Position Based Fluid Simulation

CIS 565 : GPU Programming & Architecture*

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1. PROJECT PROPOSAL

We want to implement a GPU based PBD fluid simulation stable enough to support large time steps for real-time applications. Through the enforcement of constant density positional constraints, the simulation will allow for incompressibility and convergence similar to smooth particle hydro-dynamic solvers. Our project will be largely based on Muller and Macklin's paper "Position Based Fluids." We propose implementing the following features:

- Particle-based position based dynamics fluid simulator that runs on the GPU
- Uses the density constraint to enforce incompressibility
- Artificial pressure term to simulate surface tension
- Vorticity confinement to replace energy
- Viscosity term
- GPU Hash Grid for optimization of finding particle neighbors
- Meshless rendering (bilateral Gaussian or curvature flow)

2. PROJECT TIMELINE

- Mon, 11/25 (Alpha): Set up framework for simulation. Set up visualization for particles.
- Mon, 12/9 (Last Day of Class) : Begin writing paper. Simulator finished with optimizations using GPU Hash Grid.
- TBD (Final) : Meshless screen space rendering. Paper finished.

3. EVALUATION

We will be keeping progress and posting our work on github. The repository will be visible to everyone, and is located at *https://github.com/harmoli/FinalProject-PBDWater*. We will also be tweeting and blogging about the progress of our project throughout its entirety. While this project has a narrow scope, we are hoping to go in depth, focusing first on the real-time simulation and then real-time rendering using screen space techniques.

4. EXTERNAL LIBRARIES

The implementation of the simulator calls for the use of a parallel Jacobi iterative solver. While this would be a good academic exercise and in and of itself, we will be using an opern source Jacobi iterative solver.

*Advisor: Patrick Cozzi (pcozzi@siggraph.org).

5. REFERENCES

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[2] Wladimir J. van der Laan, Simon Green, and Miguel Sainz. Screen space fluid rendering with curvature flow. In *Proceedings of the 2009 Symposium on Interactive 3D Graphics and Games*, I3D '09, pages 91–98, New York, NY, USA, 2009. ACM.

[3] Jihun Yu and Greg Turk. Reconstructing surfaces of particle-based fluids using anisotropic kernels. In *Proceedings of the 2010 ACM SIGGRAPH/Eurographics Symposium on Computer Animation*, SCA '10, pages 217–225, Aire-la-Ville, Switzerland, Switzerland, 2010. Eurographics Association.