SUBJECT CODE: CS 6630
SUBJECT: SCIENTIFIC VISUALIZATION

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PART A AND B (Univariate clormaps)

Visualizing images as color-mapped plane and heightfields

FILES USED

CODE FILE: unicolormap.tcl writeplydat.tcl
DATA FILES PROVIDED:assignment1.pts assignment1.data MtHood.pgm Arenal_copy.jpg
POLYDATA FILE: humpoints.vtk

VTK PIPELINE:

)POLYDATAMAPPER2D-->ACTOR2D

Thorax.vtk -->POLYDATA READER -->ELEVATION FILTER -->-)

)POLYDATAMAPPER-->ACTOR

)POLYDATAMAPPER2D-->ACTOR2D

MtHood.pgm -->PNM READER -->IMAGEDATAGEOMETRY FILTER -->WARP FILTER -->ELEVATION FILTER -->-)

)POLYDATAMAPPER-->ACTOR

)POLYDATAMAPPER2D-->ACTOR2D

Arenal_copy.jpg -->PNM READER -->IMAGEDATAGEOMETRY FILTER -->WARP FILTER -->ELEVATION FILTER -->-)

)POLYDATAMAPPER-->ACTOR

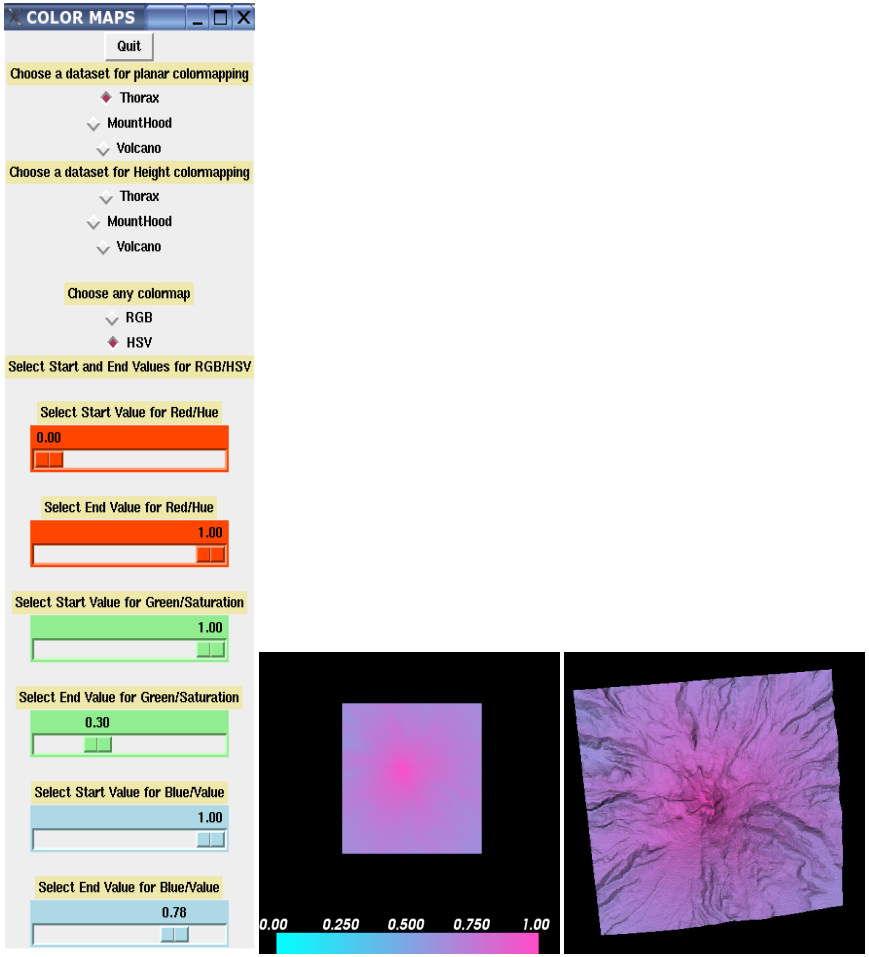
The assignment1.pts file gives the coordinates of the data points with Z coordinate always zero. There are 618 point locations derived from an MRI scan. The assignment1.data file is the electric field potential at each point, one line per datapoint. First writeplydat.tcl creates POLYDATA-type dataset using the potential value as the Z coordinate and then writes the dataset in appropriate vtk format in file humpoints.vtk.The filter "vtkPolyData" is used to convert the dataset into polydata. It is then fed to vtkElevationFilter which is a filter to generate scalar values from a dataset. The scalar values lie within a user specified range, and are generated by computing a projection of each dataset point onto a line. The line can be oriented arbitrarily. The pipeline is then fed to the 2D mapper and actor to get planar colormapped images. The lookup table is used by the 2D mapper to map scalar values to color. To get heightfields the pipeline is diverted to polydata mapper and actor. the mapper uses the lookup table as per the user choice.

