CS 557 Computer Graphics Shaders

Project #3B

Displacement Mapping, Bump Mapping, and Lighting

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Video Link: https://youtu.be/a1FMxIpEzPw

Description:

This project implements a shader that applies **displacement mapping** and **per-fragment lighting** to turn a flat quad into a curtain with pleats and use **bump mapping** to introduce noises that can create various texture effects on the curtain surface. It runs with "pleats.glib" using glman. The process of applying displacement mapping via the vertex shader is described in my report for Project #3A. Two adjustable parameters, **uA and uP**, control the amplitude and period of the sine wave equation, respectively, to generate the different patterns of curtain pleats.

Bump mapping occurs in the fragment shader, where the surface normal of each fragment is perturbed in lighting calculations to create a 3D depth effect without actual displacement. For each fragment, we sample the 3D noise texture generated by glman using the model coordinates to obtain two noise values, which are treated as angles to rotate the normal around the x and y axes, respectively. The variables **uNoiseAmp and uNoiseFreq** control the amplitude and frequency of the noise function, allowing for varying patterns of noisy crinkles created by the lighting effects on the curtain surface.

Per-fragment lighting is implemented in the fragment shader, as in previous projects, with adjustable parameters (**uKa, uKd, uKs, uShininess, uLightX, uLightY, uLightZ**) that can be modified through the glman user interface. The only difference is that I used eye-space lighting instead of world-space lighting to keep the light stationary relative to the world coordinate. Besides, the parameter **uColor** allows users to change the curtain color using glman's color palette.

[Screenshots are on the next pages]

Screenshots:

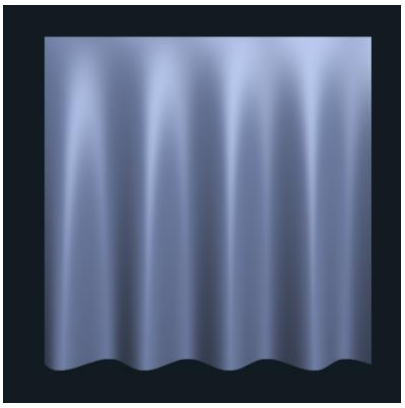

Fig 1. Default Curtain **without bump mapping**

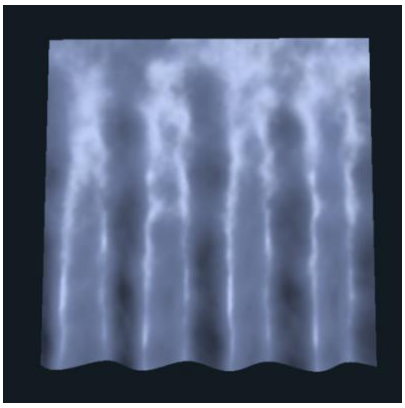

Fig 2. Noisy curtain **created by bump mapping with low uNoiseAmp and low uNoiseFreq**

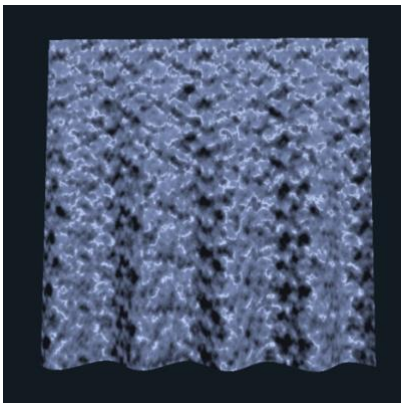

Fig 3. Noisy curtain **with high uNoiseAmp and high uNoiseFreq**

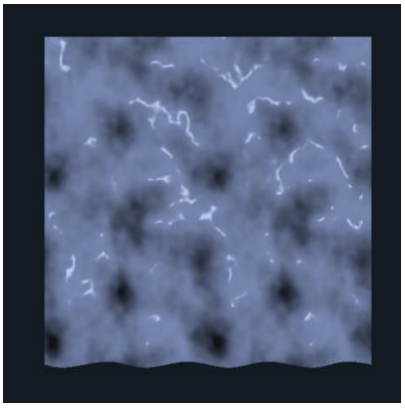

Fig 4. Noisy curtain **with high uShininess, high uNoiseAmp, and low uNoiseFreq**

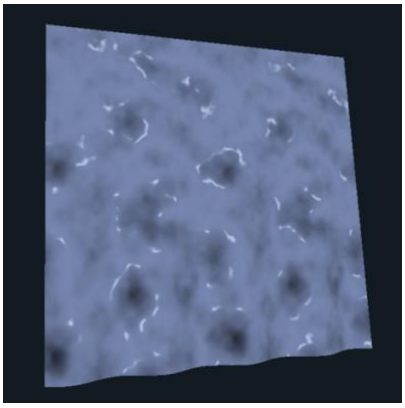

Fig 5. The highlight changes **around the noisy crinkles** as the curtain in Fig 4 rotates.

