CS 557 Computer Graphics Shaders

Project #2

Noisy Elliptical Dots

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Video Link: https://youtu.be/OARHakawOe0

Description:

This project implements a shader that uses a 3D noise texture to add noise to the repeating elliptical dots on the surface of a 3D model. The project runs in glman using the "ovalnoise.glib" file. The selected models resemble a "Matryoshka doll", consisting of a large sphere that contains a smaller sphere, which in turn encloses an even smaller cup. Two spheres are generated using the OsuSphere function provided by "osusphere.cpp", and the cup model is retrieved from cgtrader.com (https://www.cgtrader.com/free-3d-models/household/kitchenware/cup-01-df22b3b5-6497-4599-acfd-f5f51920d915). The code for generating repeating elliptical dots with both hard and smooth edges is derived from my Project #1, which uses the elliptical equation and blending techniques involving the smoothstep() and mix() functions.

The glman tool randomly generates 3D noise and stores it in texture unit 3. In the fragment shader, this noise can be indexed using either 2D texture coordinates or 3D model coordinates. The choice of the coordinate system is controlled by the **uUseXYZ** checkbox. The noise value is obtained using all four octaves stored in the RGBA channels of the sampled "noise vector" texture. When calculating the distance between the current fragment and the ellipse center using the elliptical equation to determine whether the fragment lies within the local ellipse, the noise is introduced to distort the result. This creates irregularities at the elliptical boundaries and results in noisy elliptical dots. Two variables, **uNoiseAmp** and **uNoiseFreq,** control the amplitude and frequency of the noise function, allowing for varying noisy effects on the elliptical dots. I also include the variable **uAlpha**, which ranges from 0 (hollow) to 1 (solid), to control the transparency of the sphere's background color. When uAlpha is set to 0, the discard function is used to create the hollow effect.

Per-fragment Lighting is implemented with associated variables (uKa, uKd, uKs, and uShininess), which can be modified through glman user interface. Additional color variables, uEllipseColor and uObjectColor, control the pattern and sphere colors respectively, which can be adjusted using glman's color palette.

Screenshots:

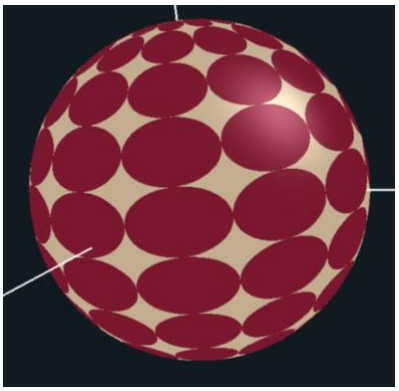

Fig 1. Original Hard-Edged Elliptical Dot Pattern

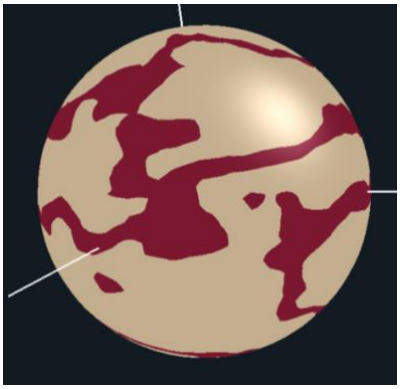

Fig 2. Noisy Elliptical Dot Pattern with increased **uNoiseAmp**

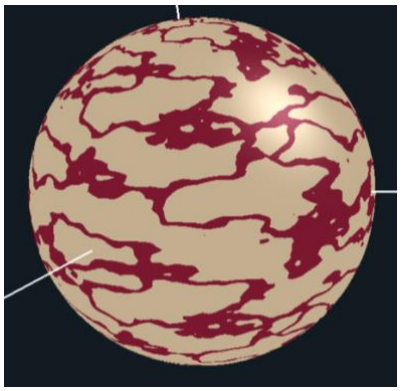

Fig 3. Noisy Elliptical Dot Pattern with increased **uNoiseFreq**

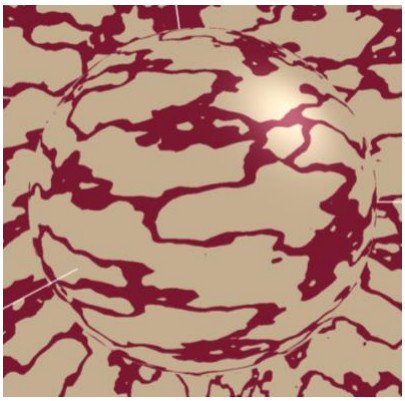

Fig 4. The small sphere displays the **same noisy pattern** as the large sphere when using **ST texture coordinates** for noise indexing

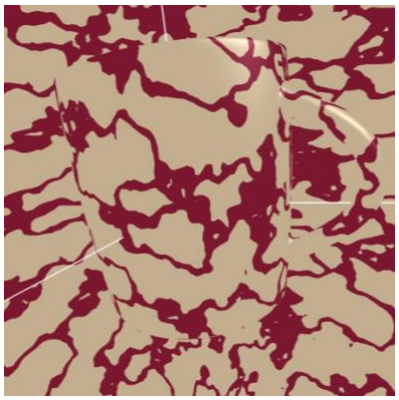

Fig 5. Noisy Elliptical Dot Pattern on the cup when using **ST texture coordinates** for noise indexing

