EL EUCH Farah CSE306

# Assignment 2 Report

## Lab 5 : Sliced optimal transport approach for color matching

In this lab, we took two images (target I and model M) as arrays of 3D vectors and implemented the sliced optimal transport algorithm to apply the color palette of the model to the target image, by iteratively projecting both images on random **axes**, and after sorting, transferring colors from M onto the closest ones in I, according to this ranking.


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## Lab 6 : Voronoï diagram computation

- Creation of 2D Vector Class with the same functions as the previous assignment.

- Creation of Polygon Class taking vertices (list of 2D Vectors) as input

- Implementation of function intersect which returns the point of intersection between the Edge [A,B] and line (u,v)

- Implementation of function inside which takes in a point and a pair of points representing a half-plane and checks whether the point is inside this half-plane

- Implementation of Sutherland-Hodgman polygon clipping algorithm (using intersect and inside functions) as written in the lecture notes.

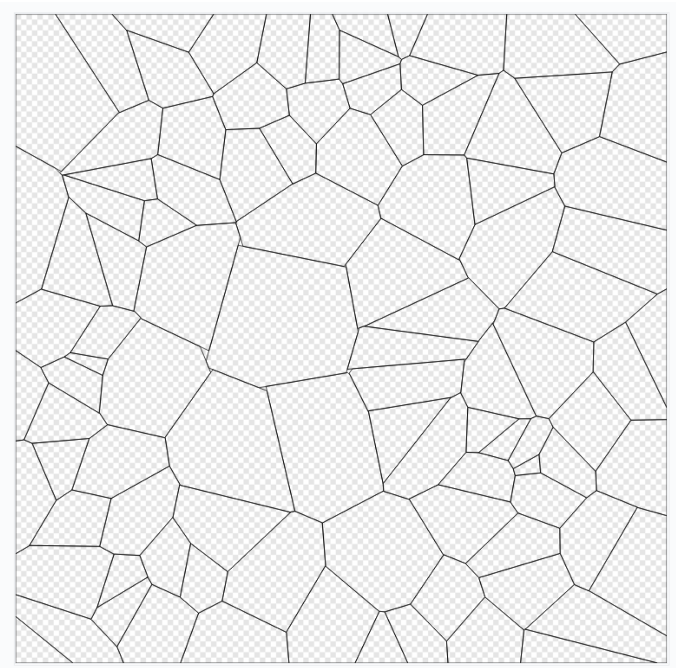
- Implementation of the Voronoï Parallel Linear Enumeration : for each point we started with a large square, which was iteratively clipped by half planes representing the neighboring points/cells. We could emulate this by creating squares and clipping the current polygon using the Sutherland-Hodgman algorithm.

## Lab 7 : Power diagram

LBFGS Algorithm:
Input : Points (list of type Vector), lambda (list of doubles) corresponding to the "mass" of the Voronoï cells.
Output : Weight (list of doubles) associated to the points

We added to our algorithm the capability to adjust the size of the cells: by adding weights to our points, we were able to control where the clipping half-plane would cut the current polygon.

To control the sizes of the cells we optimised the weights, trying to match the mass associated to each cell with the integral of the squared distance to the cell origin. We optimised them using the LBFGS algorithm for gradient ascent, which we implemented according to the lecture notes instead of relying on the provided library.



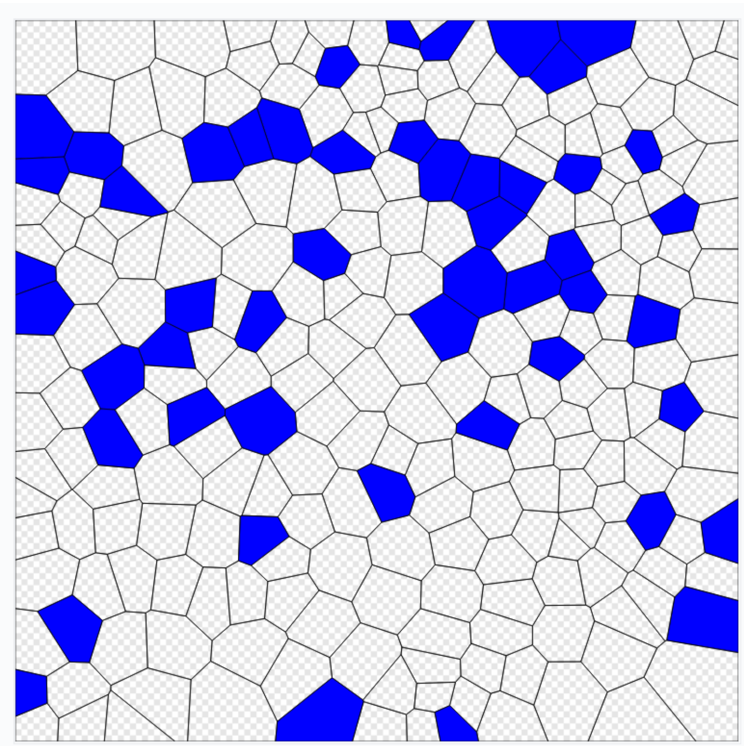
We could compute this Power diagram, where the Voronoï mass attributed to each point was following an exponential decay, with its distance from the center. Creating slightly larger cells in the center.

