Assignment 2 Report

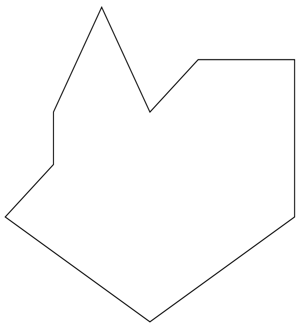
Introduction

This assignment consists of 3 labs concerning geometry processing and fluid simulation.

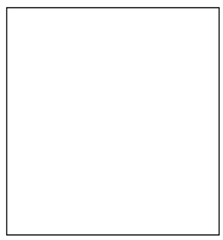
The first thing to do is defining new classes. In the **class** directory, a Polygon class is thus defined with a vector containing all its vertices and a vector containing all its edges; an Edge class is defined with its two vertices; a Particle class is defined for the fluid simulation part packing the information of the particle: position, velocity, and mass; finally a Generator is defined to generate random samples. In the **func** directory, the functions for the 3 labs are defined. In the **lib** directory lies the libraries to be included. The **image** directory contains the generated images.

Lab 6

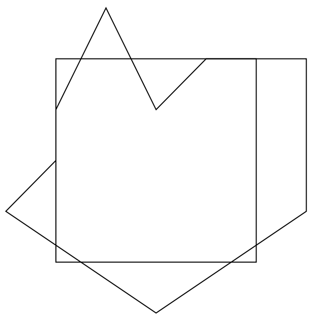
The first lab requires a Voronoi diagram using Voronoi Parallel Linear Enumeration with Sutherland-Hodgman polygon clipping algorithm. The Sutherland-Hodgman clipping algorithm is basically clipping the target polygon with a clipping polygon edge-by-edge. Every clipping results in an elimination of a half plane. It is to be noticed that the vertices are to be inserted counterclockwise.



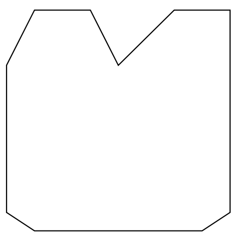
(a)



(b)



(c)



(d)

Figure 1: The result of the Sutherland-Hodgman algorithm. (a) the original polygon to be clipped; (b) the clipping polygon; (c) how they are overlapping; (d) the result of clipping.

The next task is to implement Voronoi Parallel Linear Enumeration. It uses the method implemented above to obtain a Voronoi cell for each site and combine them together.

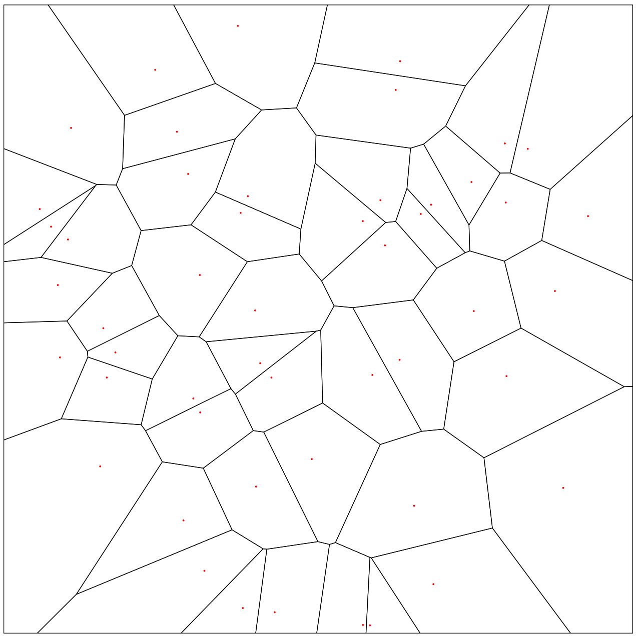


Figure 2: The result of Voronoi diagram. The sites are randomly placed in a disk centered at the center of the box.

The Lloyd iteration method was also implemented.

