

---

# Assignment 3

## Part 2

In this part, the potential with the bottle-neck is inserted. Then, the electric field is plotted in 2-D

```
close all
clear

nx = 50; %
ny = nx*3/2; % rectangular region so 3/2
G = sparse(nx*ny); %
D = zeros(1, nx*ny);
S = zeros(ny, nx);
sigma1 = .01;
sigma2 = 1;
box = [nx*2/5 nx*3/5 ny*2/5 ny*3/5]; % Setting up the bottle neck
conditions

sigma = zeros(nx, ny);
for i = 1:nx
    for j = 1:ny
        if i > box(1) && i < box(2) && (j < box(3) || j > box(4))
            sigma(i, j) = sigma1;
        else
            sigma(i, j) = sigma2;
        end
    end
end

for i = 1:nx
    for j = 1:ny

        n = j + (i-1)*ny;
        nip = j + (i+1-1)*ny;
        nim = j + (i-1-1)*ny;
        njp = j + 1 + (i-1)*ny;
        njm = j - 1 + (i-1)*ny;

        if i == 1
            G(n, :) = 0;
            G(n, n) = 1;
            D(n) = 1;
        elseif i == nx
            G(n, :) = 0;
            G(n, n) = 1;
            D(n) = 0;
        elseif j == 1
            G(n, nip) = (sigma(i+1, j) + sigma(i, j))/2;
            G(n, nim) = (sigma(i-1, j) + sigma(i, j))/2;
```

