2D Spatial Data

Height Field

In this first part of the assignment you will be visualizing a 2D spatial data set as a height field. The two spatial dimensions will determine the X and Y coordinates, while the value at each data point will determine the Z coordinate.

We have provided a 2D scalar dataset which gives the electric field potential at each of 618 data points(*assignment1.data*). The data is a simulation result of the electric field produced by the heart in a slice through a human thorax; the point locations(*assignment1.pts*) are derived from an MRI scan. We are providing this data to you in a raw format which vtk cannot directly handle. Your first step is to convert the data into the appropriate vtk format. Hand in the vtk file you create for this data.

The input data is an unconnected point set, with no connectivity information. Your second step is to produce a triangulation between the data points. **Hint:** since you've gone to the trouble of importing the data points into a vtk format, look for a vtk filter which can triangulate the points for you.

The .pts file gives the coordinates of the data points: each line in the file is a data point, with coordinates ordered X, Y, Z. The Z coordinate for this data set is always 0.0. The .data file is the electric field potential at each point, again with each line for a data point. The lines in these two files are in a one-to-one correspondence: the 100th line in the pts file gives the coordinates of the 100th data point and its voltage is on the 100th line of the data file. These are the two files which you will have to merge into one dataset in the vtk file format. You should create a POLYDATA-type dataset, using the potential value as the Z coordinate (hence, the *height* in the height field). Or, you can put the potential values in a separate "attribute" within a single vtk file, but this will mean you use a different sequence of modules to produce the visualizations.

The other dataset you will visualize for this part of the assignment is elevation data of Mount Hood. This data is being given to you in an image format which is recognized by vtk: no conversions or file format hacking is required. The pgm file is in what is called PNM format; there is a vtk module which reads in this format. The gif version is here so that you can look at the image in any web browser and determine the correct orientation for how the image should appear on the screen. The versions starting with "m" are "mini" versions of the images: polygonal meshes of full-resolution images can be slow to work with, so having a low-resolution version is faster when you're developing and debugging

your program.

Visualize both data sets as height fields by mapping the data value to a height displacement – you can keep the color constant here. Hand in the python script you wrote to produce the visualizations, and include an image of each in your electronic notebook. Is this a good way to look at these data sets? Why or why not?

Contour Maps

Another way to visualize this type of data is to produce a contour map. We have provided two additional data sets, *body.vtk* and *brain.vtk*, that we would like you to visualize as contour maps. The first is an infrared image of the human body, the second is a brain dataset.

The *body.vtk* data set is a greyscale conversion of an infrared view of the human body. There are 25308 points (148x171). Each value represents the greyscale value at that point. This dataset was converted from a full color image of the infrared view of the human body.

The *brain.vtk* data set is a greyscale conversion of an DICOM (MRI Scan) image of the brain. It is formatted in the same way as the body data set. Again, please hand in the python scripts you create and include images in your electronic notebook. Additionally, answer the the following questions:

1. What properties does a dataset need to have in order to have contour lines that make sense and contribute to the visualization?

2. What kinds of data typically have these properties can be found?

Additional requirement for cs6630 students
Now that you understand vtk's contour map capability we would like you to obtain your own data set and incorporate it into your above program for contour maps. Be creative and obtain a dataset that will create an interesting contour map. What data are you visualizing? Why do you think it is interesting?

Color Maps

Visualize the above two data sets(*assignment1.pts, assignment1.data*, *Mthood.pgm, Mthood.gif, mMtHoodh.pgm, mMtHood.gif*) with vtk in two ways:

1. as a color-mapped plane (data is planar, but map the data value to color)

2. using the colormap on the height field.

What are the benefits of the different approaches? Which do you think works best, and why?

Additional requirements for cs6630 students What is visually wrong with the color map of the thorax data(*assignment1.pts, assignment1.data*)? What

is causing this? (Answer this question with what you know about graphics, colormaps and interpolation.) Now that you have identified the problem, find a way for vtk to visualize the thorax data without the "artifacts".