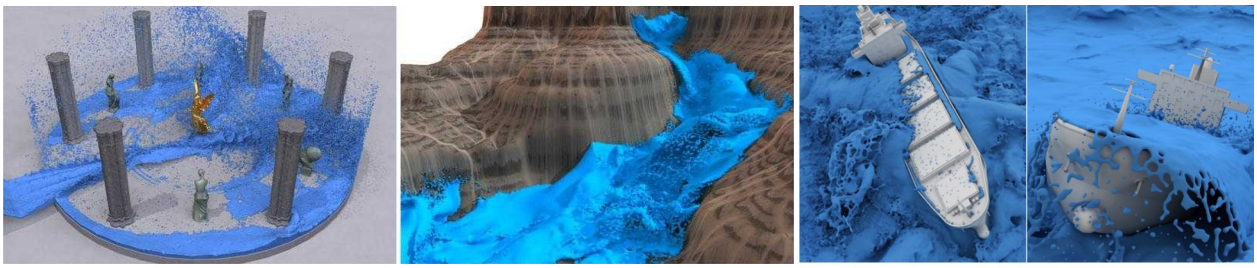
Three-dimensional Liquid Simulation

This project aims for an efficient and effective liquid simulator implementing one of the popular SPH variants such as IISPH or DFSPH. This requires essential programming/software skills for generating computer animations and good understanding of numerical simulations for fluid, which solve the Navier-Stokes equations that model a variety of fluid flows.



Objectives

The first step is to understand the fundamental knowledge of a particle-based liquid simulation method such as Implicit Incompressible SPH (IISPH) [1] or Divergence-Free SPH (DFSPH) [2]. You will start with implementing an SPH solver. The simulation outputs are a set of particles representing temporal and spatial changes of liquid volumes. You can reuse the codebase used for your previous classes such as IGR202. However, you have to aim for a 3D solver. For visualization, you need to have a way to construct surfaces (i.e., triangular meshes) from the particles. To this end, you will utilize an open-source library, OpenVDB[1]. For the final step, you visualize them using a rendering software, Blender[2]. In summary, this topic expects three deliverables:

- Simulator codes written in C/C++ (or Python)
- Mesh generator codes utilizing OpenVDB
- Blender scene file for rendering

You are strongly encouraged to work further to improve the pipeline with own ideas, e.g., speeding up via multiprocessing, simulating different types of fluid such as viscous flow, etc.

Topic difficulty: ☐ *easy* | ■ *intermediate* | ☐ *advanced*

Prerequisites

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

References

[1] 2014, Ihmsen et al., Implicit Incompressible SPH, TVCG.
[2] 2017, Bender and Koschier, Divergence-Free SPH for Incompressible and Viscous Fluids, TVCG.

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1 https://www.openvdb.org/
2 https://www.blender.org/