## Lab 8 : Implementation of de Gallouet-Mérigot incompressible Euler scheme

Input : X (list of type Vector corresponding to points), v (list of type Vector corresponding to the velocity of these points), m (list of doubles corresponding to the masses).

Output : Pair of two lists of vectors of type Vector corresponding to the new positions and new velocities.

Our algorithm considers the area of a water cell to be the same as an air cell. So we used a uniform repartition, eps = 0.004 and dt = 0.002 and followed the code given in the lecture notes to simulate the system over time, integrating forces and velocities step by step.

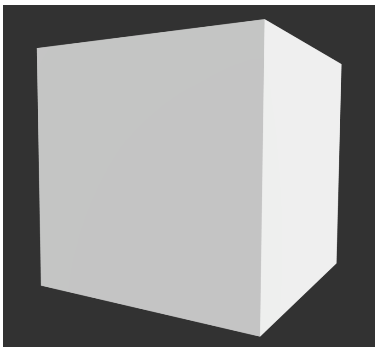
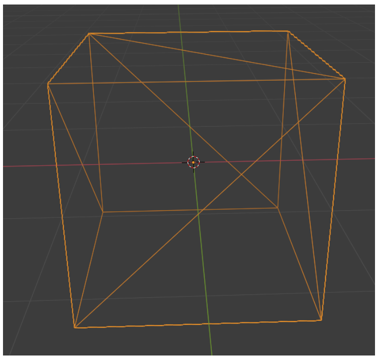
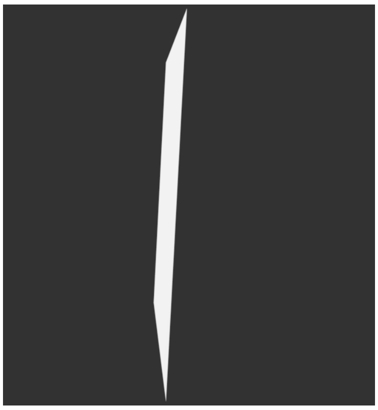
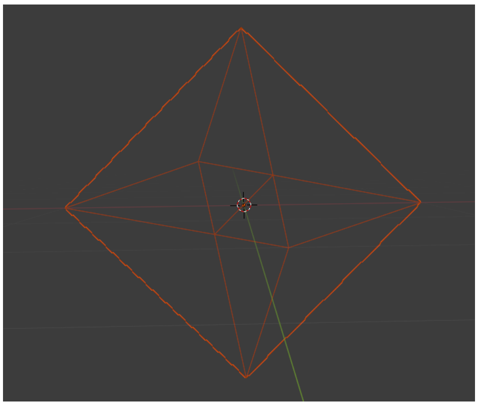


Step of the fluid simulation

## Lab 9 : Implementation of Tutte embedding

For UV-mapping and other applications, we are sometimes required to project our meshes on a 2D surface. For a mesh which is homeomorphic to a disk, we can create a Tutte embedding.

It works in the following way: we fix the border dM on a circle, keeping the relative spacing, and iteratively move the inner points to the centroid of their topologic neighbors, so that in the end we get a stable embedding, which preserves the topology and keeps points relatively well spread out.

| | shaded | wireframe |
|---|---|---|
| input |  |  |
| output |  |  |

Feedback on the Course :

I personally think the course was really interesting and challenging. Before this semester I've never been so motivated for a computer science class. I really liked computer graphics and I would love to keep on improving the skills I acquired.

Although I found the amount of work required a bit too heavy considering that this semester is short and our other classes also have a heavy workload, I think that having on-site TDs and lectures next year will make things easier for students. Slack was however really useful and thank you for your and Mrs. Wei's disponibility.

The only thing that could be improved is to create TDs sheets or webpages as we are used to in other CS classes instead of having them in lecture notes. I found it a bit inconvenient.

Thank you for this semester !