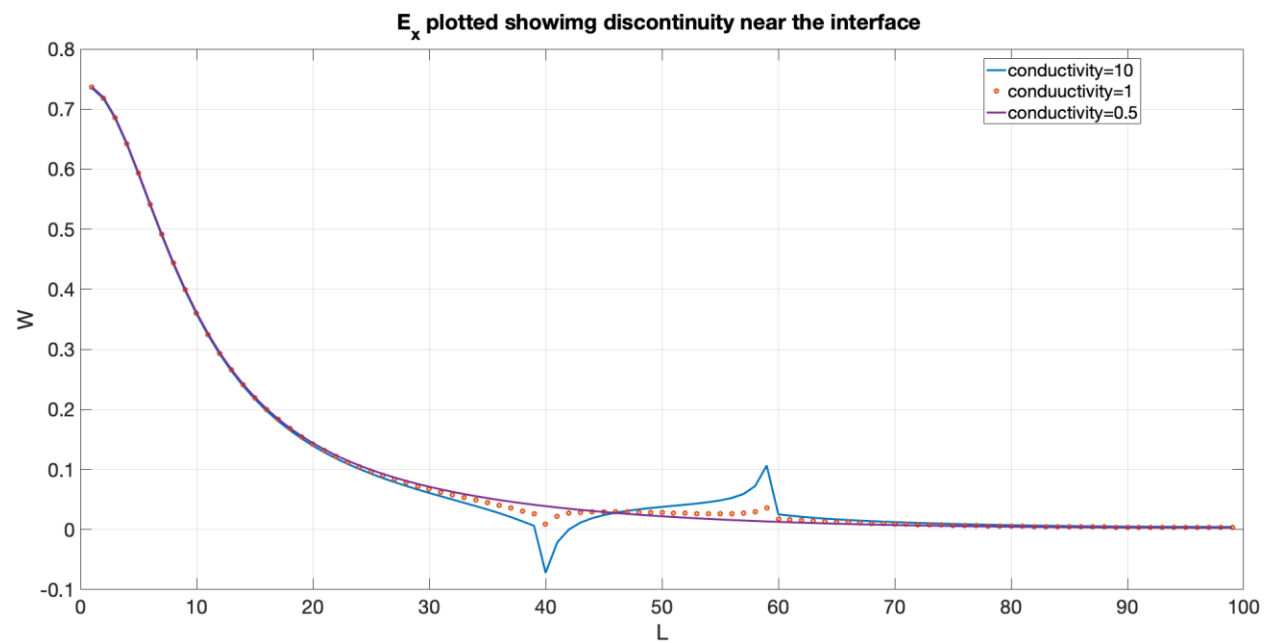


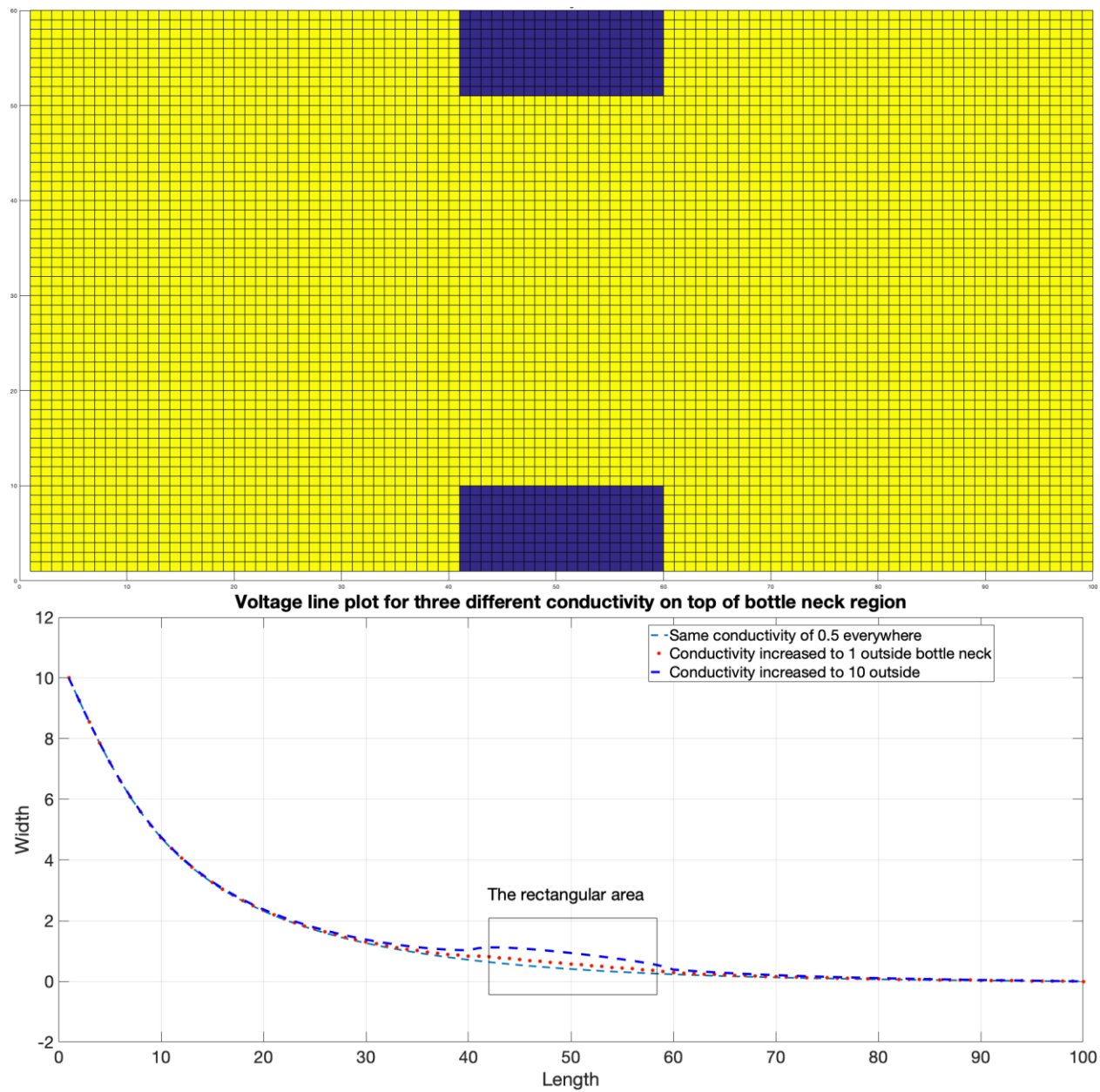
comparison of analytic and numeric at line parallel to x axis at half the height



For the second part the codes were in separated files and can be found in the same folder as the pdf.

The following simulated plots were generated:





(in sigma variation plots we can see how the current changes around it) No flow in the low conductance regions. With different widths and length for the box/ rectangular.