

Report for Advance Algorithm Programming Assignment 1

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1 Implementation Details

1.1 algorithm

The alpha shape algorithm is as follows:

1. Create points in 4D using 3 coordinates : $(\mathbf{x}, \mathbf{y}, \mathbf{z}, \mathbf{x}^2 + \mathbf{y}^2 + \mathbf{z}^2)$
2. Compute convex hull in 4D by calling `qhull[?]` with 4D points.
3. Looping through all facets in 4D convex hull,
 - Save the vertices of a facets as the vertices of tetrahedron. This vertices are 3 coordinates $(\mathbf{x}, \mathbf{y}, \mathbf{z})$.
 - Compute the volume of tetrahedron
 - If the normal vector of tetrahedron points downward and the volume is not zero, compute the radius of circumsphere. Otherwise, continue the loop with new facet.
 - If squared radius is bigger than alpha value, remove tetrahedron. Otherwise, generate faces of tetrahedron.

1.2 software

OS : Window 8.1K

IDE : Visual Studio 2013

*NOTE : I use the dynamic library for freeglut.

2 Example Output

Each model was given three different alpha values. In Fig. 1 - Fig. 12, the alpha value increases through (a) - (c). The exact alpha values are shown in Table 1.

3 Know bugs/limitations

In case of cube (Fig. 1), it is a degenerate case that all the tetrahedra is on the same circumsphere. Therefore, it removes all the faces after specific radius.

Table 1: Alpha values of each model.

Model	(a)Alpha1	(b)Alpha2	(3)Alpha3
cube	50	78	-
ellipsoid	5000	10000	1E+5
bunny	1000	10000	1E+6
U	100	10000	1E+6
bull	1E+5	1E+6	1E+7
baby	100	10000	1E+6
woman	100	10000	1E+6
T	10000	15000	1E+5
Y	1000	10000	1E+5
screwdriver	10000	1E+6	1E+8
spoon	10000	1E+9	1E+13
teeth	1000	1E+6	1E+9

