Date: 4-24-98
Due Date: 5-5-98

CS 523: Scientific Visualization

Assignment 2

The purpose of this assignment is to let you experiment with reconstructing surfaces from contours and visualization of isosurfaces.

We have provided a 3D scalar data set in the file brain.s.dat on the CS 523 web page. This is a binary file of a magnetic resonance scan of a human head (of one of my graduate students - David Weinstein). It is sampled on a uniform grid. The data is of size $128 \times 128 \times 32$, with the spacing between samples in Z being 4 times the spacing in X and Y. Each sample is stored as an unsigned 8 bit value between 0 and 255 in a single byte in the data file. The samples are organized as a 3D array, with X varying fastest, followed by Y, followed by Z. In other words, you can think of the data set as a set of 32 slices, each slice is a 128×128 2D array of bytes. Each byte is one 8 bit sample value.

Through an interactive segmentation program, we have determined cross section contours on each of the 32 slices. For this assignment, we only segmented the outer contour (the scalp), though in principle we could have segmented inner contours too. The contours are stored in the files: scalp/scalp.* in the Data directory. Each cross section is a separate file and consists of a set of points provided in clockwise order around the contour. Each point is an XYZ triple.

Your task in this assignment is to visualize this data set in two ways:

Option 1

First, you will write a program to lace all of the cross sections together (creating a strip of triangles between each cross section) and then use `vtk` to visualize the resulting mesh.

Second, you will convert the binary scalar data into a form acceptable by `vtk` and using the `vtkContourFilter` module, extract and visualize isosurfaces. Experiment with different isovalues to try to find an isovalue which produces a surface similar to the surface you constructed from the cross section contours. Try other isovalues which pick out internal features rather than the scalp.

Option 2

In case you would like to tackle learning more visualization software packages and/or want to take a break from `vtk`, then you can use `nuages`, `geomview` and `SciAn` instead of `vtk`.

First, you will fit a surface to the cross section contours using an existing package called *nuages* (see the nuages directory within the Code directory for more information). The output of nuages can be viewed with a surface rendering program called *geomview*. Both packages are installed in the class directory in subdirectories `nuages` and `geomview` respectively. You will need to convert the scalp contour data into the form acceptable to nuages, apply nuages to construct surfaces through the contours, and view the results with geomview. Geomview accepts surfaces in `OFF` format, which nuages is capable of generating. See the nuages man pages, attached, for details.

Second, you will take the scalar data directly into SciAn and view it using isosurface rendering. Experiment with different isovalues to try to find an isovalue which produces a surface similar to the surface you constructed from the cross section contours. Try other isovalues which pick out internal feature rather than the scalp. You will need to convert the data set into a form acceptable to SciAn. You can use either HDF or STF format. Be sure to take into account the fact that the Z spacing is different from the spacing in X and Y.

What to turn in

Please turn in the source code for all programs that you write via electronic handin:

```
handin cs523 hw2 <list of files>
```

Please also include a short writeup (in the form of a web page; see Nate's class directory `<http://www.cs.utah.edu/~narobins/cs523>` for a template) describing what you did to fulfill the requirements of the assignment. Be sure to include a comparison of the surfaces obtained from the contour data with those from the isosurface rendering, in terms of quality and speed.