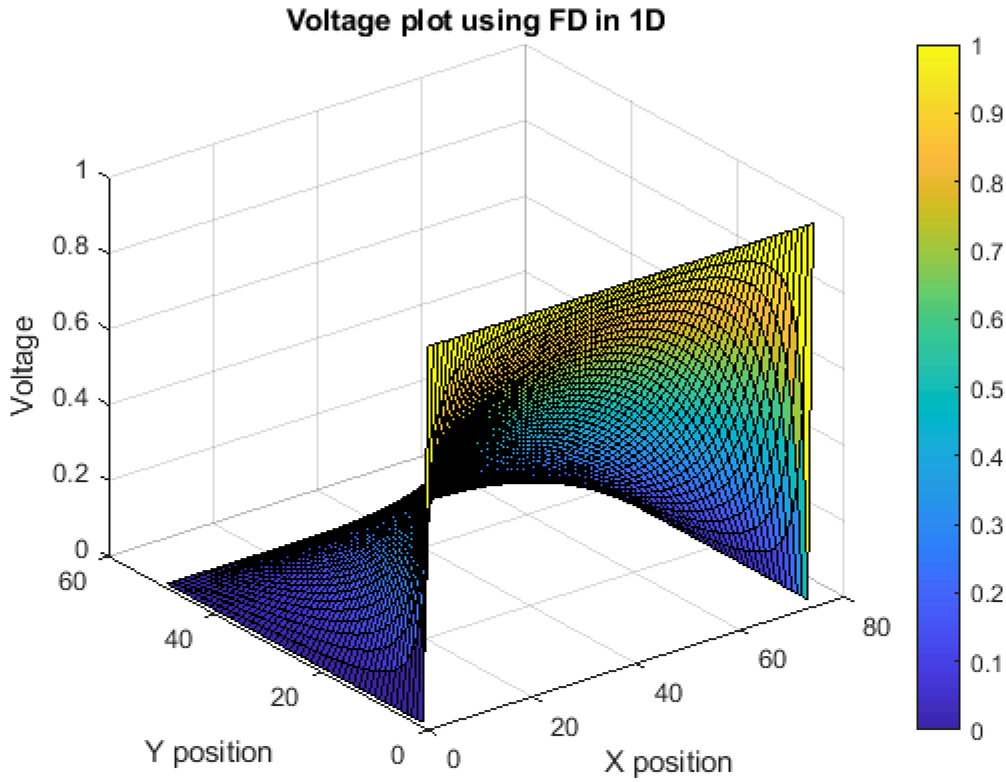
```
close all
clear
%Miranda Heredia 100996160
%Assignment 2
```

