

Lab Assignment 6 – CSE 332/564, Spring 2008

Due: Tuesday, April 28, 11:59pm

This lab will introduce you to shaded rendering. Continue to use the code you developed for lab 5. Upon completion of the assignment you will submit the following, via blackboard:

- the complete software (all that is needed to build the executable: source code, project files, etc)
- an executable (.exe file) of your work
- a comprehensive report that illustrates with images and narrative text all aspects of your work

All of these components are equally important. Please note the policies posted on the class webpage.

The overall theme of this project is to add illumination for better shape delineation in the visualizations. For CSE 332 you may implement the lab either for the CPU or the GPU. For CSE 564 a GPU implementation is mandatory. Use the volume datasets given on the lab webpage. High-resolution versions of these and also additional datasets will be made available soon at the same place.

Note that the fragment code in the demo is NOT what this lab asks you to do. So it is OK to have a look at it, but it uses different ‘technology’.

Have a look at the handouts on local illumination before you start. We will use central difference gradient estimation and post-interpolative classification, that is, we will first interpolate the densities and then look up color and opacities in the transfer function.

1. New menu and canvas items

Add a new sub menu item to ‘Volume rendering’: ‘DVR’, which stands for Direct Volume Rendering. Control the light source color with three sliders (RGB) and provide three additional sliders for I_A (ambient color RGB), and one each for the scalars k_a , k_s , and k_d .

2. Histogram

Compute the histogram of the volume dataset and paint it into the transfer function window as you did in lab 2. It is best to set to zero density entries less than 10 since these will be usually very large but are only due to non-interesting structures (in most cases), noise, or air.

3. DVR rendering

First interpolate the densities and see if the α -transfer function specifies something of interest, that is, has a value greater a small threshold, say 0.1, at that density (recall that we assume that the transfer functions return values in the range [0.0, 1.0]). If the opacity is less than 0.1 the volume is considered transparent and there is no need to go any further. In this case, just advance the ray.

If the sample is not transparent, evaluate the gradient. If its magnitude is below a certain threshold, say 10 or even higher (but you could add a slider for this), then there is no notable surface and there is no need to

do shading. Since we are looking for surfaces in this lab assignment, we can skip this sample and move on with the ray

If the sample has survived these two stages, we shade it using ambient, diffuse, and specular shading. Use the normalized gradient vector as the normal vector. Now composite the resulting RGBA value with the current ray value.

Finally, if the new ray value is greater than say 0.9, then you stop the ray (early ray termination) and return. Else, continue to the next sample point.

Experiment with different α -transfer functions. You will find that a soft step function (one with a curve at either end) will give better results for iso-surfaces. Also experiment with different layers of semi-transparent structures. You will soon see that the simple transfer function interface is quite primitive. You could first find single structures with a step function (use the histogram to help where interesting structures are), then color them and reduce the height of the step and make it more semi-transparent. Then you could find the next structure inside. But this still is quite laborious. Some final projects address this exploration problem.

Extra credit (+10%): Empty space skipping

Implement empty-space skipping with a bounding box, but a more general bounding volume would be preferable.