Computational Electromagnetics

Hw6-Q3

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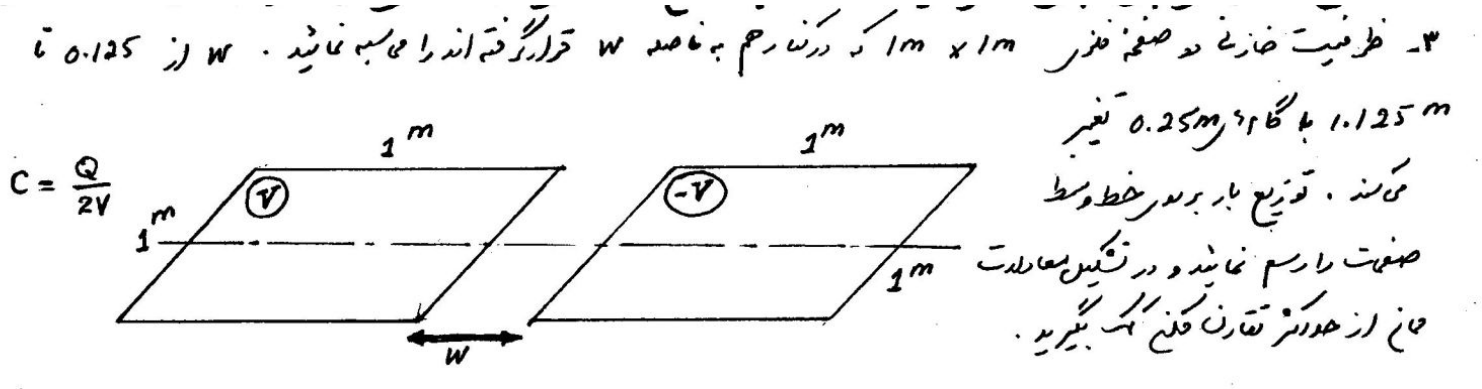
```
clear ; clc; close all;
```

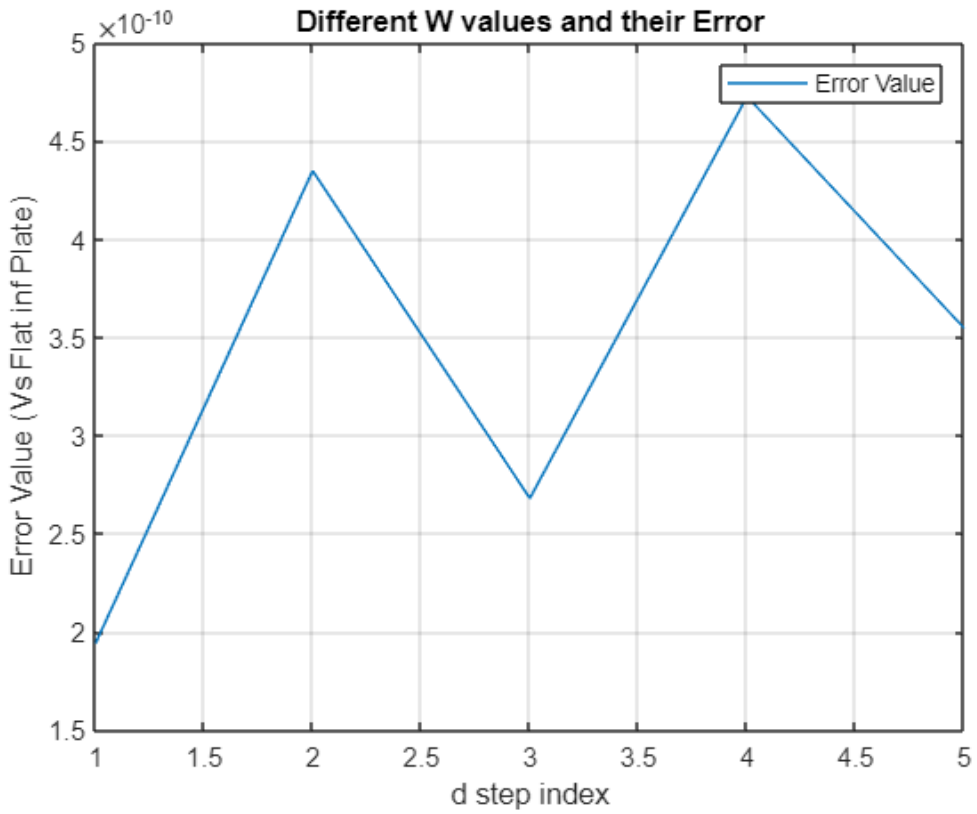



```
a = 1/2;

N = 9;

b = a/sqrt(N) ;


eps0 = 8.854*1e-12  ;  % F/m

delta_X = 2*b;
delta_Y = 2*b;
```

```
N = 9;

W      = 0.125: 0.25 : 1.125 ;
Sweep_N = [ 9 , 16 , 25 , 36 , 49 , 64  , 81 , 100];

C       = zeros( length(W) , length(Sweep_N));
C_plate = zeros( length(W),1);

A  = (2*a)^2;

Alpha_t =cell(1,length(W)) ;

for i=1:length(W)
    for j=1:length(Sweep_N)
```

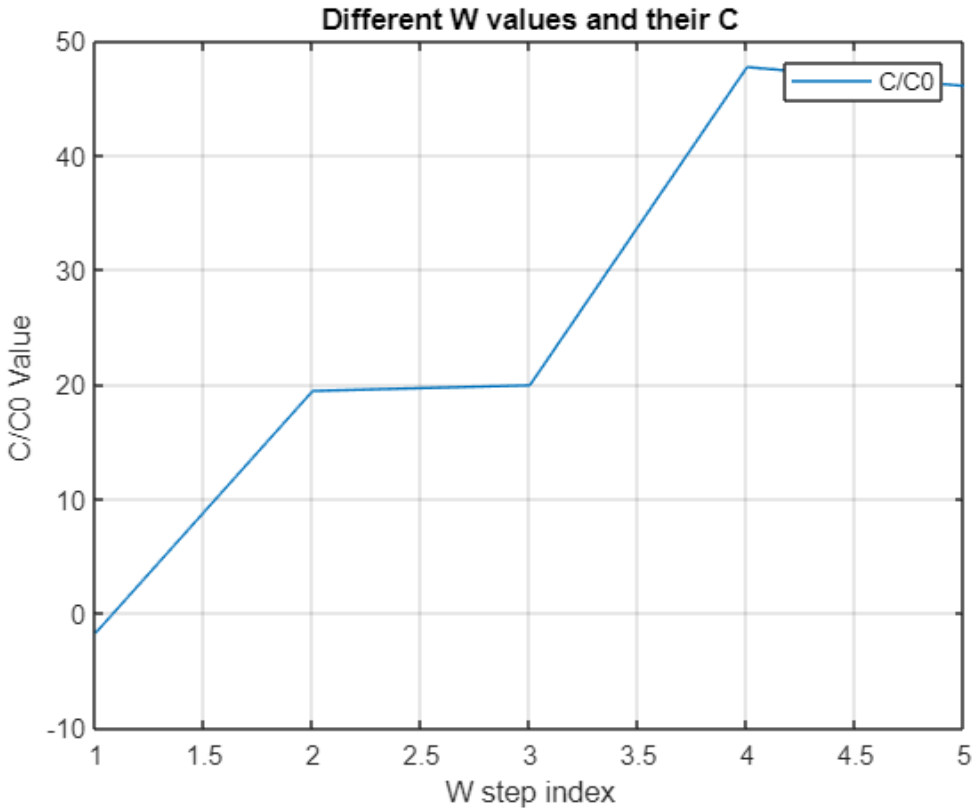
```
        [C(i,j) , Alpha_t{i}] = Find_C(W(i) , Sweep_N(j),a );

    end
    C_plate(i,1) =  eps0*A/W(i);

end
```

```
% Compare:
rep_C_Plate = repmat(C_plate , 1,length(Sweep_N));
Error  =   sqrt ( abs( rep_C_Plate  - C  ).^2  )  ;

figure(1)
plot(1:length(W) , Error(:,end))
