

Report for Advance Algorithm Programming Assignment 1 Part2

Moran Kim

1 Implementation Details

Given N number of points in \mathbb{R}^3 to get a 3D α -shape we need to compute the radius of circumsphere of Delaunay triangulation. By mathematical proof we know the center of the circumsphere of Delaunay triangulation is the voronoi vertex. We can get the voronoi vertex(center) by using `qh.setvoronoi.all()` (I used dot . instead of bottom dash line) as implemented in "*alpha - shape.c*". From the tetrahedrons we obtained from Delaunay triangulation, we check whether the radius of circumsphere of each tetrahedron is less than α or not.

(1)Tetra part: By reporting only the vertices of tetrahedron whose radius of circumsphere is less than α .

(2)Face part: By reporting only the vertices of tetrahedron which satisfies

- whose radius of circumsphere is less than α . [1]
- whose neighbor is upper Delaunay or whose radius of neighbor circumsphere is greater than α . [2]

if vertices satisfy [1] and [2], then report them to the vertex information.

(3)Edge part: By reporting only the vertices of the tetrahedron which is obtained from(1).

If we give $\alpha = \infty$ then the shape will be the convex hull of given data set. As we use smaller value of α , we will obtain more accurate 3D shape which close to the given set of points. If we give $\alpha = 0$, the shape will be exactly same as the data points.

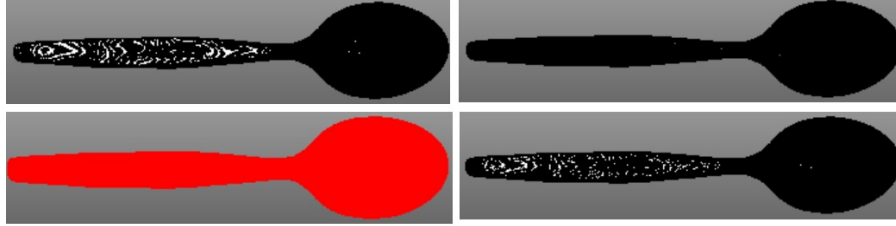
(In the code you can find a reference in every line)

2 Example Output

I tried the spoon and bb which are in the given data. When I tried spoon for $\alpha = 100000$ (Fig.1) there was not much difference in $\alpha = 0$ and that means the distance between the set of points are really huge. So when I gave $\alpha = 10000000$ I obtained the pictures below. The smaller value we give to α the more elaborately carved one we can see.