The vtk filter "vtkPNMReader" is used to read .pgm data which creates structured point dataset. This dataset is fed as input to the "vtkImageDataGeometryFilter" which is used to extract the geometry. Then "vtkWarpScalar" filter scales the data in the z direction to produce the height field. It is then fed to vtkElevationFilter which is a filter to generate scalar values from a dataset.The pipeline is then fed to the 2D mapper and actor to get planar colormapped images. The lookup table is used by the 2D mapper to map scalar values to color. To get heightfields the pipeline is diverted to polydata mapper and actor. the mapper uses the lookup table as per the user choice.

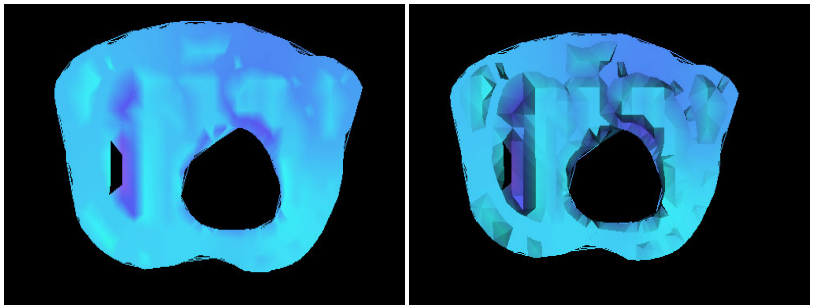
The filter "JPEG READER" is used to read .jpeg file. The pipeline is then connected to "vtkImageGeometryFilter".Then "vtkWarpScalar" filter scales the data in the z direction to produce the height field. It is then connected to vtkElevationFilter which is a filter to generate scalar values.Then the pipeline is connected to 2D mapper and actor to get planar images or it is connected to mapper and actor to get heightfields.

I have provided an interactive color mapping tool that allows the user to efine a univariante colormap by setting start point and end point of a linear path through a color space. Users are allowed to switch between RGB and HSV color spaces. They are also allowed to switch between planar images and height fields.

The images of GUI and all images are as follows

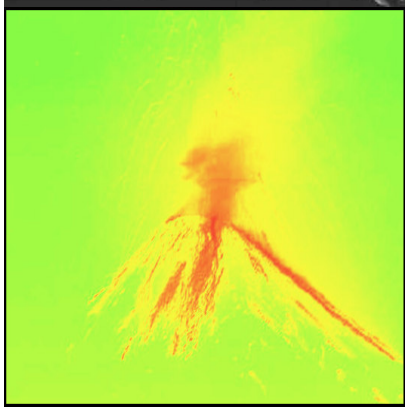


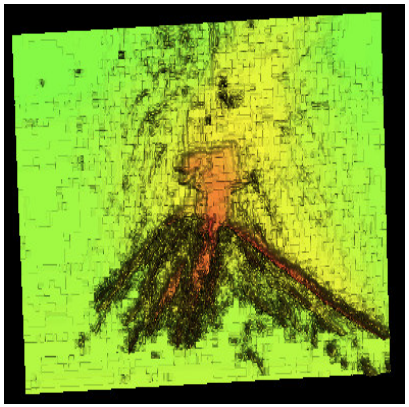
The snapshots of mounthood was taken with the colormap HSV with Hue varying from 0 to 1, saturation varying from 1 to 0.30 and value varying from 1 to 0.78.



The snapshots of thorax data was taken with the colormap HSV with Hue varying from 0 to 1, saturation varying from 1 to 0.30 and value varying from 1 to 0.78. I think the best colormap for representing thorax data is HSV. I personally like HSV which can highlight features of the data in a better as in the above case.

The following is my image which i have chosen to visualize using colormaps.





The image i have chosen is a volcano Arenal, Costa Rica,which is a stratovolcano that was dormant until 1968 when it burst into eruption. That strong explosion threw huge blocks as far as 5 kilometers. Activity has continued since with slow moving, thick lava flows and intermittent explosions of incandescent blocks. I have used HSV colormap which i think is the best. I have used Hue varying from 0.73 to 0, saturation varying from 0.59 to 0.67 and value varying from 1 to 0.88. I have used red color for representing hot lava and light red for relatively cool lava. The picture of the height field represents the elevation along with the slight color change.

Questions

What do you think works best, or what are the benefits of the different approaches?