grid on
legend("Error Value")
title("Different W values and their Error")
xlabel("d step index")
ylabel("Error Value (Vs Flat inf Plate)")
```

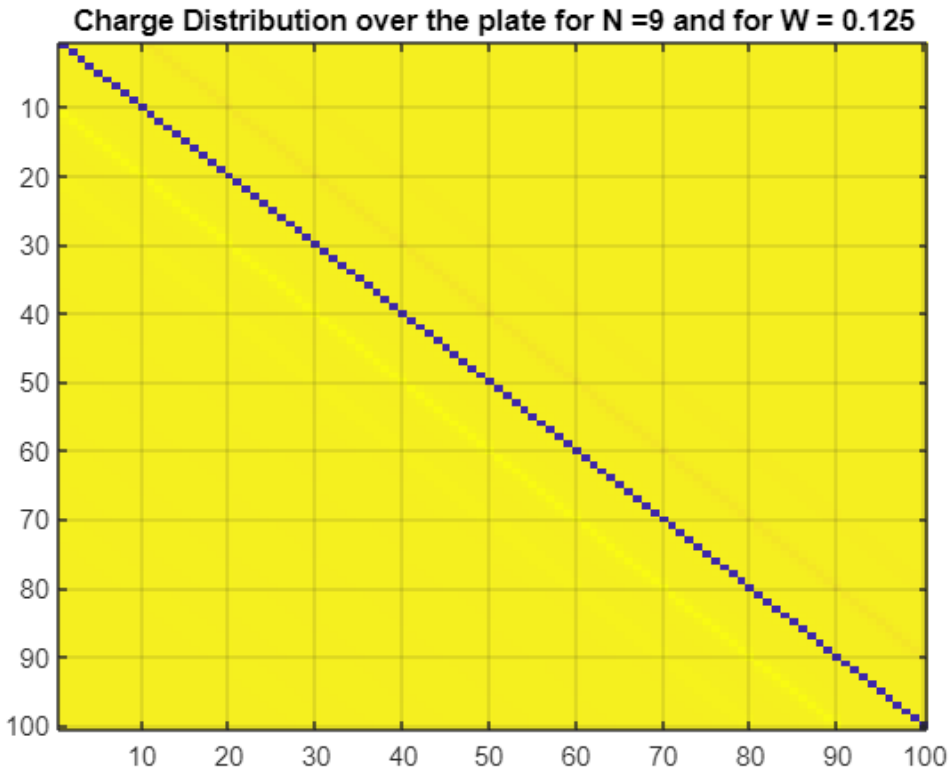



```
figure(2)
plot(1:length(W) , C(:,end)./C_plate)
grid on
```

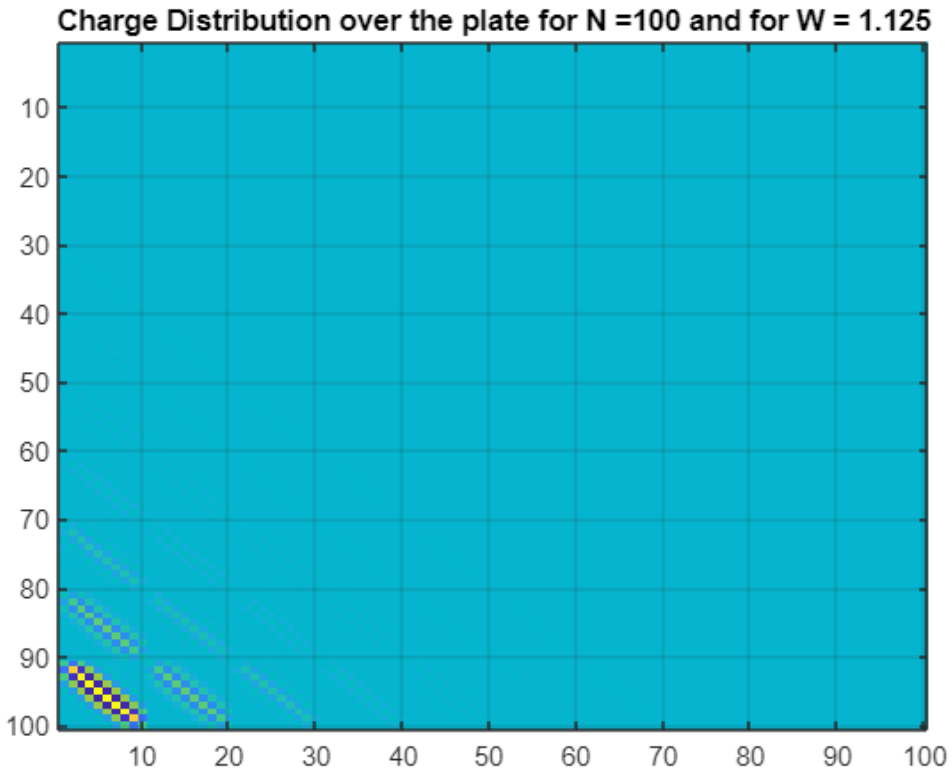
```
legend("C/C0")
title("Different W values and their C")
xlabel("W step index")
ylabel("C/C0 Value ")
```




```
delta_Sn = (2*b)^2;
Q_T = sum( Alpha_t{1} , 'all' ) * delta_Sn; % Total Q

Charge_Distribution = Alpha_t{1};

figure(4)
imagesc(Charge_Distribution)
title("Charge Distribution over the plate for N =" + num2str(Sweep_N(1))+ " and for W = "+num2s
grid on
```




```
Charge_Distribution_end = Alpha_t{end};

figure(5)
imagesc(Charge_Distribution_end)
title("Charge Distribution over the plate for N =" + num2str(Sweep_N(end))+ " and for W = "+nu
grid on
```




```