References

[1] Qhull. <http://www.qhull.org/>. Accessed: 2015-10-14. 2

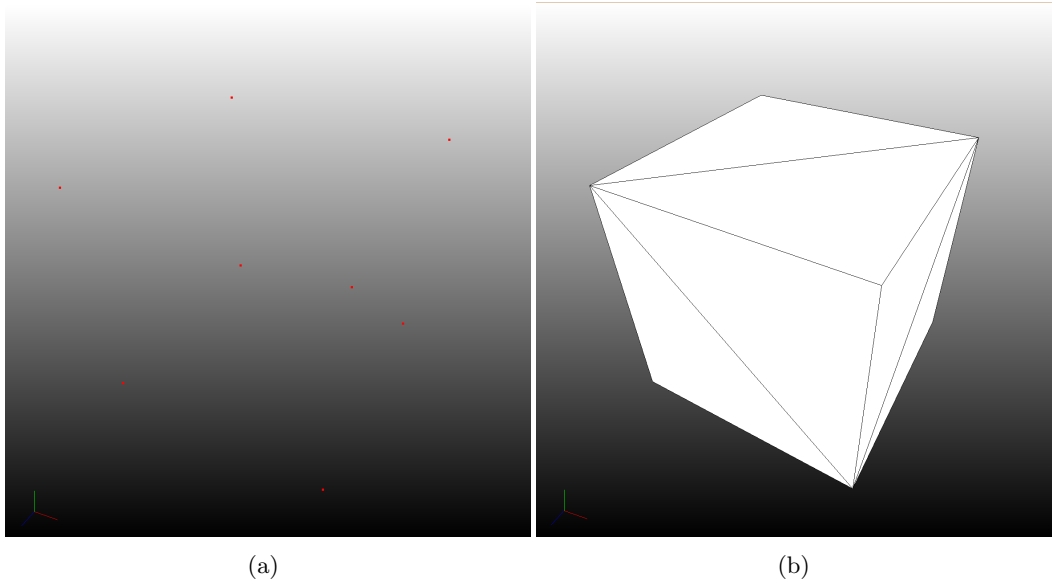


Figure 1: A cube example

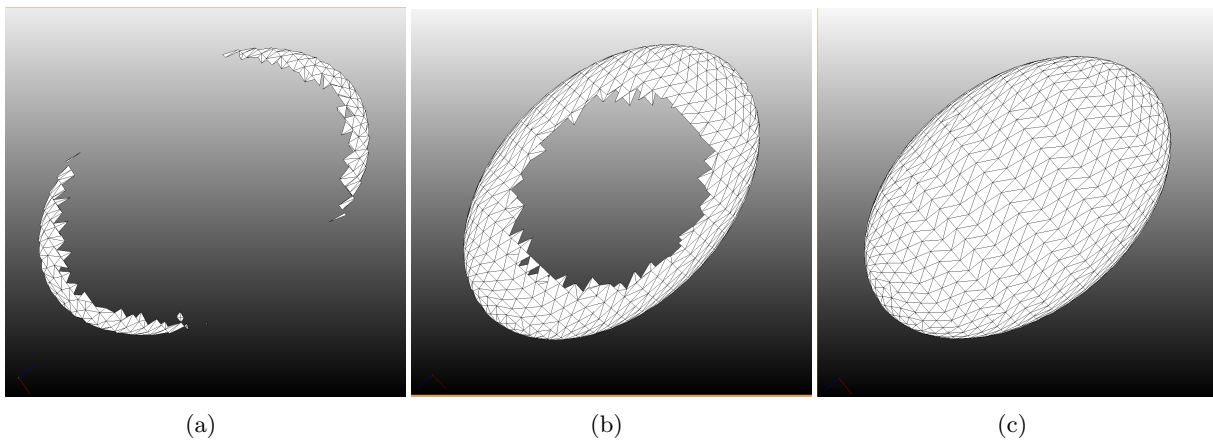


Figure 2: An ellipsoid example

