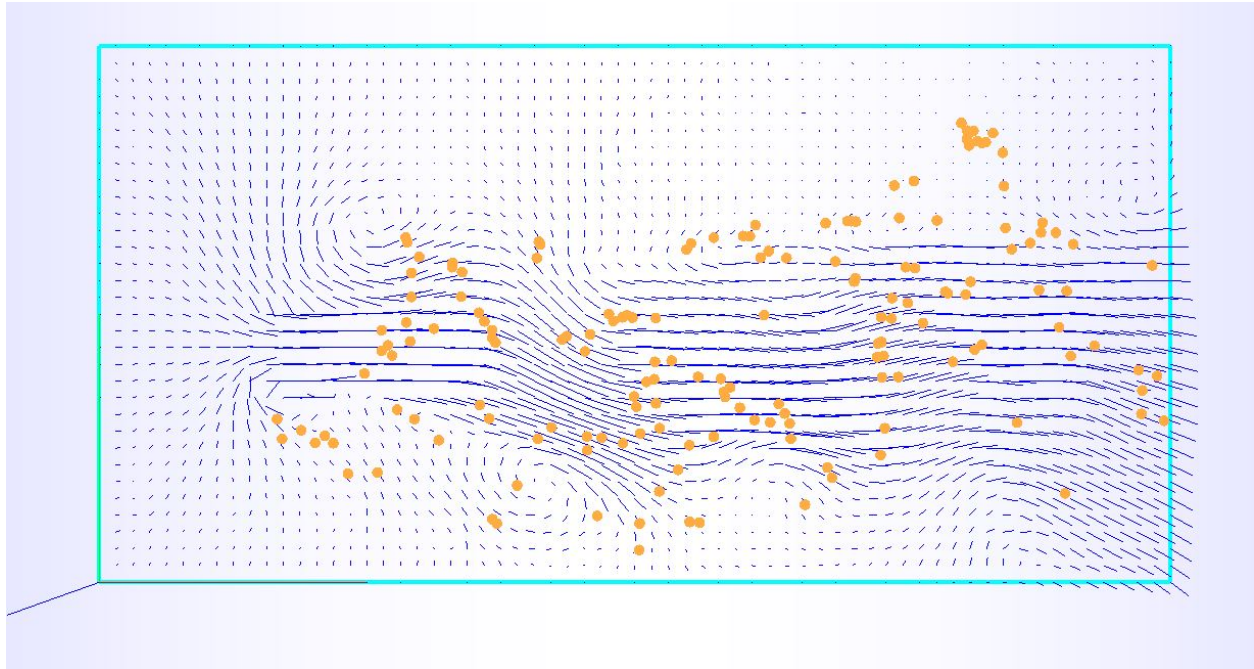Instructor: Bo Zhu (bo.zhu@dartmouth.edu)

Assignment 3: Grid-based Fluid

Reading

In this assignment we are implementing the Navier-Stokes equations on a Cartesian grid. Before getting started, please read the course notes 4, Stam's paper on stable fluid, and the slides.

Starter Code

Check out the latest starter code for assignment one from the course GitLab: https://gitlab.com/boolzhu/dartmouth-phys-comp-starter The project for Assignment 3 is in proj/a3_grid_fluid. The code can be compiled using CMake or the script (the same way as for Assignment 1).

Requirements

You are expected to implement your own grid-based fluid simulator for this assignment. There are three implementation tasks: advection (.5 point), projection (1 point), and vorticity confinement (.5 point).

Implementation Tips

All your code will be in GridFluid.h. The three implementation tasks are in the function of Advection, Projection, and Vorticity_Confinement.

For Advection, you are expected to implement the semi-Lagrangian advection scheme for each grid node.

For Projection, you are asked to implement two parts: the Gauss-Seidel iterative solver for the Poisson equation of $\nabla \cdot \nabla \hat{p} = \nabla \cdot \vec{u}^*$ and the velocity correction step to obtain a divergence free velocity field with the updated pressure. We already implemented the calculation of the rhs of the equation for you. Please read through that part of the sample code to learn how to traverse the grid nodes and access the data array using grid node coordinates.

For Vorticity Confinement, you are asked to implement two parts: the calculation of vorticity on each grid node, and the calculation of N according to the vorticity.

* Before you start your implementation, please make sure to read all the helper functions in GridFluid.h to understand how to access grid-based index, coordinate, position, and interpolation.

* After finishing your code, press 'p' to start the interactive simulation. Left click inside the fluid domain to add source velocities and seed visualization particles. Press 'v' to turn on/off the background velocity visualization.

Grading

We will have the grading session in the X-hour of Week 7. You are expected to run the interactive demos in the grading session and answer questions from a TA. You also need to submit your source code to Canvas.