function   X_pos = Find_Cordx(m , N )

    if(m > sqrt(N) )
        Rem =  m - sqrt(N);
        X_pos = Find_Cordx(Rem , N);
    else
        X_pos  = ( m - 1/2);
    end
end

function   Y_pos = Find_Cordy(m , N )

     Y_pos =floor(m/sqrt(N+1)+1)*1 -  1/2;
end

function  R  = R_finder(m,n,delta_X,delta_Y,N, reside,W)
    if(reside ==0 )
        R =               abs(  delta_X*Find_Cordx(m , N ) - delta_X*Find_Cordx(n , N ) )^2  +
                          abs(  delta_Y*Find_Cordy(m , N ) - delta_Y*Find_Cordy(n , N ) )^2  ;
    else
        R =               abs(  delta_X*Find_Cordx(m , N ) - delta_X*Find_Cordx(n , N ) )^2  +
                          abs(  delta_Y*Find_Cordy(m , N ) - delta_Y*(W+Find_Cordy(n , N )) )^2
```

```
    end
end

function lmn =  lmn_tt(m, n , delta_Sn , delta_X ,  delta_Y , N )
    eps0 = 8.854*1e-12  ;  % F/m

    if(m==n)
        lmn = (sqrt(delta_Sn)/eps0)*0.2806;
