CS224 Project Proposal

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We're proposing to implement as much of the "Efficient Simulation of Large Bodies of Water by Coupling Two and Three Dimensional Techniques" paper as possible. Our goal is implement a water renderer that is as physically accurate and as nice-looking as possible.

We are aiming to complete the Navier-Stokes algorithm (Stam 1999) and MAC grid (Enright 2002) part of the paper, along with a good quality water simulation renderer, either a basic level set renderer or a particle level set renderer. If possible, we would also like to implement the two-dimensional technique the paper describes involving tall cells. One extension the paper mentioned that they thought would "probably" be better would be to use octrees rather than a uniform grid near areas of high resolution, so we can add this regardless of whether we can successfully implement tall cells or not.

In terms of resources, we will definitely need to utilize the CS grid, as the project will be very computationally heavy. Finding some way to parallelize it, either GPU or CPU, would probably very beneficial as well. We won't need any other resources outside of perhaps some sample meshes.

Timeline

By 4/14:

- Read all relevant papers.
- Thomas: ability to render particles in an arbitrary flow field

4/15 - 4/20:

- Dylan: Spend time understanding the math required, get reasonably far on Navier-Stokes
- Thomas: Get reasonably far on a basic level-set renderer
- Get a general idea on how the code will look like when put together

4/21 - 4/27:

- Integrate the two parts together and try to render some basic outputs, figure out how to render efficiently on the CS grid
- This will most likely be the week we finish Navier-Stokes/renderer

4/28 - 5/4:

- Dylan: Add MAC-grid to Navier-Stokes
- Thomas: Upgrade to a particle level set renderer

5/5 - 5/11:

- If things are going well, one of us will work on adding tall cells and the other will work on adding octrees
- Buffer for us to debug and complete parts

5/12 - 5/17:

- Render some nice-looking water simulations
- Make presentation

Dylan: Essentially, I'll be focusing on the simulation part, because I think I have a strong math background to understand what's going on in the paper.
Thomas: I'll be focusing on the rendering portion because I feel like I have a strong grasp of the necessary graphics concepts. New concepts I will need to learn include intersections with arbitrary implicit surfaces (as opposed to geometrically convenient ones such as spheres, cubes, etc.), and a basic understanding of Navier-Stokes to help Dylan with the simulation portion as needed.