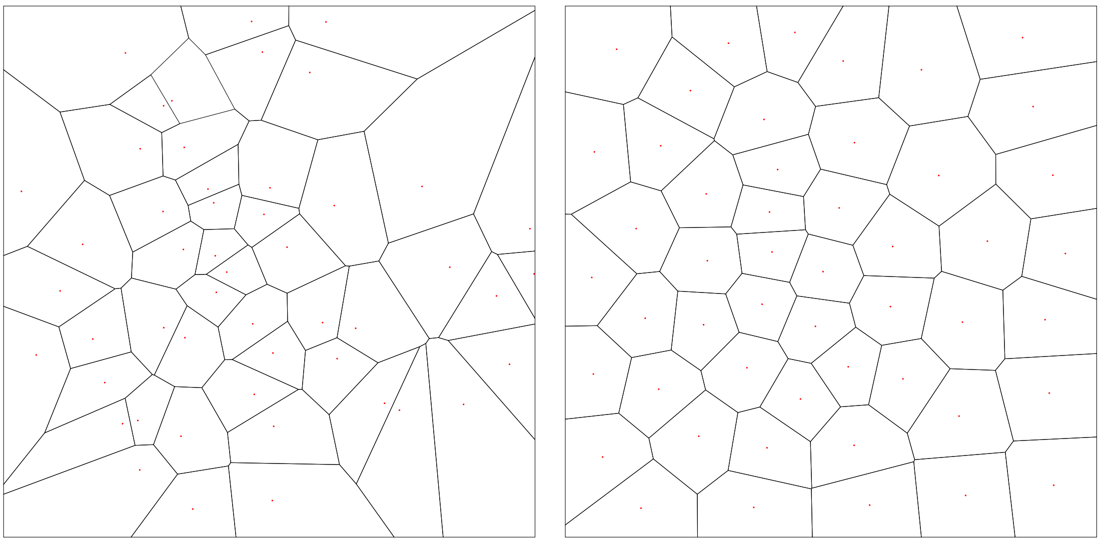


Figure 3: The result of Lloyd iterations. Left: Voronoi diagram; Right: corresponding diagram after 5 Lloyd iterations.

<u>Lab 7</u>

This lab requires to generate power diagrams given the weights of the cells and using semi-discrete optimal transport to optimize a set of weights to corresponds to the desired volume of the cells. An quasi-Newton solver L-BFGS is used and a such library with a sample is integrated into the project.

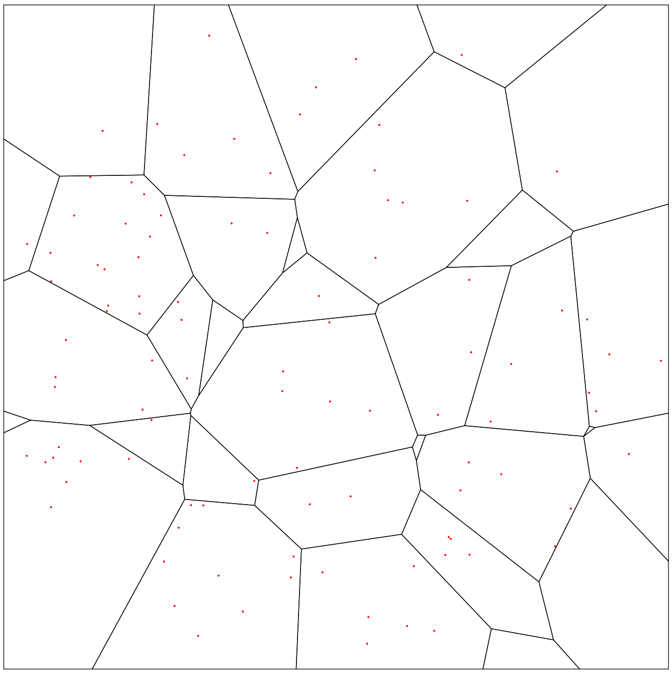


Figure 4: A power diagram with random weights (the weights are between 0 and 0.1). We can see that some cells are now hidden.

