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CIS 565 GPU Programming & Architecture

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Final Project Pitch

**Volumetric Rendering of Clouds**

For my final project, I hope to implement a CUDA ray casting program for rendering cloud volumes which simulate light scattering and realistic cloud dynamics. This program would have three distinct parts, which are as follows:

**Part 1: User Interface:**

This part of my project would run using OpenGL for simple user-guided creation of cloud volumes. I hope to implement a minimal interface where users can specify proxy geometry for the initial shape and form of the clouds to be rendered, and possibly specify some dynamic conditions that would be used in the simulation of the cloud volumes (i.e., wind, air pressure, temperature, etc.). This interface would also allow the users to place lights (or alternatively just enter their position/direction in space) and specify a time of day or choose a sky background plane, from which I can create sky color conditions and lighting effects.

**Part 2: Volumetric Renderer**

As of right now in the process, I am still doing research into this stage of the program. I am looking into past papers and projects and tutorials to try and learn how to convert from my user input proxy geometry to voxelized renderable volumes. As I understand it, I must first create a perturbed surface using various shaders that implement noise functions in 3D space. It then seems that this process usually involves ray tracing through the perturbed volume, sampling uniformly throughout the interior, and mapping each sample point to a color/opacity value from a specified lookup table. These samples are then rendered from back to front along the cast rays, creating the appearance of a full volume (which can be viewed from within the volume and still create the effect of clouds). My biggest goal would be to learn how to implement this stage, and combine it with realistic light scattering conditions. For resources on light scattering, I will be looking at many papers from the site provided by Patrick, the Game Engine Gems and GPU Gems chapters on volume rendering, and several SIGGRAPH presentations (one specifically made by Dreamworks in 2012 about the creation of art directed cloud volumes for *Puss in Boots* from 2012:

<http://www.dreamworksanimation.com/media/insidedwa/tech/papers/PIB_CloudModeling.pdf>

**Part 3: Cloud Dynamics**

Time allowing, I hope to take my initial state render and apply dynamics to the volume to replicate realistic cloud and atmospheric movement, especially as guided by this GPU implementation paper (<http://www.markmark.net/cloudsim/harrisGH2003.pdf>) by Mark Harris et al. from 2003. This would be a really interesting step to take in the project and could produce some really exciting results.