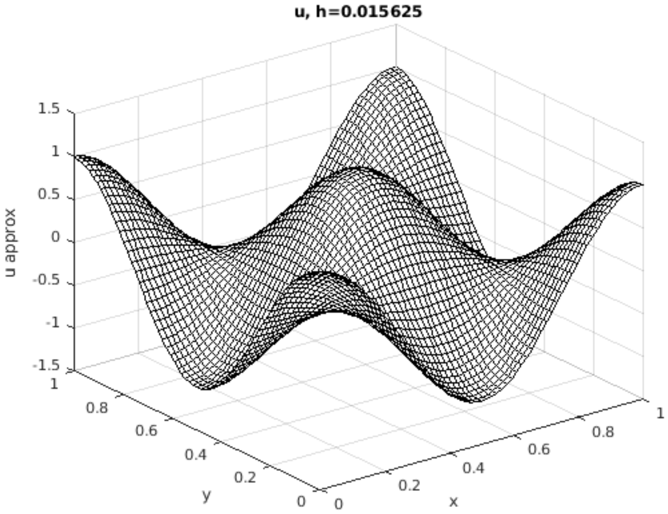
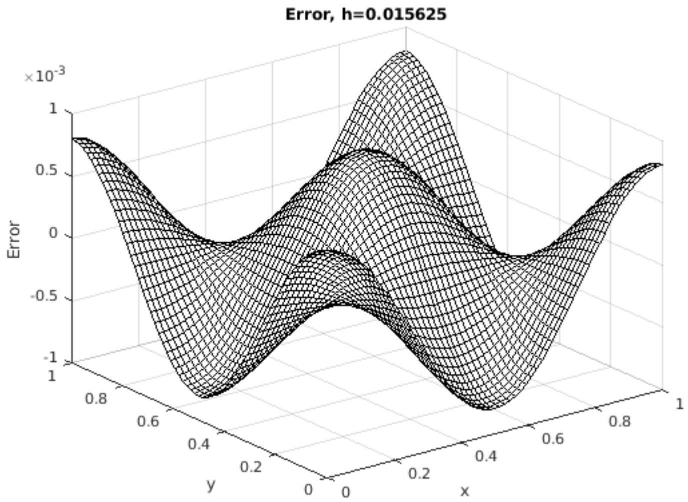
```
%Using the code from part(a) to solve the Poisson equation with f(x,y) =  -8*(pi^2)*(cos(2*pi*x)).*(cos(2*pi*y))

m=(2^6)-1;
a=0;b=1;
h=(b-a)/(m+1);

%fuction f(x,y)
pfun=@(x,y) -8*(pi^2)*(cos(2*pi*x)).*(cos(2*pi*y));

%Approximated
[u,x,y]=fd2poissondct(pfun,a,b,m);

%Numerical solution to the poisson equation
figure, set(gcf,'DefaultAxesFontSize',8,'PaperPosition', [0 0 3.5 3.5]),
mesh(x,y,u), colormap([0 0 0]),xlabel('x'),ylabel('y'),
zlabel('u_ approx'), title(strcat('u, h=',num2str(h)));

%Exact function
uex=@(x,y) (cos(2*pi*x)).*(cos(2*pi*y));
ue=uex(x,y);
error = (u-ue);

%Plot error
figure, set(gcf,'DefaultAxesFontSize',8,'PaperPosition', [0 0 3.5 3.5]),
mesh(x,y,error), colormap([0 0 0]),xlabel('x'),ylabel('y'),
zlabel('Error'), title(strcat('Error, h=',num2str(h)));

%Table showing the convergence of the solution to the true solution.
k1 = zeros(7,1);
h1=zeros(7,1);
L2=zeros(7,1);
m1=zeros(7,1);

for k = 4:10
    k1(k-3) = k;
    m1(k-3) = (2^k) - 1;
    m = (2^k) - 1;
    h1(k-3) = (b-a)/(m+1);
    h = (b-a)/(m+1);

    [x1,y1] = meshgrid(a:h:b);

    [u,x1,y1] = fd2poissondct(pfun,a,b,m);
    ue = uex(x1,y1);

    error = u - uex(x1,y1);

    L2(k-3) = R2Norm(error,ue);
end

%table
T = table(k1(:),m1(:),h1(:),L2(:), 'VariableNames',{'k','m','h','R2-norm'})
fprintf('Its clear from the table that as m increases due to increasing k, \n h decreases, and the value of the relative 2-norm significantly dec

%polyfit
p=polyfit(log(h1),log(L2),1);
p
fprintf('Since the order of convergence,p, is 2.0014, which is approximately 2, \n hence the method is second order accurate.\n')

function L2 = R2Norm(error, uexact)
    R = error .^2;
    u_ex = uexact.^2;
    L2 = sqrt(sum(R,'all')/sum(u_ex,'all'));
end
```

```
T =

  7×4 table

    k      m          h          R2-norm
    __    ____    __________    __________

     4      15        0.0625      0.012951
     5      31       0.03125      0.003219
     6      63      0.015625    0.00080358
     7     127     0.0078125    0.00020082
     8     255     0.0039062    5.0201e-05
     9     511     0.0019531     1.255e-05
    10    1023    0.00097656    3.1375e-06

Its clear from the table that as m increases due to increasing k,
 h decreases, and the value of the relative 2-norm significantly decreases as m grows big.
 Hence the big the m, the faster the solution converges to the true solution.

p =

    2.0014    1.1992

Since the order of convergence,p, is 2.0014, which is approximately 2,
 hence the method is second order accurate.
```





Published with MATLAB® R2020a