Implicit Incompressible SPH

This project aims for an efficient and effective liquid simulator that implements one of the popular SPH variants, so-called IISPH. This requires thorough understanding of partial differential equations, in particular, the Navier-Stokes equations that model a variety of fluid flows. You are expected to perform autonomous research and investigation of how to generate liquid animations using computer.

Objectives

The first step is to understand the fundamental knowledge of liquid simulation pipeline for one of the popular particle-based solvers, i.e., implicit incompressible SPH (IISPH) [1]. You have to implement yourselves the simulation core of IISPH. You will start with handling two-dimensional setups and continue to three-dimensional ones. The simulation outputs will be a set of particles representing temporal and spatial changes of their positions. Thus, as the next step, you have to have a way to construct surfaces (i.e., meshes) from the particles via either own implementation of known technique [2] or an open-source library such as OpenVDB[1]. For the final step, you have to visualize them using a rendering software such as Blender[2]. These three (simulation, surfacing, and rendering) modules are the outcomes of this topic. Once achieving them, it is strongly encouraged to improve the pipeline with own ideas, e.g., speeding up each module via multiprocessing, adding another variant of SPH, changing rendering setups, etc.

Prerequisites

- Good programming skill in C/C++ both for implementing new codes and utilizing existing codes
- Knowledge of numerical simulation
- Experience of computer graphics libraries/tools or interest in using them

References

[1] 2014, Ihmsen et al., Implicit Incompressible SPH, TVCG.

[2] 2005, Zhu and Bridson, Animating Sand as a Fluid, ACM Trans. Graph.

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1 https://www.openvdb.org/

2 https://www.blender.org/