CS 557 - Winter Quarter 2024 - Project #4 Report

TITLE: Cube Mapping Reflective and Refractive Bump-mapped Surfaces

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Introduction:

In this project, I implemented cube mapping techniques to create reflective and refractive surfaces with bump mapping effects. The goal was to simulate realistic materials and interactions using a mathematical function as the basis for surface displacement and texture mapping. The project involved manipulating various parameters to control the appearance of circular ripples on the surface and achieving accurate reflection and refraction behaviors.

Implementation Details:

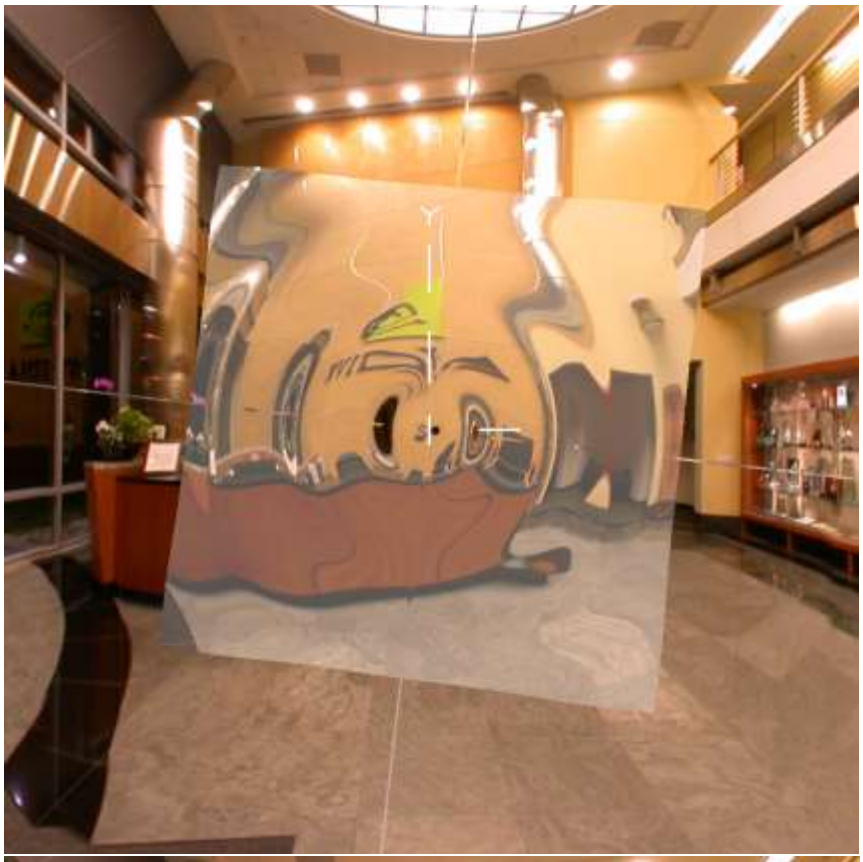
1. I used the same mathematical function from Project #3, which generates circular ripples on the surface based on parameters ‘uA’, ‘uB’, and ‘uD’.
2. The ‘uA’ parameter controls the amplitude of the ripples, ‘uB’ controls the frequency, and ‘uD’ controls the decay.
3. Bump mapping was implemented to add surface details by perturbing surface normals.
4. I used noise textures to simulate surface irregularities, with parameters ‘uNoiseAmp’ and ‘uNoiseFreq’ controlling the amplitude and frequency of the noise.
5. Cube maps were employed to provide environment maps for reflection and refraction.
6. Reflection was achieved by sampling a cube map texture using the reflected eye vector.
7. Refraction was achieved by refracting the eye vector through the surface using an index of refraction parameter ‘uEta’.
8. Vertex and fragment shaders were utilized to handle vertex transformations and pixel shading.
9. The vertex shader calculated displacement of vertices based on the mathematical function parameters and bump mapping.
10. The fragment shader computed the reflection and refraction effects using cube maps, noise textures, and parameter values.