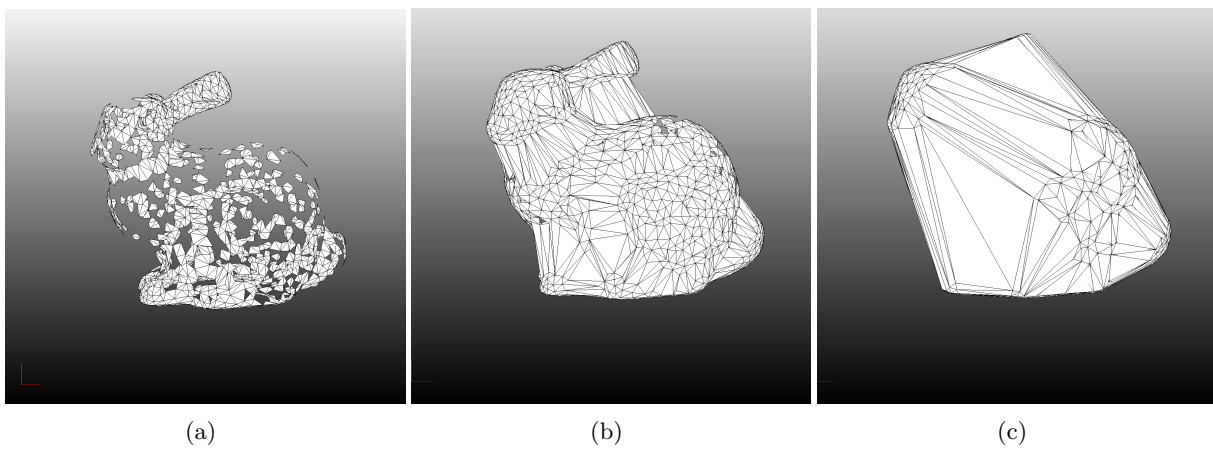


Figure 3: A bunny example

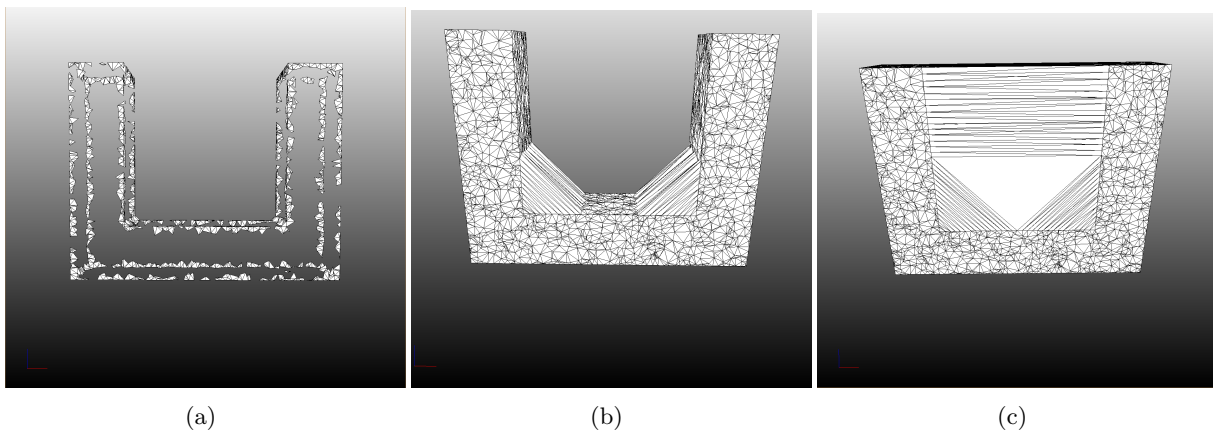


Figure 4: An 'U' example

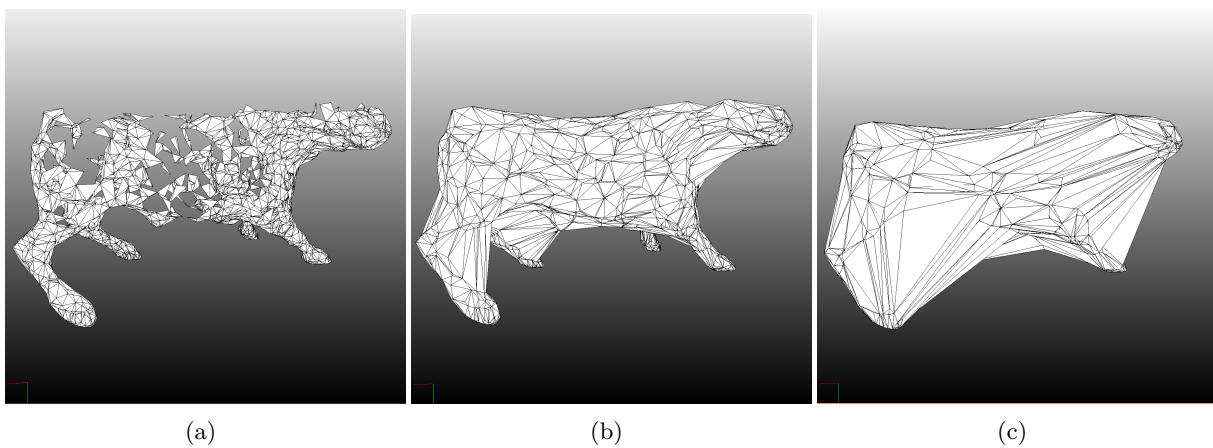


Figure 5: A bull example

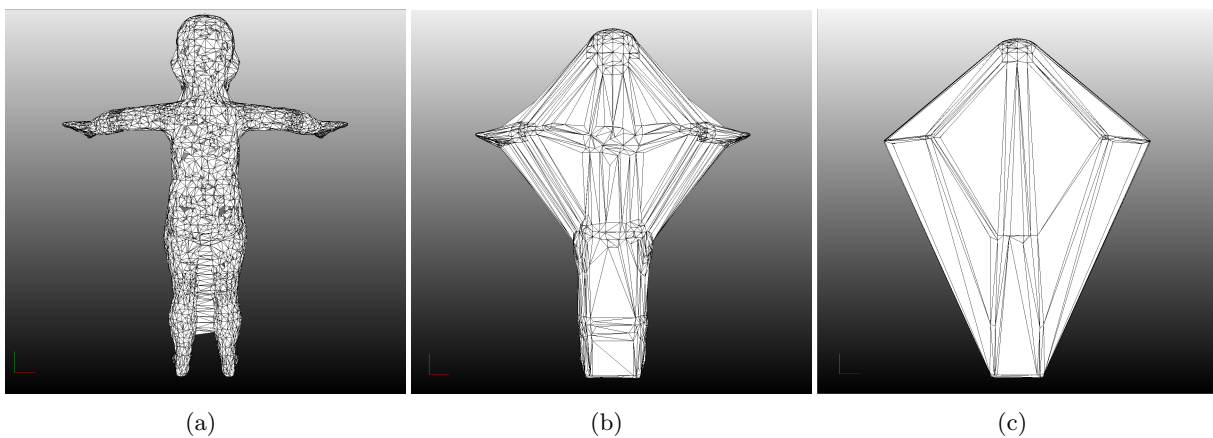


