An Advection-Reflection Solver for Detail-Preserving Fluid Simulation

This project aims to build a smoke simulator that implements the advection-reflection solver [1]. The topic requires thorough understanding of partial differential equations, in particular, the Navier-Stokes equations that model a variety of fluid flows and good programming skills in C/C++. You should be able to make good use of open-source tools such as Eigen\(^1\), OpenVDB\(^2\), and Blender\(^3\).

Objectives

In this project, you will build a smoke simulation software that implements the advection-reflection solver. To begin with, you will first implement a 2D version solver. The core module for numerical simulation will require an efficient linear system solver where you should utilize the open-source linear algebra library, Eigen. For the 2D version, you should be able to visualize simulation results with simple OpenGL APIs. Once you achieve the 2D version, you should extend it to 3D. The core part will not change much, but, you should be able to export your simulation results using OpenVDB. The results should be loaded from the external renderer tool such as Blender and then nicely visualized with the renderer. You are responsible to figure out how to use the open-source libraries for each module.

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References


\(^{(1)}\) [http://eigen.tuxfamily.org/](http://eigen.tuxfamily.org/)
\(^{(2)}\) [https://www.openvdb.org/](https://www.openvdb.org/)
\(^{(3)}\) [https://www.blender.org/](https://www.blender.org/)