MATLAB EXERCISE 1.39 **MoM-based MATLAB program for a charged square plate.** Using the method of moments and functions developed in previous three MATLAB exercises, write a computer program in MATLAB to determine the charge distribution on a very thin charged square plate of edge length a at a potential V_0, in free space. Subdivide the plate into N square patches, and assume that $a = 1$ m and $V_0 = 1$ V. (a) Tabulate and plot the results for the surface charge density (ρ_s) of the patches, taking $N = 100$ (ten partitions in each dimension). (b) Compute the total charge of the plate, taking (i) $N = 16$, (ii) $N = 36$, (iii) $N = 64$, and (iv) $N = 100$, respectively. *(ME1_39.m on IR)*

SOLUTION:

(a) Results for the surface charge density of $N = 100$ patches in the tabulated form and as a 3-D plot are shown in Fig.S1.20.

ρ_s [pC/m^2]

100.3	66.4	60.7	57.9	56.8	56.8	57.9	60.7	66.4	100.3
66.4	34.1	30.0	28.1	27.4	27.4	28.1	30.0	34.1	66.4
60.7	30.0	25.9	24.0	23.2	23.2	24.0	25.9	30.0	60.7
57.9	28.1	24.0	22.1	21.3	21.3	22.1	24.0	28.1	57.9
56.8	27.4	23.2	21.3	20.6	20.6	21.3	23.2	27.4	56.8
56.8	27.4	23.2	21.3	20.6	20.6	21.3	23.2	27.4	56.8
57.9	28.1	24.0	22.1	21.3	21.3	22.1	24.0	28.1	57.9
60.7	30.0	25.9	24.0	23.2	23.2	24.0	25.9	30.0	60.7
66.4	34.1	30.0	28.1	27.4	27.4	28.1	30.0	34.1	66.4
100.3	66.4	60.7	57.9	56.8	56.8	57.9	60.7	66.4	100.3

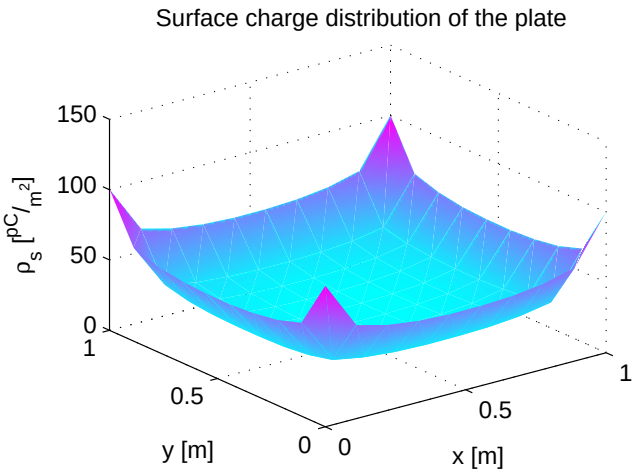

Figure S1.20 Surface charge density (ρ_s) of $N = 100$ (ten partitions in each dimension) patches modeling a thin charged square plate in free space: results obtained, in MATLAB, using the method of moments (MoM) – tabulated charge densities of patches and MATLAB display of ρ_s using function `surf`; for MATLAB Exercise 1.39.

(b) The total charge of the plate, taking (i) $N = 9$, (ii) $N = 25$, (iii) $N = 49$, and (iv) $N = 100$, amounts to (i) $Q = 37.29$ pC, (ii) $Q = 38.71$ pC, (iii) $Q = 39.33$ pC, and (iv) $Q = 39.8$ pC, respectively.

```
%
%   Book: MATLAB-Based Electromagnetics (Pearson Prentice Hall)
%   Author: Branislav M. Notaros
%   Instructor Resources
%   (c) 2011
%
%   This MATLAB code or any part of it may be used only for
%   educational purposes associated with the book
%
%
%


%   MoM-based MATLAB program for a charged square plate


clear all;
close all;
N = 100;  %total number of patches
a = 1;
V0 = 1;
EPS0 = 8.8542*10^(-12);
n = sqrt(N);

%coordinates of centers of patches

[x,y,S] = localCoordinates(n,n,a,a);

%matrix A

A = matrixA(EPS0,S,x,y);

%matrix B

B = V0*ones(1,N)';  %transpose -- to make it a column matrix

rhos = A\B;  %solving the equation

% making 2D matrix rhos2D from results for rhos in 1D array

for i = 1:n
rhos2D(i,:) = rhos((i-1)*n +1:i*n);
end;

figure(1);
[x2D,y2D] = meshgrid(0:1/(n-1):1);
surf(x2D,y2D,rhos2D*10^12);
colormap('cool');
shading interp;
title(' Surface charge distribution of the plate');
xlabel('x [m]');
ylabel('y [m]');
```

```
zlabel('\rho_s [^{pC}/_{m^2}]');
zlim([0,150])


figure(2);

imagesc(rhos2D);
colormap('cool');
axis equal;
shading interp;
title('Surface charge density');
xlabel('x');
ylabel('y');
axis off;

Qtot = totalCharge(S,rhos);

fprintf(['\nTotal charge of the plate is '...
    '%2.3d pC'], Qtot*10^12);
```