Meshes and Computational Geometry
Master 2 Informatique ID3D – Université Lyon 1

TP4– Flip an edge, Improve the quality of a triangulation, Incremental Delaunay Triangulation,

Flip an edge in a 2D triangulation

- Provide a procedure to flip an edge in a triangulation data structure. Note that there are several ways to specify an edge in the face-based data structure (which means you can provide several overloads of the flip operation).

Insertion of a point outside the convex-hull of a 2D naïve triangulation

- Once you have the flip operation, you can use it to insert a point outside the convex-hull of a set of points being triangulated using the 2D naïve incremental triangulation. This means that you don't need any more a 2D bounding box.

Improve the quality of a triangulation, Delaunay triangulation

- Provide a predicate function to check whether an edge is locally Delaunay.

- Provide a procedure that turns a 2D naïve triangulation of a set of 2D points into a Delaunay triangulation. You should implement Lawson's algorithm that we have studied in the class.

- Given a Delaunay triangulation, provide a way to update it after the insertion of a point using Lawson's algorithm only on a small subset of the edges.

Test your algorithms on terrain data

- Download the file terrain.xyz in which you will find the 3D coordinates of a set of points.
- Insert those points in a 2D Delaunay triangulation without using the z coordinates for the non-Delaunay tests.
- Display the triangulation with the points at their original height.
- As you can see, a triangle lifted in 3D can have its quality degraded compared to the Delaunay triangle using only the x and y coordinates. Provide a procedure that improves the quality of the terrain triangulation using Lawson's algorithm. Since we run the algorithm in 3D, it is possible that the algorithm converges to a terrain triangulation corresponding only to a local optimum of the triangulation quality (and not a global optimum). Thus, we encourage you to use a priority queue instead of a

queue to perform Lawson algorithm. Note that for a locally Delaunay edge the sum of the two angles A1 and A2 opposite to the edge does not exceed Π. Therefore you can use A1+A2-Π as a priority to be used in the priority queue.