12.010 Computational Methods of Scientific Programming
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12.010 Computational Methods of Scientific Programming

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Overview Today

• Examine image and 3-D graphics in Matlab
Simple 3-D graphics

- Simple line and scatter plots use plot3 which takes 3 vectors as arguments and plots them much like 2-D plot.

```matlab
t = linspace(0,10*pi);
figure(1); clf;
plot3(sin(t),cos(t),t)
```
Mesh plots

[X,Y,Z] = peaks(30); % 30x30 version of Gaussians
mesh(X,Y,Z)
xlabel('X-axis'), ylabel('Y-axis'), zlabel('Z-axis')
colorbar;daspect([1 1 2.5]);
title('Lec 19.2: Mesh Plot of Peaks')
[X,Y,Z]=sphere(12);
subplot(1,2,1)
mesh(X,Y,Z), title('Lec 3a: Opaque')
hidden on
axis square off
subplot(1,2,2)
mesh(X,Y,Z), title('Lec 3b: Transparent')
hidden off
axis square off
Mesh with contour

- meshc(X,Y,Z)  % mesh plot with underlying contour plot
Surface plots

• Surface plots are like mesh except that the surface is filled
• The appearance of these plots depends on the method of shading and how they are light.
• The commands here are:
  – surf -- surface plot
    • shading flat has flat facetted look
    • shading interp interpolates the surface and looks smoother
  – surfc -- surface plot with contours (like meshc)
  – surf -- surface with lighting
  – surfnorm -- surface with normal plotted
• Following figures give example of these commands using the peaks(30) data set.
• We can look at these plots in Matlab and change colormap and view angles
Standard surf

• Generated using surf[X,Y,Z]
Surf with shading flat

• The command shading flat added
Surf with shading interp

- Command shading interp used
Surfl used

- Command surfl is surface with lighting; here the colormap is changed to pink to enhance effect
Surfnorm to add normals

• Generated on a 15 grid to keep down clutter.
Working with irregular data

• Previous figures were generated using a regular grid of X and Y values from which Z values can be computed.
• Routine griddata takes irregularly spaced x y data with associated z values and fits a surface to a regularly specified grid of values. Mesh surf etc can be used to plot results.
• Routines trimesh and trisurf form Delaunay triangles to irregular data and plot based on these facetted surfaces.
Griddata example
Trisurf example
Vertical view of each figure
Inside 3-D objects

• Matlab has methods for visualization of 3-D volumes
• These are figure generated to display some quantity which is a function of X Y and Z coordinates. Examples would be temperature is a 3-D body
• Functions slice and contourslice are used to see inside the body. Slice can be along coordinate planes or a surface shape can be specified.
• Isosurface renders the shape of the volume at a particular value. (Equivalent to a 3-D contour map with just one contour shown).
Slice along coordinate axes

\texttt{slice(X,Y,Z,V,[0 3],[5 15],[-3 5])}
\texttt{x cut 0 \& 3; y cut 5 \& 15, z cut -3 \& 5}
Slice with contours added

contourslice(X,Y,Z,V,3,[5 15],[])
Oscillating sinusoidal surface
Isosurface viewing

• Previous cut at level 2 using isosurface
Example with outer volume filled

• Added called to isocaps
Examples using Matlab flow function
Matlab flow example

- This example needs to be viewed in 3-D in Matlab.
- Here color map shows fine structure.
Making AVI Movies

hf = figure('Position',[50 50 797 634]);
set(fig,'DoubleBuffer','on');
set(gca,'Visible','off','Position',[0 0 1 1],'NextPlot','replace');
mov = avifile('YibalTotalANC.avi','FPS',1);
for n = 2:35
    f = sprintf('TotalANC%3.3d.jpg',n);
    Im = imread(f,'JPG');
    hi = image(Im);
    Fr = getframe;
    mov = addframe(mov,Fr);
end
Viewing real data

• Example of reading a geo-tiff file and displaying it on a Northing/Easting grid
• Main feature here is using imfinfo to retrieve information about the contents of an image file and then imread to read the image data
• Imagesc used to display image with coordinates: imagesc([UTMR(1:2)], [UTMR(3:4)], Def)
Figure generated imagesc
Summary

• Matlab has many 3-D view methods and functions available
• There are many options to many of these and sometime experimentation is needed to find out what works best.
• Demo example in Matlab can yield good ideas on how to solve specific problems.