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Erlangen, ***Monday, 08.12.2014***

Computer Graphics - Programming Exercises

Assignment 8 [5 Points] (Earth Shader & Bump Mapping)

In this assignment, the earth should get its own shader program which receives more than one texture from the main program. Besides the classic earth texture, there is also one which shows the city lights at night and one which contains normals (a bump map). In order to perform bump mapping, we need a tangent at each vertex. In the last exercise, we used a vertex buffer to create the scenes geometry, more specifically we assigned positions, normals and texture coordinates to each vertex. This week, we will extend the sphere creation by an additional attribute, e.g. the tangent. And because we can add user defined attributes there is no need of mapping to the color range as you might have done in the old OpenGL. The loading of the additional textures can be found as well, we recommend to copy the lines in your existing framework.

The skeleton itself only contains a sphere (which is supposed to be the earth) rotating around another sphere with a point light located at its origin (the sun).
For the actual assigment, you only have to edit the shader files `BumpShader_VS.glsl` and `BumpShader_FS.glsl`. (Adding rotation to the planet on top of the revolution requires the modification of `part8.cpp::display()`!)

a) To get a more realistic appearance of the earth, it should have a day/night cycle. First of all, the earth should only be influenced by the point light of the sun which (as before) has a diffuse and a specular component (Especially the specular component is important to see the effect of the bump map). If the current fragment is on the day side (the side which is facing the sun) the regular color texture should be used and illuminated. If the fragment is on the night side, the city light texture should be applied. However, assigning the full color of the city light texture as soon as a fragment is on the dark side does not create a nice transition between day and night. Implement a strategy so that the city lights smoothly fade in and out in the transition area.

b) Instead of using the surface normal from the respective vertex attribute for lighting, use the normal located in the normal map of the earth. As you should know from the lecture, the normals in bump maps are stored in tangent space so you have to transform the other vectors required for lighting also into tangent space. You find the tangent vector of each vertex encoded in its color attribute, as mentioned in the beginning.

c) There are no mountains or visible crevices on the surface of the oceans.

Additional Information

- The three earth textures perfectly match each other. Therefore, you can use the same texture coordinate for all textures.

- Note that the normal in the normal map is encoded as color value and therefore has to be mapped from the range [0,1] to [-1,1].
- In the current state of the planet scene, the earth rotates around the sun in a way that always the same part of the earth is facing the sun. Since this would be quite boring after this assignment, let the earth additionally rotate around its own axis. You can also extend the orbits of the planets a bit so that you can navigate better through them.

Implementation Guidelines

Have a look at the bindings of multiple textures. Since only the BumpShader requires multiple textures, we bind them in the display function.

Good Luck!

Your source code will be copied from your handin directory on:
Monday, 15.12.2014 14:00 pm
all subsequent changes cannot be taken into account!