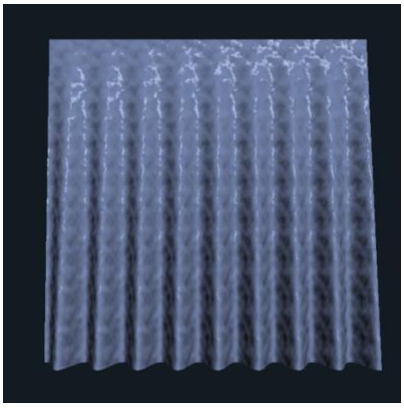

Fig 6. Noisy curtain **with high uShininess, low uNoiseAmp, and high uNoiseFreq**

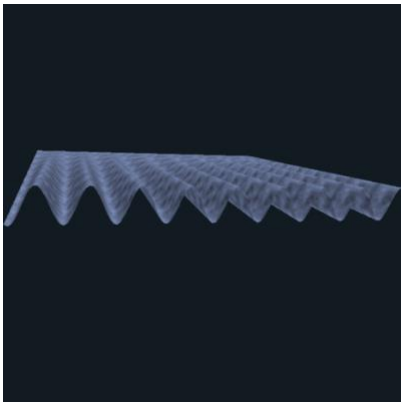

Fig 7. **Evidence of bump mapping** as the curtain in Fig 6 rotates. There is no height displacement, only noisy crinkles created by lighting effects.

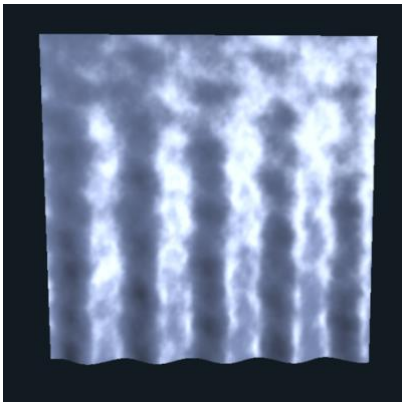

Fig 8. A metal-like, cloudy texture on the curtain with **moderate uNoiseAmp, low uNoiseFreq, low uShininess, and high uKa**.

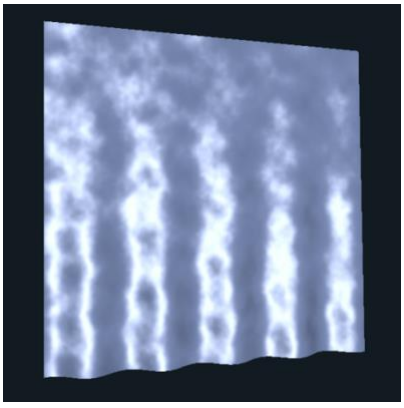

Fig 9. The highlight changes **around the noisy crinkles** as the curtain in Fig 8 rotates.

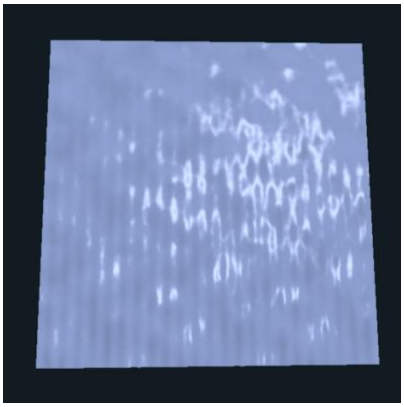

Fig 10. A reflective, corrugated noisy texture on the quad with **very low uNoiseAmp, high uNoiseFreq, high uShininess, and high uKs**.

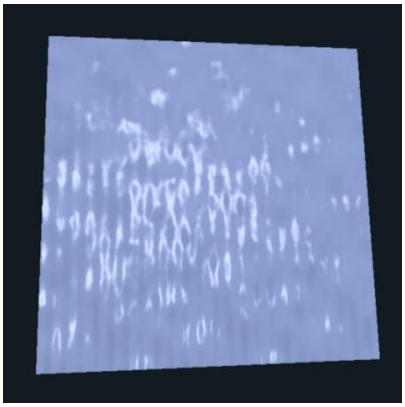

Fig 11. The highlight changes **around the noisy crinkles** as the curtain in Fig 10 rotates.