Cuda SPH Fluid Simulation - Declan Russell

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Introduction

The contents of this report follows the design and implimentation of a real time fluid simulation. This implimentation takes the form of a 3D Langrangian grid and takes advanteges of the speed of Nvidia's Cuda API to create a fast realistic fluid simulation. In the following sections you will find an explenation of maths used, optimisations made and the implimentation of this artifact.

Smoothed Particle Hydrodynamics and Fluid Theory

When implimenting fluid simulations there is an array of techniques in which you can use. Each of which have there own advantages and disadvanteges. The most prominent of these techniques are Eularian and Langrangian.

- Eularian Method Looks at fluid motion through specific locations in space. Space is devided up into cells which store attributes about the fluid in that location such as pressure, velocity and desity etc...
  - Advanteges
    - Performance determined by grid size not number of particles
    - Fast
  - Disadvanteges
    - Detail contrained to grid size
    - Simulation size limited to grid size
- Langrangian Method Focuses on individual particles of the fluid. Each particle stores attributes about its own pressure, velocity and density.
  - Advanteges
    - Simulation size not limited.
  - Disadvanteges
    - Performance tied to number of particles
    - For a realistic simulation we need to have a lot of particles

For this implimentation I will be following the Langrangian method.