In my opinion the type of representation depends on the image chosen and the requirement. If is needed to study surface properties or structure then planar colormapping works fine. If is required to study the image in detail considering the elevation then heightfield approach would be better. First approach does not represent or indicate elevation but second method indicate that with color change. Second method gives more information to the user. I think second method would be good for medical fields.

Which color space is better? What are the differences?

I prefer HSV color space. I think it can best highlight the features of the images. It can represent the images in avariate of ways. The major difference is One can vary brightness and intensity of the chosen color(hue). We can mix more colors for visualizing the images. It is intuitive and more usefull.

What is wrong with the color map of the thorax data? What is causing this?

The unconnected points are triangulated and colored.At some places in the image triangles appear to be smoothly colored, and at some places it is not. This is due to uneven data that is the data is rapidly changing which causes it highlight it. This defect is more visible in the height field representation.

In order to solve this problem we have to create more additional points. This can be done by using a filter vtkButterflySubdivisionFilter with the number of subdivisions set to some convinient number which interpolates new triangles for each triangle in the mesh. This can make edges more smooth and the triangles are less noticeable.

PART C AND D (Bivariate clormaps)

Visualizing images using bivariate colormaps

FILES USED

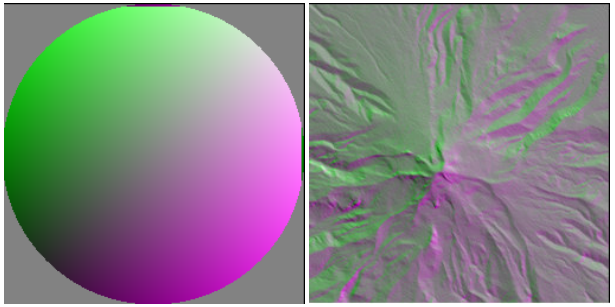
CODE FILE: bicolormap.tcl DATA FILES PROVIDED:MtHood-8.vtk MtHood-8.vtk PD-T2-8.vtk PD-T2-6.vtk tb-ax-8.vtk tb-ax-6.vtk disc-8.vtk disc-6.vtk

VTK PIPELINE:

image.vtk --> vtkStructuredpoints READER --> IMAGEMAPTOCOLOR FILTER -> IMAGE VIEWER

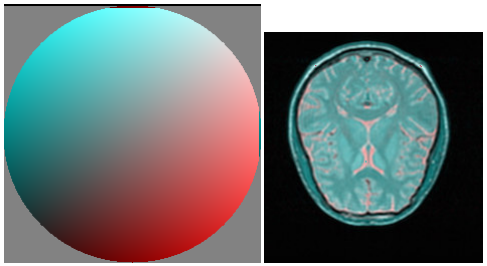
The vtk dataset is passed as input to the "vtkStructuredPointsReader" filter which reads any .vtk files. The dataset is then fed to the "vtkImageMapToColor" filter which is then the processed data is passed to "vtkImageViewer" filter to display the image.

Mt Hood Elevation Data

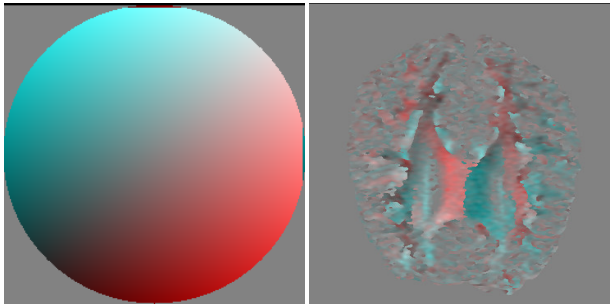


The bivariate color map in mounthood image shown above is the one which i have chosen as the best to represent than other bivariate color maps. I have chosen green and magenta for color mapping. The elevation is highlighted in a good way. Green color is indicating the low steep area while magenta is indicating high elevation.

BRAIN DATA



PD-T2-N.vtk is an axial slice of the brain (cutting perpendicular to the spinal cord) , here the vectors encoded by the bivariate data are not radially symmetric. I have used dark green and orangy red to represent the brain data. The orangy red is highlighting the gap and the structure of the brain.



tb-ax-N.vtk is an axial slice of a different brain (cutting perpendicular to the spinal cord), here the vectors are radially symmetric. I have used dark green and orangy red to represent the brain2 data too. Again orangy red is highlighting the outer part and the structure of the brain while green indicates the inner part.

Are there differences between what works better for the two brain datasets?

Here for the second brain data the bivariate double ended also works better to represent or highlight the inner parts and outer parts with the same color which may mislead or distrack the viewer in case of first brain data representation.