CS453/553 Scientific Visualization

Project I

Due 11:00pm October 6, 2021

The purpose of the this project is to help you

(1) become familiar with OpenGL and GLUT
(2) become familiar with the .PLY format and typical data structures for mesh data representation.
(3) review relevant mathematical concepts and their numerical computation algorithms.
(4) acquire experience and develop intuition with various techniques for visualization scalar fields.

Detailed tasks are listed below. Please submit everything necessary to compile and run your program, and a project report that contains results and discussions. Feel free to explore and have fun!

Note: the program **learnply** is provided for your convenience. It contains three components: I/O to .ply files, visualization, and a user-interface. Only the first component is necessary for this project and future projects. Feel free to develop your own data structures for meshes. Also, you may use other tools to construct the user interface, such as GLUT/GLUI, Microsoft API 32, or MFC. Be sure to provide a README file so that weknow how to run your program.

1. **(50 points)** For each provided dataset in the **scalar_data** folder, visualize the following scalar fields $f(v) = s$ using the following color schemes:
    a. (grey scale map): $R(v) = G(v) = B(v) = \frac{f(v)-m}{M-m}$ for where m and M are the minimum and maximum scalar values at the mesh grid points, and v is the scalar value at a grid point.
    b. (bi-color map): choose two fully saturated colors c_1, c_2 on the color wheel and use the formula $c(v) = c_1 \frac{f(v)-m}{M-m} + c_2 \frac{M-f(v)}{M-m}$ where $c(v)$ is the color for the scalar value v at a grid point (also do this for $g(v)$).
    c. (rainbow map: **553 students only**) find the formula for the heat map such that the range of [m, M] are linearly mapped to the set of saturated colors on the color wheel between red and blue.
    d. Discuss the strengths and weaknesses of each of the color schemes you have implemented. Be sure to include both text and images to support your argument.
2. **(20 points)** For each provided dataset in the **scalar_data** folder, use the height field method to visualize it with a uniform color. Contrast this method with the method in Problem 1, i.e. no height change but only varying colors.

3. (**30 points)** Augment the height field based visualization in Problem 2 with the color-schemes in Problem 1. Now compare all three approaches: (1) color only, (2) height only, and (3) a combination of height and color.