Parametric Surfaces

The functions that draw surfaces can take two additional vector or matrix arguments to describe surfaces with specific *x* and *y* data. If `Z` is an m−by−n matrix, `x` is an n−vector, and `y` is an m−vector, then

```
mesh(x,y,Z,C)
```

describes a mesh surface with vertices having color `C(i,j)` and located at the points

```
(x(j), y(i), Z(i,j))
```

where `x` corresponds to the columns of `Z` and `y` to its rows.

More generally, if `X, Y, Z`, and `C` are matrices of the same dimensions, then

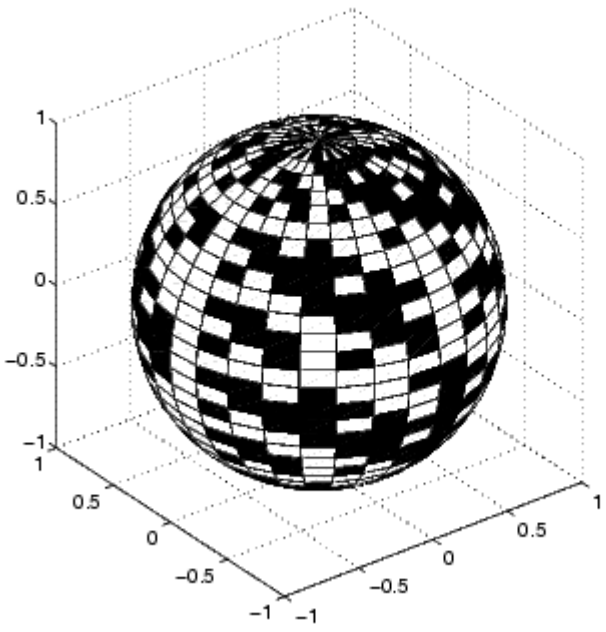
```
mesh(X,Y,Z,C)
```

describes a mesh surface with vertices having color `C(i,j)` and located at the points

```
(X(i,j), Y(i,j), Z(i,j))
```

This example uses spherical coordinates to draw a sphere and color it with the pattern of pluses and minuses in a Hadamard matrix, an orthogonal matrix used in signal processing coding theory. The vectors `theta` and `phi` are in the range $-\pi \le$ `theta` $\le \pi$ and $-\pi/2 \le$ `phi` $\le \pi/2$. Because `theta` is a row vector and `phi` is a column vector, the multiplications that produce the matrices `X`, `Y`, and `Z` are vector outer products.

```
k = 5;
n = 2^k−1;
theta = pi*(−n:2:n)/n;
phi = (pi/2)*(−n:2:n)'/n;
X = cos(phi)*cos(theta);
Y = cos(phi)*sin(theta);
Z = sin(phi)*ones(size(theta));
colormap([0 0 0;1 1 1])
C = hadamard(2^k);
surf(X,Y,Z,C)
axis square
```



Surface Plots of Nonuniformly Sampled Data Hidden Line Removal