Αλγόριθμοι και Συστήματα για 3Δ Γραφικά
Τμήμα Πληροφορικής
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ΑΣΚΗΣΗ 2: ΦΤΙΑΧΝΟΝΤΑΣ SHADERS σε HLSL με FXComposer

Στην εργασία αυτή θα υλοποιήσετε εφέ σκίασης σε μια GPU χρησιμοποιώντας το NVidia FXComposer περιβάλλον.

0. Προτού αρχίσετε

Read the FX Composer manual and the DirectX9 HLSL introduction.

1. Setup

Κατεβάστε και εγκαταστήστε τον FX Composer.

Download the file fxfiles.zip. The zip archive contains six fx-files: first.fx, Hemispheric.fx, HemiBump.fx, Gouraud.fx, Reflection.fx, and Texturing.fx. Unpack the zip archive into your home account.

Download the perlin.zip file. The zip archive contains two files implementing a vertex Perlin noise generator (needed for the procedural wood effect).

For more info you may look at:

- Programmable HLSL Shaders
- NVidia Texture Tools

Εικόνες αναφοράς μπορείτε να βρείτε στο εδώ.

2. Εξοικείωση με το περιβάλλον

A few exercises to give you a feel for FXComposer:

New geometry

Start the FXComposer application. When it starts it shows a scene with a sphere with a default material. In the scene panel, right-click and choose teapot from the new scene from shape menu.

Applying a material (shader effect)

From the application file menu, load all materials from the zip file. Click on the teapot to make sure it is selected, then (in the materials panel) apply the six materials one after the other.

Create a new effect called second by choosing new material from the file menu, choose basic empty material in the dialog, remove all effects code from the effect editor window, and copy the first effects code into the window instead. Save the material using the name “second.fx”.

Apply the second material to the teapot. In the simpleVS vertex shader, change the following line in order to create a simple vertex displacement effect:

```
clipPosition = mul( position, ModelViewProj);
```

to

```
clipPosition = mul( position + float4(1,0,0,0), ModelViewProj);
```

Press Ctrl-S to save and apply your modified effect.

Annotations

Open the Gouraud effect and study the tweakables section. Add a slider to the properties panel of the second effect that allows moving the teapot in the x direction using vertex displacement. Add a color selector that allows you to change the color of the teapot. (You can create a new material using the file menu->new->material and study it for various annotations).

Panels

Look at the scene panel. Investigate the different buttons for manipulating objects and navigating the scene. Right click in the window to get a menu with further options. Turn on rendering of object normals. Add a new object (cube) to your scene and apply your color material to it. Using the play and stop button it is also possible to create simple animations; click play and stop when the frame counter reaches 50. Drag the cube to a new position. Click play.

Another way of manipulating the scene is through the scene graph panel. Look at the materials panel and click on the scene graph tab. You will find the objects of the scene located in a hierarchical list. Find the cube and right click on it, choosing properties from the menu. In the properties panel you will now see the cube properties. Change the cube depth and verify that the size of the cube has changed.

3. Η Άσκηση

Implement all effects below (one file per effect). Use annotations to make important effect parameters adjustable.

1. Write a pixel shader effect that paints an object green. Annotate color.

2. Write a bulge vertex shader (moving vertex positions along surface normals). The bulging effect should be animated (sin) through the FXComposer TIME semantic. Annotate animation speed.

3. Write a vertex / pixel Phong shader for one point light source. Include ambient, diffuse and specular terms. Calculate all vectors in the vertex shader and transfer them to the pixel shader for light computation. Hint: use TEXCOORDn semantics for parameter transfer. Annotate material parameters and light color.

Phong variations:

4. Write a new effect combining the Phong shader with the bulge effect.
5. Write a new effect using Phong shading but taking the kd material constant from a texture. Use the "default_color.dds" texture.
6. Write a new effect combining Phong with bump mapping. Use the "default_bump_normal.dds" texture. Apply the shader on a sphere. Explain artifacts. Hint: make sure the entire tangent space is transfered to the pixel shader (not done in hemibump!).
7. Write a new effect combining Phong with environment mapping.
8. Write a new effect combining Phong, environment mapping, bump mapping, and bulging.

9. Write a texture twister effect, i.e. the closer a u,v coordinate is from a center, the more the pixel shader rotates the coordinate around the center point. The twist should occur in u,v space. To see the effect properly you should apply the effect on a plane object.

10. Write a vertex twister effect, i.e. the farther a vertex is from the center of the window, the more the vertex program rotates the vertex around the center of the window. The twist should occur in projected space. Pan around the object in the window.

11. Write a Mandelbrot procedural texture effect (iterate in the pixel shader).

12. Write a procedural wood effect. Calculate a perturbed wood radius in the vertex shader. Assign wood color in the pixel shader. Utilize per-vertex Perlin noise for perturbations (available from the assignment homepage as a GPU vertex program). Hint: the quality of the wood effect will depend on object tessellation, you might want to increase the default object mesh resolution to get good result.

4. Examination

Θα παρουσιάσετε τις υλοποιήσεις στο μάθημα στις 6/12/2006.