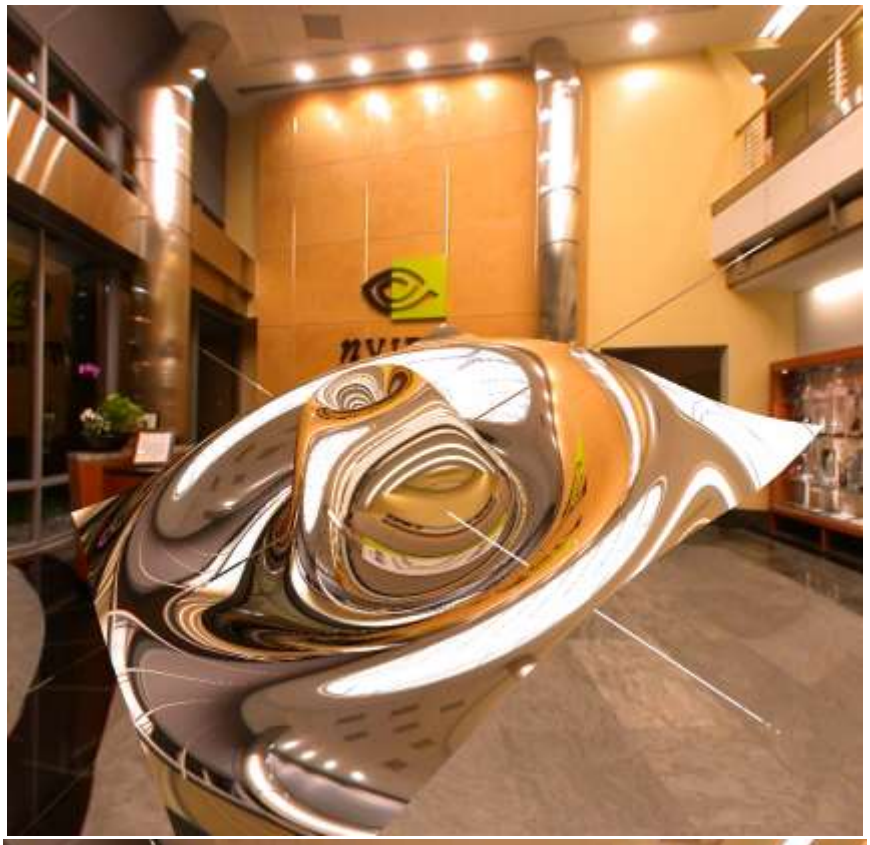
Results and Observations:

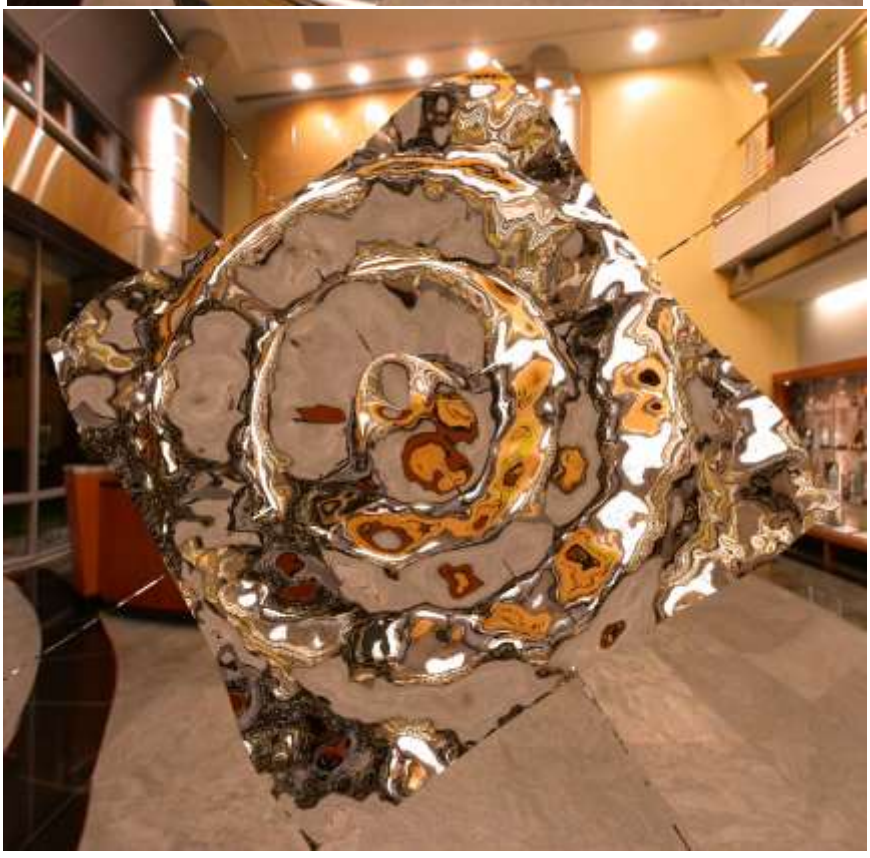
- The implementation successfully generated visually appealing reflective and refractive surfaces.
- Varying the parameters ‘uA’, ‘uB’, and ‘uD’ produced different ripple patterns, demonstrating the flexibility of the mathematical function.