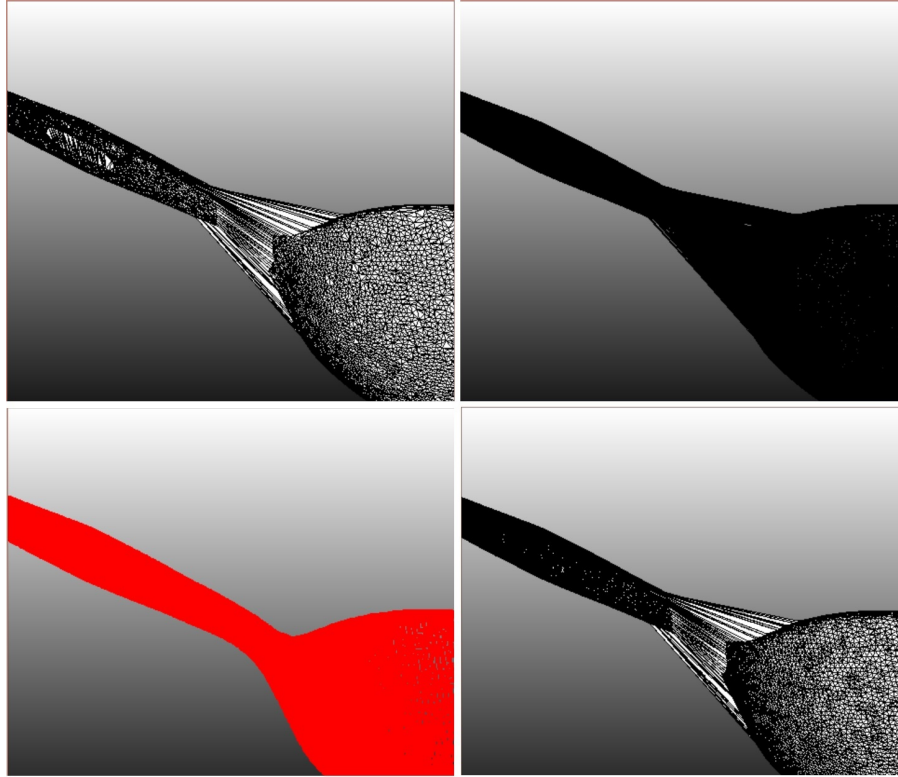
3 Known bugs/limitations

I used the `qh.setvoronoi.all()` here to get the center of the circumsphere of tetrahedrons. It was confusing that whether the center is calculated from 4D, since the coordinate of the center was consists of four component. But for the every coordinate of center, the 4th component was same



10000.jpg

Fig 1. $\alpha = 100000$ facets, edges, points and tetrahedra (order from left to right, top to bottom)

