Outline

- Announcements
  - HW II due Friday
  - HW III option
- Interpolation
- Colormaps

HW III

- On HWIII, you will have the option to create your own programming assignment
  - Write a function using Matlab graphics which does something useful for your work, and present an example
    - Ex: Visualize a particular data type
    - Ex: Produce a specific type of plot

HW III Requirements

- Your function
  - Must be a function
  - Must be general (not restricted to a single data set)
  - Must do something interesting
- You must clear your idea with me by next Wednesday
- You will have to give a (very brief) description of your function/example in the last lecture

Syllabus

7. Colormaps & Interpolation
8. Lighting
9. Transparency & Movies
10. Volumetric Visualization
11. GUI's
12. GUI's (HW III projects)

Interpolation

- If we want to plot with surfaces (or patches), we need some kind of mesh
- But, we are rarely able to sample on a grid
  - observations are often made at irregular intervals of time and space due to sampling constraints or equipment error (missing data)
- It is possible to calculate what the observations should've been at locations where we didn't sample
  - This is known as *interpolation*

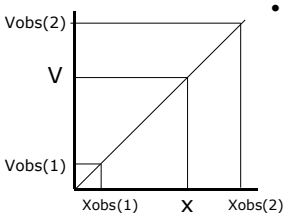
Interpolation

- It is possible to calculate what the observations *should've been* at locations where we *didn't sample*
  - This implies that we know something about the system we're observing
  - But, if we know so darn much, why bother observing?
  - The bottom line is that we are creating data and we have no way of knowing whether or not we've done this correctly
    - All interpolations should be treated with suspicion

Formal Statement of Problem

- Inputs:
  - Xobs= locations where we observed data (time, space, etc., can also have Yobs, Zobs)
  - Vobs= observed values: Vobs=f(Xobs)
    - Remember, we don't know the exact form of f, but we may know something about its structure
  - X=locations where we would like to know the values
- Then,
  - V=INTERPMETHOD(Xobs, Vobs, X)
  - Ideally, we have enough observations and know enough about f so that INTERPMETHOD ≈ f

Linear Interpolation

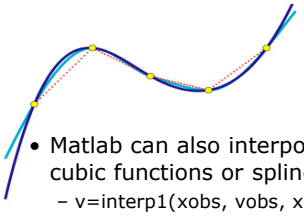


- Linear interpolation is the simplest form of interpolation (other than picking a constant)
  - If we have two observations, we can fit a line between them and use the equation of the line to determine v
  - linear interpolation is used implicitly when plotting with lines or using interpolated shading

Linear Interpolation in Matlab

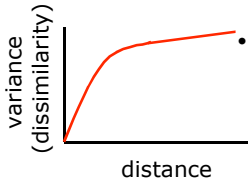
- Matlab's interpolation routines use linear interpolation by default
  - V=interp1(Xobs, Vobs, X)
  - V=interp2(Xobs, Yobs, Vobs, X, Y)
    - Xobs, and Yobs must define a grid (i.e. same form as inputs for pcolor or surface)
    - interp3, interpN work for higher-dimensional data
  - V=griddata(Xobs, Yobs, Vobs, X, Y)
    - observations need not be gridded
    - uses Delaunay triangulation

Higher-order Interpolation



- Matlab can also interpolate using cubic functions or splines
  - v=interp1(xobs, vobs, x, 'spline');
  - the results are smoother, but potentially very wrong

Objective Analysis and Kriging



- Matlab's default interpolation schemes are simple, but stupid
- Kriging (a.k.a objective analysis) is a statistical interpolation technique
  - requires you to know (or guess) the structure of your data's spatial variance

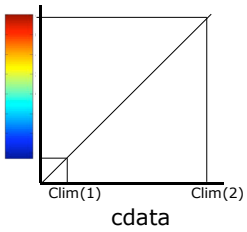
Kriging

- In kriging, Error=f(distance)
  - Assumes your knowledge about v declines as you move away from your observations
  - Can often determine error function from your observations
- v(j)=w1*vobs(1)+w2*vobs(2)+…+wn*vobs(n)
  - The v's are weighted means of the observations, the weights are determined by the distance from v(j) according to the error function
  - In addition to v, we can also get an estimate of the interpolation error

Kriging in Matlab

- Kriging is computationally simple, but there are some statistical condiderations
  - Isaaks & Srivastava "Applied Geostatistics"
- Matlab does not have a built-in kriging function (that I know of)
  - http://globec.whoi.edu/software/kriging/easy_krig/easy_krig.html
  - other software exists

Colormaps



- Matlab colormaps are m-by-3 matrices, where each row is an RGB vector
- When a color property (face or edge) is set to flat or interp, Matlab will determine the color using Cdata, Clim, and the colormap

Colormaps

- Built in colormaps (help graph3d)
  - map=copper(N);--gets copper colormap with N rows
  - map=colormap--gets current colormap (default is jet)
  - colormap(map);--sets colormap to map
    - map could be a built-in colormap (copper)
- Colormap is a property of the figure, not the axes
  - This means that we can have only one colormap per figure

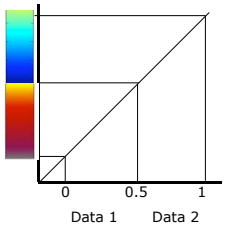
Creating New Colormaps

- Matlab colormaps are usually adequate, but will need to create your own if:
  - You need more than one map/figure
  - You don't like Matlab's

Creating New Colormaps

- Simplest approach is modify Matlab's
  - map=colormap(gray);map=flipud(map);
    - map will go from black to white rather than white to black
  - brighten lets you "brighten" or "darken" current colormap
- Create your own with interp1
  - v=[1 3 4]'; col=[0.5 0.5 0.5; .75 0 0; 1 1 0];
  - map=interp1(v,col,linspace(1,4,64)', 'cubic');

Multiple Colormaps



- Working with multiple colormaps gets very complicated
  - requires lots of handle graphics work
- Tips & Things to remember
  - Single Clim-space, so pick something simple [0 1],[-2 1]
  - Transform actual clims to this space