CIS-565 Final Proj - Real-time Particle Simulation Engine

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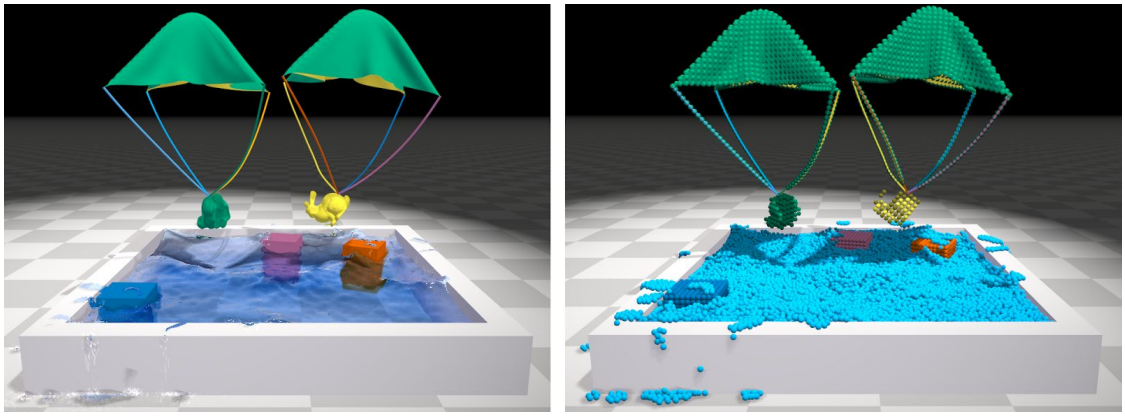

Overview

We are going to implement a real-time particle simulation engine. The engine would proposedly include particle sampling, rigid body and fluid interactions. Preferably the engine would also include particle meshing and shading via ray marching.

Application

Real-time particle simulation is useful for a wide range of purposes, especially for fields that needs simulation demo for interactions among various bodies. For example, fluid simulation in games, aerodynamics visualization, and meteorology simulation.

Proposed Pipeline

Preprocessing → Simulation → Vertex Shader (→ Geometry Shader / Meshing → Primitive Assembly → Rasterization) → Fragment Shader

Milestone Plan

11/16	Preprocessing, vertex shader, fragment shader (sphere ray marching)
11/23	Simulation (solvers)
11/30	Simulation (solvers)
12/07	Simulation (solvers) / Meshing

Analysis Plan

Comparison on performance/effect with FPS, snapshot(resolution, iteration)

1. Different particle sampling resolution
2. Global vs Tile-based collision detection, ray cast, etc.
3. Different iteration times numerically solving equations

Time spent on different pipeline: rendering / simulation ...

...

Reference/Utils

1. Main ref paper: Unified Particle Physics for Real-Time Applications
   http://mmacklin.com/uppfrta_preprint.pdf
2. NVIDIA CUDA Particle Tutorial:
   http://docs.nvidia.com/cuda/samples/5_Simulations/particles/doc/particles.pdf
3. GPU Gems3, rigid body particles: http://http.developer.nvidia.com/GPUGems3/gpugems3_ch29.html
4. GPU Gems 3, fluid particle simulation:
   https://developer.nvidia.com/gpugems/GPUGems3/gpugems3_ch30.html
5. Use OpenGL for rendering
6. Utils:
   a. obj loader: https://github.com/syoyo/tinyobjloader , Or use obj loader in previous Proj
   b. pcl(for particle system meshing): http://pointclouds.org/
   c. Eigen: http://eigen.tuxfamily.org/index.php?title=Main_Page
   d. cuBLAS: https://developer.nvidia.com/cublas