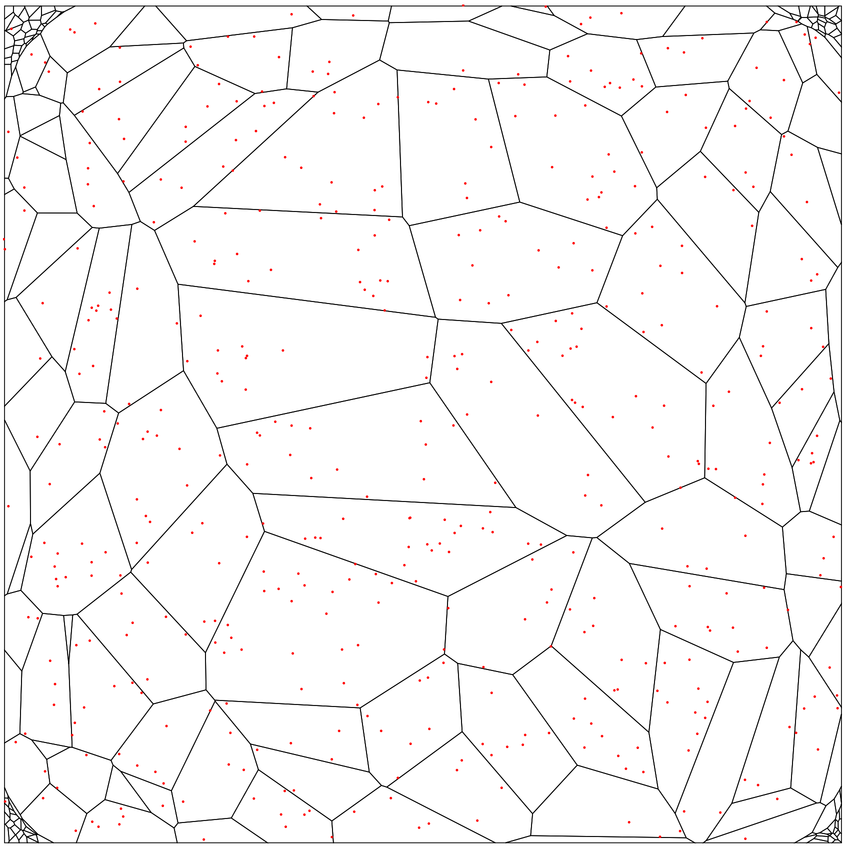


Figure 5: Optimal transport result using Gauss distribution as target. As seen in the lecture notes, the cells in the center are larger in size, while those in the corners are small. 500 samples with 1000 optimization iterations.

Lab 8

This lab requires to implement the Gallouet Merigot one-step scheme and use semi-discrete optimal transport to simulate the motion of free-surface fluid. The Gallouet Merigot scheme is implemented but the modification to the optimal transport formulation was not yet very well understood and is not completed. But a preliminary simulation is able to be shown.

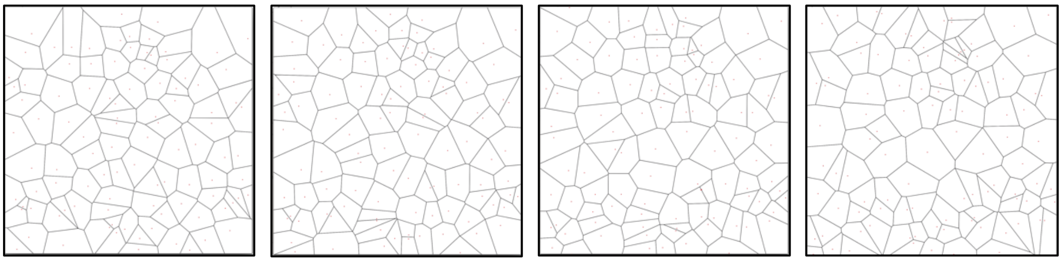


Figure 6: The first 4 frames of simulation; captured from the video (fluid.mov and points.mov).