CS4204 Computer Graphics Spring 2010
Homework 5: OpenGL Shading Language

1 Due Date

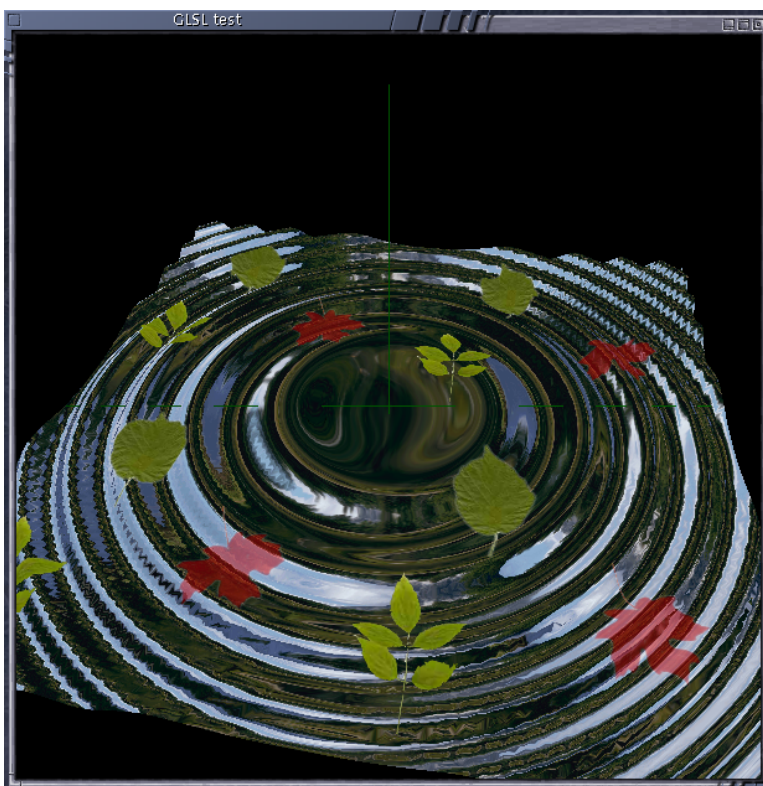Homework 5 is due on Tuesday April 27th, 2010, 11:59pm.

2 Introduction

Figure 1: A water ripple effect.

The fixed functionality of OpenGL can be changed by programmable *Shaders*, which can be used to create customized special effects in your graphics applications. Shader technology has been widely adopted in modern graphics community. It includes three types of programs: Vertex Shader, Geometry Shader, and Fragment Shader.

In this homework, we use OpenGL Shading Language (GLSL) to write vertex and fragment shader to create water ripple effect[1], as shown in Figure 1.

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[1] Referred to homework 8 of course CS171 from Computer Science Department at CalTech.

3 Project requirement

Please write an OpenGL program, with help from GLSL, to create a rippling water effect with blended leaves on top of the water surface. The water surface is also textured with an environment map. Both textures for the environment map and leaves are provided in the template code.

We have provided a template code here. This piece of code has already done most of basic functions for this homework, such as rendering a mesh grid, applying a vertex shader and fragment shader, and mapping the textures onto the mesh. You need to change the existing shader code, both vertex shader and fragment shader, to finish the required features of this homework.

Your vertex shader should include the following functions:

1. Compute the transformation for each point.

2. Calculate the vertical displacement based on time and radius from the center.

3. Calculate a normal, depending on the mode.

4. Set the texture coordinates.

Your fragment shader should include the following functions:

1. Calculate a normal, depending on the mode.

2. Determine the water color using environment mapping.

3. Get the leaf color using the texture coordinate.

4. Blend them together using the leaf alpha value.

You should be able to compile and run the template code in Linux system. If you prefer to use MS Windows system, please follow the tutorials provided by LightHouse3D to create Visual Studio project.

Your program should have the following features.

1. (6 points) Your shader program should be able to render ripple effect, using a Sin-Wave function.

2. (2 points) The environment texture should be mapped on the water surface.

3. (2 points) The leaves texture should be blended on top of the environment map.

4. (10 points) You should support two different rendering modes to replace default OpenGL lighting: per vertex normal calculation and per fragment normal calculation for phong shading model. In per vertex mode, the normals are computed in the vertex shader, and the interpolated normals are used for phong shading in the fragment shader. In per fragment mode, the normals are computed for each fragment, which will generate smoother surface than per-vertex mode. A key should be assigned to switch between these two modes.

4 What to Submit

Put your solution in one or more C++ source files. The main file (which includes function main) should be named homework5.cpp. Include all your source files in a zip file and upload to class Scholar site in your own dropbox. Please do not forget to include your shader files. Please do NOT include the compiled EXE files. Please also include a description file, called descriptions.txt that describes how to use your program.