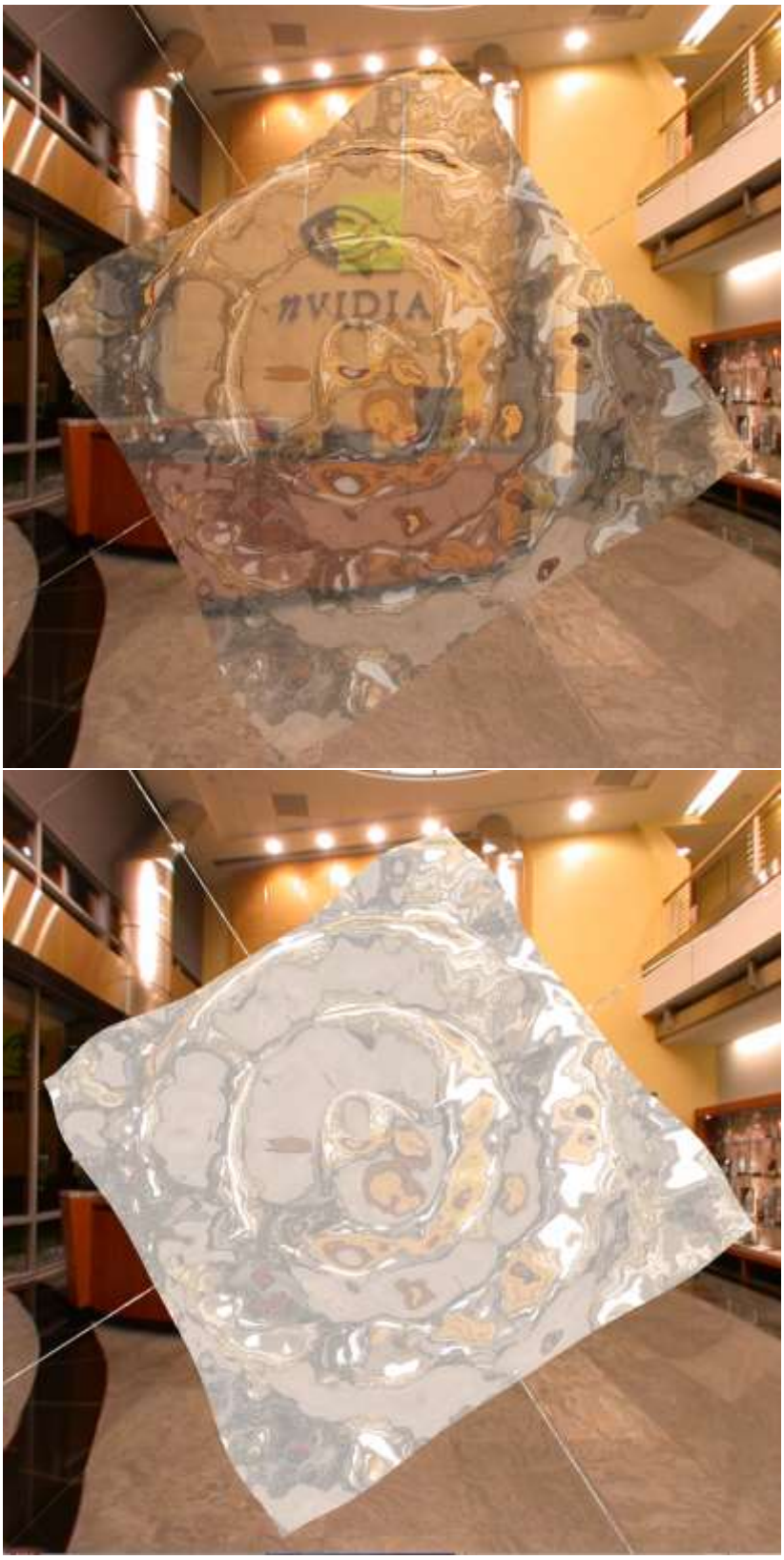
- Bump mapping added surface details, enhancing the realism of the rendered surfaces.
- Reflection and refraction effects accurately simulated the behavior of light interacting with the surfaces.
- The blending of reflective and refractive outputs using the ‘uMix’ parameter yielded smooth transitions between the two effects.

Screenshots:









Kaltura Link – [Project #4 Cube Mapping Reflective and Refractive Bump-mapped Surfaces - OSU MediaSpace (oregonstate.edu)]