```

        G(n, njp) = (sigma(i, j+1) + sigma(i,j))/2;
        G(n, n) = -(G(n,nip)+G(n,nim)+G(n,njp));
    elseif j == ny
        G(n, nip) = (sigma(i+1, j) + sigma(i,j))/2;
        G(n, nim) = (sigma(i-1, j) + sigma(i,j))/2;
        G(n, njm) = (sigma(i, j-1) + sigma(i,j))/2;
        G(n, n) = -(G(n,nip)+G(n,nim)+G(n,njm));
    else
        G(n, nip) = (sigma(i+1, j) + sigma(i,j))/2;
        G(n, njp) = (sigma(i, j+1) + sigma(i,j))/2;
        G(n, njm) = (sigma(i, j-1) + sigma(i,j))/2;
        G(n, nim) = (sigma(i-1, j) + sigma(i,j))/2;

        G(n, n) = -(G(n,nip)+G(n,nim)+G(n,njp)+G(n,njm));
    end
end
end

% Voltage calculation
V = G\D';

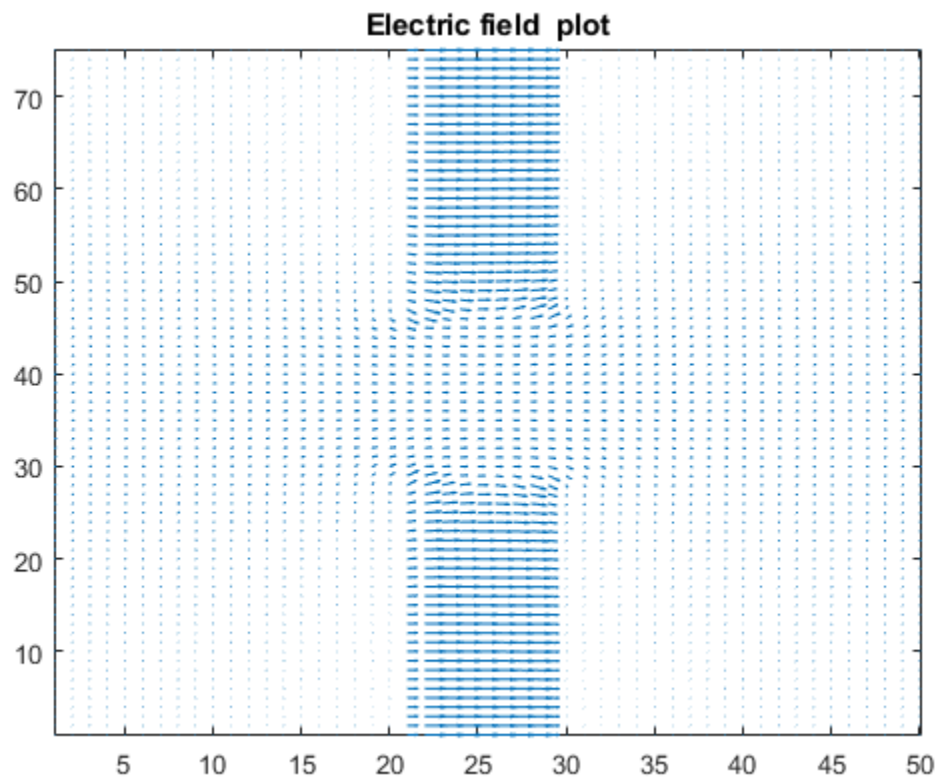
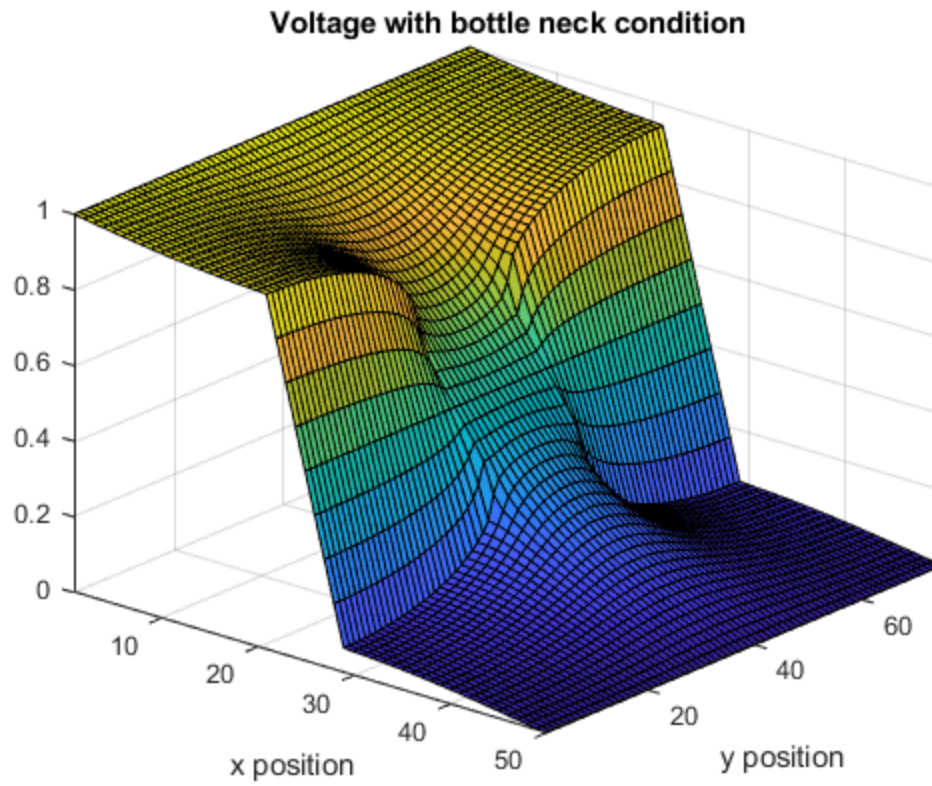
X = zeros(ny, nx, 1);
for i = 1:nx
    for j = 1:ny
        n = j + (i-1)*ny;
        X(j,i) = V(n);
    end
end

figure(1)
surf(X)
axis tight
view([40 30]);
title("Voltage with bottle neck condition")
xlabel("x position")
ylabel("y position")

[Ex, Ey] = gradient(X);

figure(2)
quiver(-Ex, -Ey);
axis tight
title("Electric field plot")

```



*Published with MATLAB® R2018a*