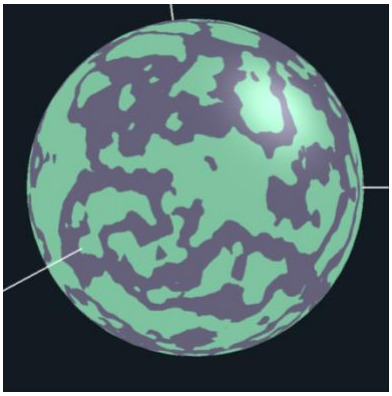

Fig 6. Noisy Elliptical Dot Pattern when using **XYZ model coordinate** for noise indexing

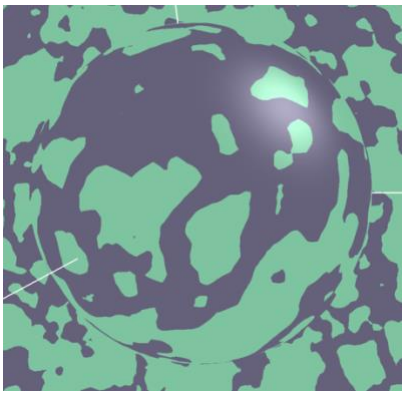

Fig 7. The small sphere displays the **different noisy pattern** as the large sphere when using **XYZ model coordinates** for noise indexing

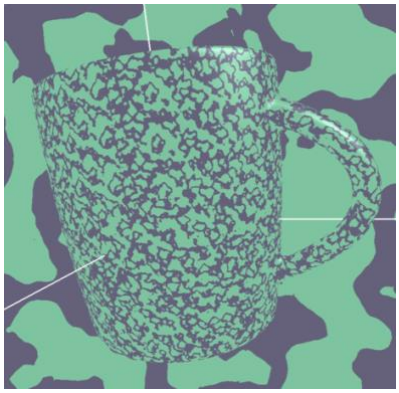

Fig 8. Noisy Elliptical Dot Pattern on the cup when using **XYZ model coordinates** for noise indexing

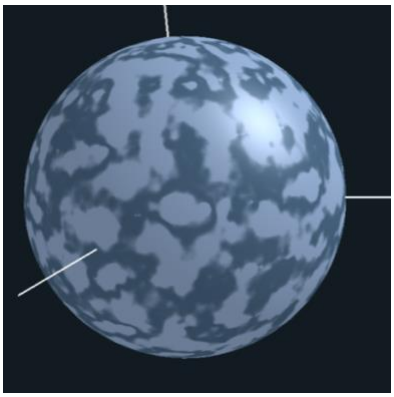

Fig 9. Noisy Elliptical Dot Pattern on the sphere with increased **uTol**

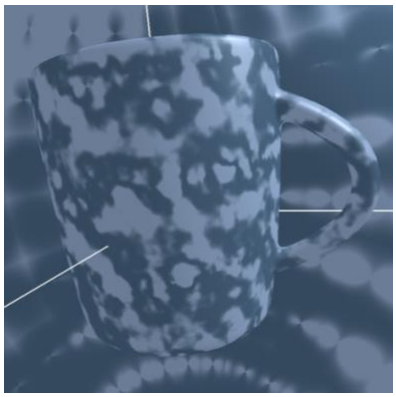

Fig 10. Noisy Elliptical Dot Pattern on the cup with increased **uTol**

Fig 11. Original Noisy Elliptical Dot Pattern on the sphere

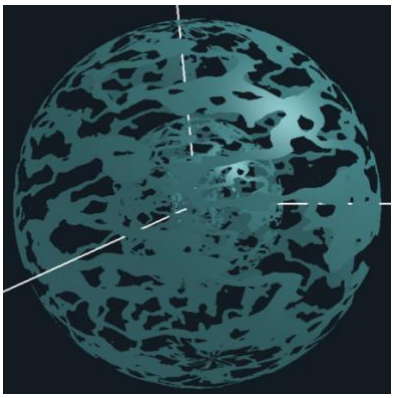

Fig 12. Hollow Noisy Elliptical Dot Pattern on the sphere when **uAlpha = 0**, revealing the sphere and cup inside the larger sphere.

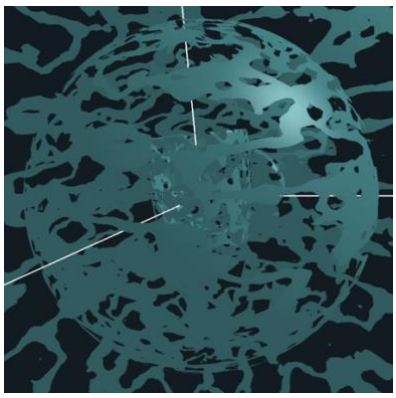

Fig 13. Hollow Noisy Elliptical Dot Pattern on the smaller sphere when **uAlpha = 0**.

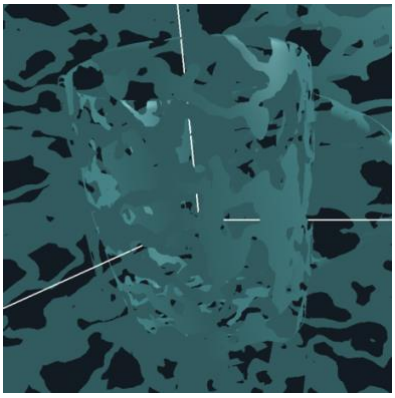

Fig 14. Hollow Noisy Elliptical Dot Pattern on the innermost cup when **uAlpha = 0**.