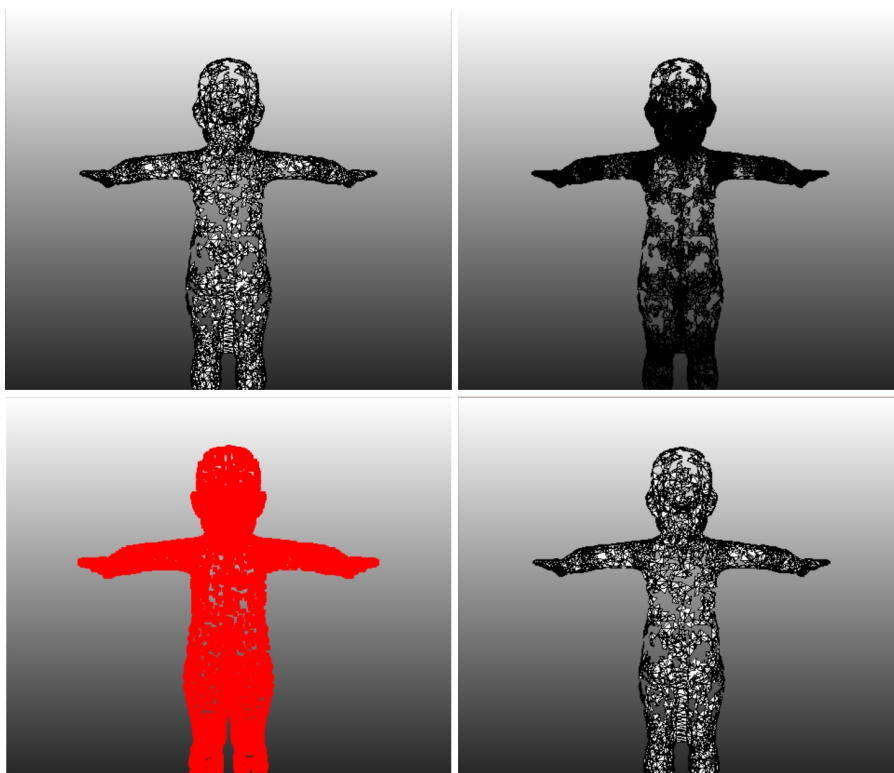


10000000.jpg

Fig 2. $\alpha = 10000000$ facets, edges, points and tetrahedra

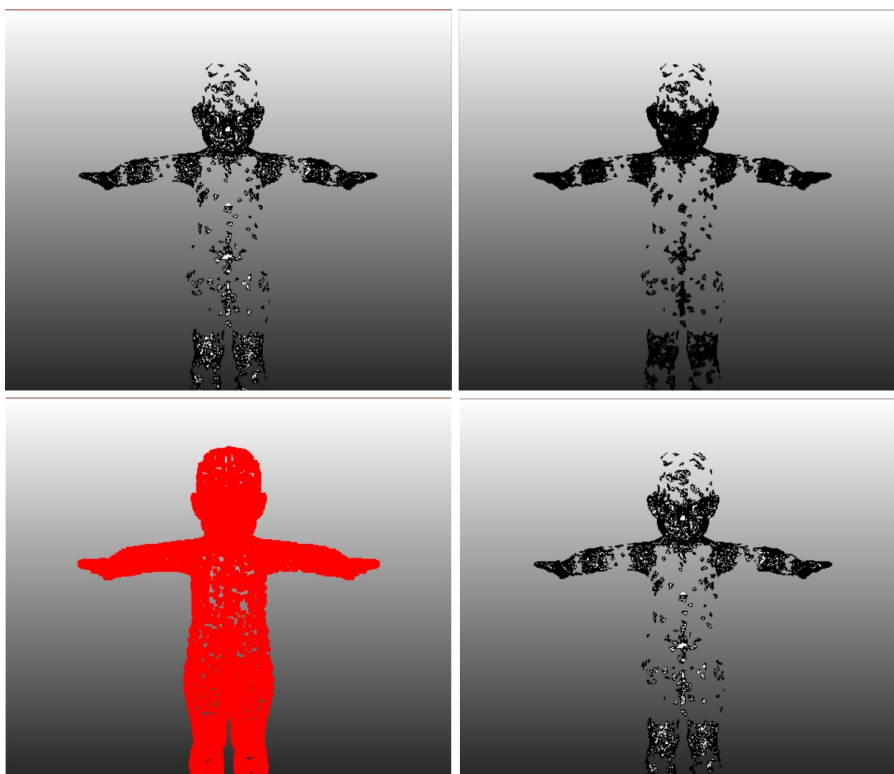
with the 1st component so I understood it as a redundant and the `qh.setvoronoi.all()` returns the coordinate of center in 3D.

The circumsphere does great work to find the more exact shape of given scattered point in \mathbb{R}^3 . It is really awesome. I completed the edge part in `Delaunay()` and `alpha-shpae()`. I want you to check it professor.



30.jpg

Fig 3. $\alpha = 30$ facets, edges, points and tetrahedra



10.jpg

Fig 4. $\alpha = 10$ facets, edges, points and tetrahedra

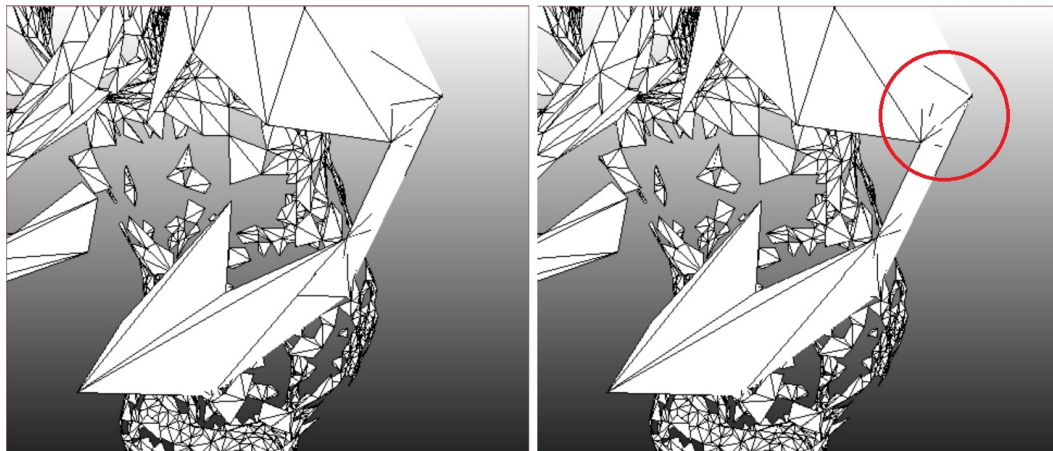


Fig 5. $\alpha = 10000000$ The difference between facets and tetrahedra