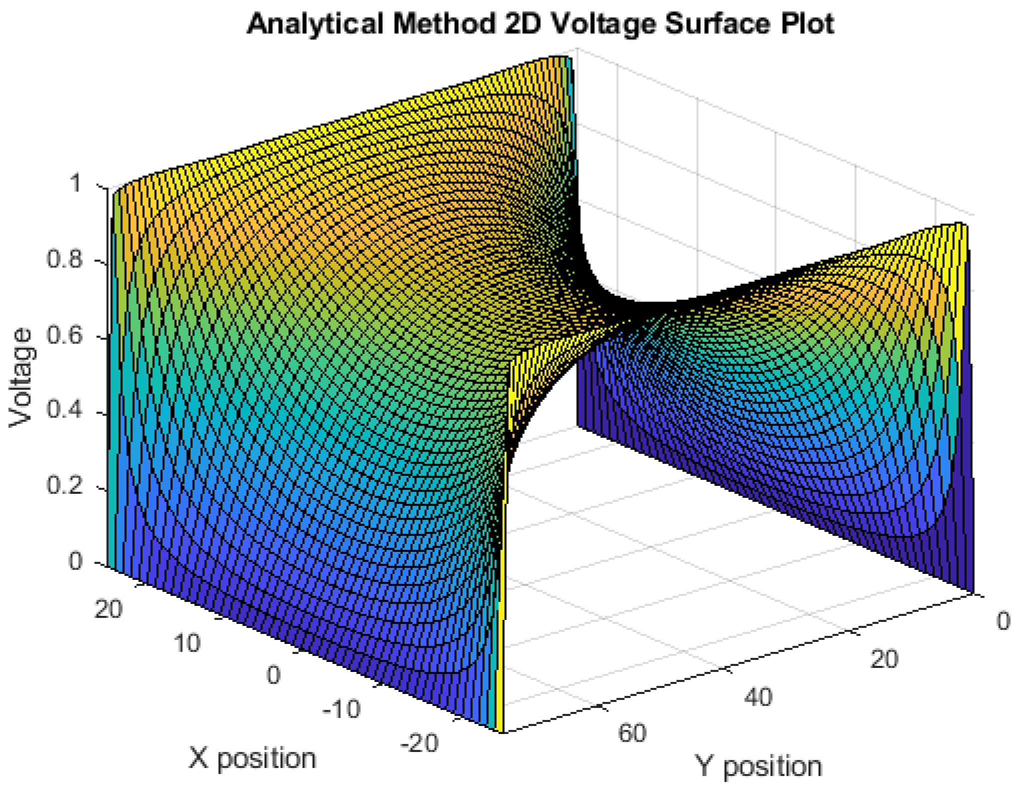
Question 1 - Part B

```
%Similar to part A, using FD method but in 2D. Using the analytical
 method.


%Initializing dimensions of matrix

Length = 50;
Width = (3/2)*Length;

G = sparse(Length*Width, Length*Width); %sparse to store non-zero
 elements
F = zeros(Length*Width, 1);

% Populating G matrix
for x =1:Length
    for y=1:Width
        n =  y +(x-1)*Width;    %Mapping equation FD
        %Local mapping of the nodes around (x,y)
        nxm = y+(x-2)*Width;
        nxp = y+(x)*Width;
        nym = (y-1)+(x-1)*Width;
        nyp = (y+1)+(x-1)*Width;

        %Boundaries
        if x==1     %Left BC
            G(n,n) = 1;
            F(n) = 1;
        elseif x==Length    %Right BC
            G(n,n) = 1;
            F(n) =0;
        elseif y==Width     %Upper BC
            G(n,n) = 1;
        elseif y==1         %Lower BC
            G(n,n) = 1;
        else
            %Laplacian Equation in Differences
            G(n,n) = -4;
            G(n,nxm)= 1;
            G(n,nxp) = 1;
            G(n,nym) = 1;
            G(n,nyp) = 1;
        end
    end
end
```

```
SolV = G\F;

%must create matrix to plot the surf()

SolVmatrix = zeros(Length, Width);

for i=1:Length
    for j=1: Width
        n = j+(i-1)*Width;
        SolVmatrix(i,j) = SolV(n);
    end
end

figure(1)
surf(SolVmatrix)
colorbar
title("Voltage plot using FD in 1D")
xlabel("X position")
ylabel("Y position")
zlabel("Voltage")


%variables to be used in our anayltical solution
a = Width;
b = Length/2;

x2 = linspace(-b,b, 50);
y2 = linspace(0,Width,Width);

[i,j] = meshgrid(x2,y2);

Vx = sparse(Width,Length);

%iterating to create a summation of the infinite series (finite in
 this
%case, ideally would be infinite for analytical)
% as n increases, the precision of the solution increases.


%Using fixed number of iterations (600) beause the analytical
 soltution had
%cosh and singh. Going over 600 iterations the plot does not match the
%soltion

for n = 1:2:600

    Vx = (Vx + (cosh(n*pi*i/a).*sin(n*pi*j/a))./(n*cosh(n*pi*b/a)));
    figure(2)
    surf(x2,y2,(4/pi)*Vx)
    title("Analytical Method 2D Voltage Surface Plot")
    xlabel("X position")
    ylabel("Y position")
    zlabel("Voltage")
```

```
    axis tight
    view(-130,30);
    pause(0.001)
end
```





Conclusion

After using both methods, I can conclude that the meshing and analytical approach similar results. However, there are some pros and cons to each methods. The numerical method is easy to visualize, easy to implements and provides decent approximations. Although some weakness is that this method could only handle simple equations.

```
%The analytical method requires an infinite sumation, so could not be
%implemented here on MATLAB. This method is slower due to sparsity.
%However, it proved a more accurate solution.
```

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