Visualizing Volume Data

This example shows several methods for visualizing volume data in MATLAB®.

**Display Isosurface**

An *isosurface* is a surface where all the points within a volume of space have a constant value. Use the isosurface function to generate the faces and vertices for the outside of the surface and the isocaps function to generate the faces and vertices for the end caps of the volume. Use the patch command to draw the volume and its end caps.

load mri D % load data

D = squeeze(D); % remove singleton dimension

limits = [NaN NaN NaN NaN NaN 10];

[x, y, z, D] = subvolume(D, limits); % extract a subset of the volume data

[fo,vo] = isosurface(x,y,z,D,5); % isosurface for the outside of the volume

[fe,ve,ce] = isocaps(x,y,z,D,5); % isocaps for the end caps of the volume

figure

p1 = patch('Faces', fo, 'Vertices', vo); % draw the outside of the volume

p1.FaceColor = 'red';

p1.EdgeColor = 'none';

p2 = patch('Faces', fe, 'Vertices', ve, ... % draw the end caps of the volume

'FaceVertexCData', ce);

p2.FaceColor = 'interp';

p2.EdgeColor = 'none';

view(-40,24)

daspect([1 1 0.3]) % set the axes aspect ratio

colormap(gray(100))

box on

camlight(40,40) % create two lights

camlight(-20,-10)

lighting gouraud

**Create Cone Plot**

The coneplot command plots velocity vectors as cones at *x*, *y*, *z* points in a volume. The cones represent the magnitude and direction of the vector field at each point.

cla % clear the current axes

load wind u v w x y z % load data

[m,n,p] = size(u);

[Cx, Cy, Cz] = meshgrid(1:4:m,1:4:n,1:4:p); % calculate the location of the cones

h = coneplot(u,v,w,Cx,Cy,Cz,y,4); % draw the cone plot

set(h,'EdgeColor', 'none')

axis tight equal

view(37,32)

box on

colormap(hsv)

light

**Plot Streamlines**

The streamline function plots streamlines for a velocity vector at *x*, *y*, *z* points in a volume to illustrate the flow of a 3-D vector field.

cla

[m,n,p] = size(u);

[Sx, Sy, Sz] = meshgrid(1,1:5:n,1:5:p); % calculate the starting points of the streamlines

streamline(u,v,w,Sx,Sy,Sz) % draw the streamlines

axis tight equal

view(37,32)

box on

**Plot Streamtubes**

The streamtube function plots streamtubes for a velocity vector at *x*, *y*, *z* points in a volume. The width of the tube is proportional to the normalized divergence of the vector field at each point.

cla

[m,n,p] = size(u);

[Sx, Sy, Sz] = meshgrid(1,1:5:n,1:5:p); % calculate the starting points of the streamlines

h = streamtube(u,v,w,Sx,Sy,Sz); % draw the streamtubes and return an array of surfaces

set(h, 'FaceColor', 'cyan') % use 'set' to change properties for an array of objects

set(h, 'EdgeColor', 'none')

axis tight equal

view(37,32)

box on

light

**Combine Volume Visualizations**

Combine volume visualization in a single plot to get a more comprehensive picture of a velocity field within a volume.

cla

spd = sqrt(u.\*u + v.\*v + w.\*w); % wind speed at each point in the volume

[fo,vo] = isosurface(x,y,z,spd,40); % isosurface for the outside of the volume

[fe,ve,ce] = isocaps(x,y,z,spd,40); % isocaps for the end caps of the volume

p1 = patch('Faces', fo, 'Vertices', vo); % draw the isosurface for the volume

p1.FaceColor = 'red';

p1.EdgeColor = 'none';

p2 = patch('Faces', fe, 'Vertices', ve, ... % draw the end caps of the volume

'FaceVertexCData', ce);

p2.FaceColor = 'interp';

p2.EdgeColor = 'none' ;

[fc, vc] = isosurface(x, y, z, spd, 30); % isosurface for the cones

[fc, vc] = reducepatch(fc, vc, 0.2); % reduce the number of faces and vertices

h1 = coneplot(x,y,z,u,v,w,vc(:,1),vc(:,2),vc(:,3),3); % draw the coneplot

h1.FaceColor = 'cyan';

h1.EdgeColor = 'none';

[sx, sy, sz] = meshgrid(80, 20:10:50, 0:5:15); % starting points for streamline

h2 = streamline(x,y,z,u,v,w,sx,sy,sz); % draw the streamlines

set(h2, 'Color', [.4 1 .4])

axis tight equal

view(37,32)

box on

light