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%Miranda Heredia
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Question 2 - Part C

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%Miranda Heredia
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% In this part the current flow is calculated for different sizes of
 the
% bottleneck

Length=150;
Width=(2/3)*Length;
I = zeros(1,10);
sigmaMap = zeros(Length,Width);

for bottleneck =1:10

    bottle=bottleneck;



    G=sparse(Length*Width,Length*Width);
    F=zeros(Length*Width,1);

    sigOut= 1;
    sigIn= 1e-2;

    % Using method from part A because I wasnt able to get Box[]
 method to
    % work for narrowing  bottleneck

    %setting bottleneck dimensions
    midX = Length/2;
    midY = Width/2;

    boxW = Width*2/3;
    spaceW = Width - boxW;
    boxL = Length/4;
    boxW = spaceW/bottle;

    leftBC = midX - boxL/2;
    rightBC = midX + boxL/2;
    topBC = midY + boxW/2;
    bottomBC = midY - boxW/2;

    %Populating G matrix and sigma matrix

    for x=1:Length
        for y=1:Width
            n=y+(x-1)*Width; %Current Position
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nxm = y+(x-2)*Width;
nxp = y+(x)*Width;
nym = (y-1)+(x-1)*Width;
nyp = (y+1)+(x-1)*Width;
  if x == 1
    G(n,n) = 1;
    F(n) = 1;
    sigmaMap(x,y) = sigOut;
elseif x == Length
    G(n,n) = 1;
    F(n) = 0;
    sigmaMap(x,y) = sigOut;
elseif (y == Width)
    G(n,n) = -3;
    if(x>leftBC && x<rightBC)
        G(n,nxm) = sigIn;
        G(n,nxp) = sigIn;
        G(n,nym) = sigIn;
        sigmaMap(x,y) = sigIn;
    else
        G(n,nxm) = sigOut;
        G(n,nxp) = sigOut;
        G(n,nym) = sigOut;
        sigmaMap(x,y) = sigOut;
    end
elseif (y == 1)
    G(n,n) = -3;
    if(x>leftBC && x<rightBC)
        G(n,nxm) = sigIn;
        G(n,nxp) = sigIn;
        G(n,nyp) = sigIn;
        sigmaMap(x,y) = sigIn;
    else
        G(n,nxm) = sigOut;
        G(n,nxp) = sigOut;
        G(n,nyp) = sigOut;
        sigmaMap(x,y) = sigOut;
    end
else
    G(n,n) = -4;
    if( (y>topBC || y<bottomBC) && x>leftBC && x<rightBC)
        G(n,nxp) = sigIn;
        G(n,nxm) = sigIn;
        G(n,nyp) = sigIn;
        G(n,nym) = sigIn;
        sigmaMap(x,y) = sigIn;
    else
        G(n,nxp) = sigOut;
        G(n,nxm) = sigOut;
        G(n,nyp) = sigOut;
        G(n,nym) = sigOut;
        sigmaMap(x,y) = sigOut;
    end
end
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        end
    end

    SolV = G\F;
    SolVmatrix=zeros(Length,Width);

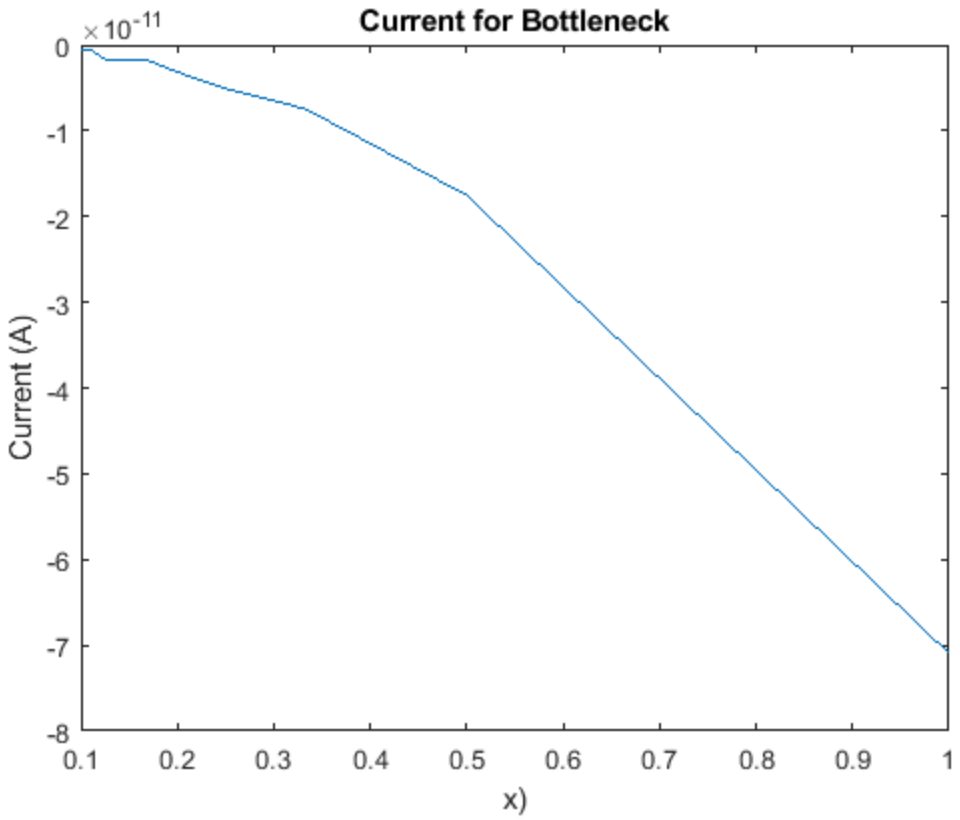
    for x=1:Length
        for y=1:Width
            n=y+(x-1)*Width;
            SolVmatrix(x,y)= SolV(n);
        end
    end

    [Ey,Ex] = gradient(SolVmatrix);
    E = gradient(SolVmatrix);
    J = sigmaMap.* E;

    area = Length*Width;
    I(bottleneck)= (sum(sum(J))/(Length*Width))/area;
end

x = 1./linspace(1,10,10);

%Plot current vs narrowing of bottleneck
% As bottleneck is narrowed, the current decreases
figure(1)
plot(x,I);
title('Current for Bottleneck')
xlabel('x)')
ylabel('Current (A)')
```



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