    else
        lmn =  delta_Sn/(4*pi*eps0*sqrt( R_finder(m,n,delta_X,delta_Y,N,0,0))  ) ;
    end

end



function lmn =  lmn_rl(m, n , delta_Sn , delta_X ,  delta_Y , N , W)
    eps0 = 8.854*1e-12  ;  % F/m
%     aeq  = sqrt(delta_Sn/pi)  ;
    reside =1;

    lmn =  delta_Sn/(4*pi*eps0*  sqrt( R_finder(m,n,delta_X,delta_Y,N, reside,W) ))  ;

end



function [C , Alpha_t] = Find_C(W, N,a )

    Lmn_tt = zeros(N,N);

    Lmn_rl = zeros(N,N);

    V =1;
    b = a / sqrt(N);
    delta_Sn  =  (2*b)^2 ;
    % eps0 = 8.854*1e-12  ;  % F/m
    delta_X = 2*b;
    delta_Y = 2*b;

    for i=1:N
        for j=1:N
            Lmn_tt(i,j)  = lmn_tt(i, j , delta_Sn , delta_X ,  delta_Y , N );
            Lmn_rl(i,j)  = lmn_rl(i, j , delta_Sn , delta_X ,  delta_Y , N , W);
        end
    end

    Alpha_t = inv(  Lmn_tt - Lmn_rl  ) * V;
```

```
    C = 1/(2*V) * sum(Alpha_t,'all')*delta_Sn;

end
```