Figure 6: An baby example

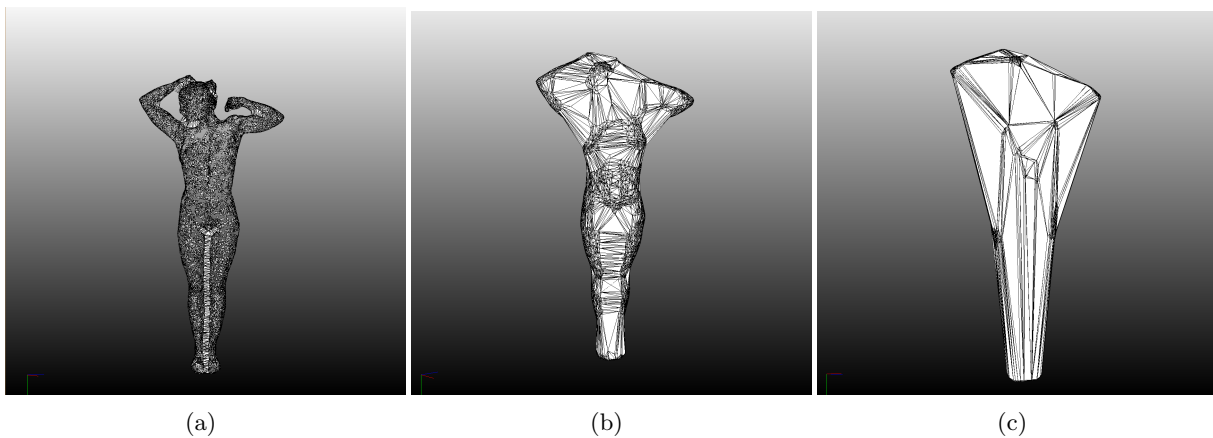


Figure 7: An woman example

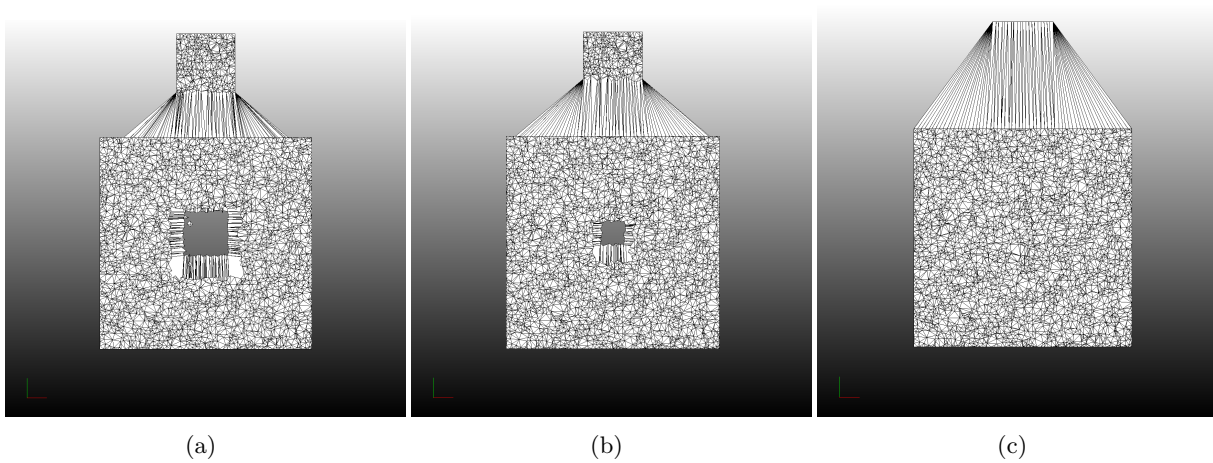


Figure 8: A 'T' example

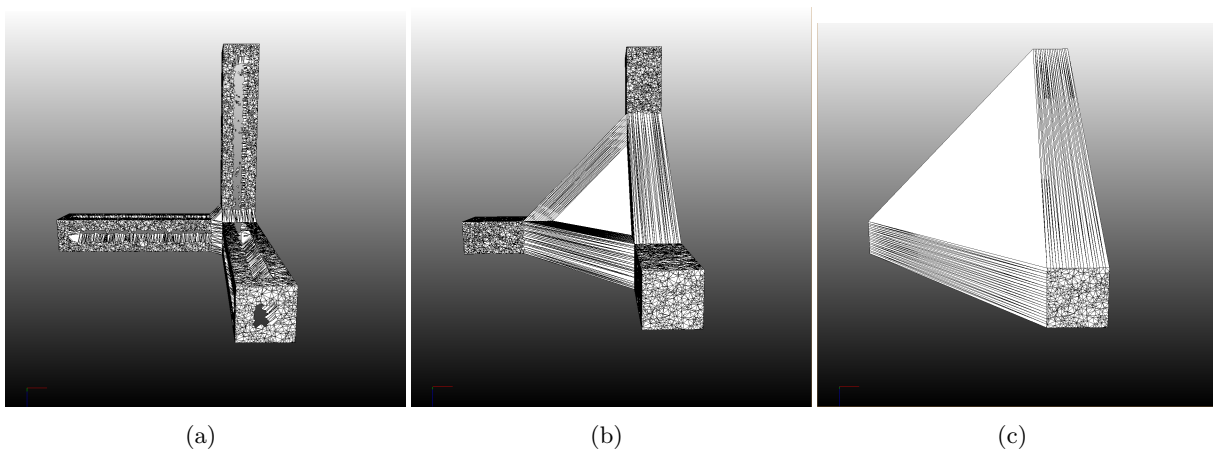


Figure 9: An 'Y' example

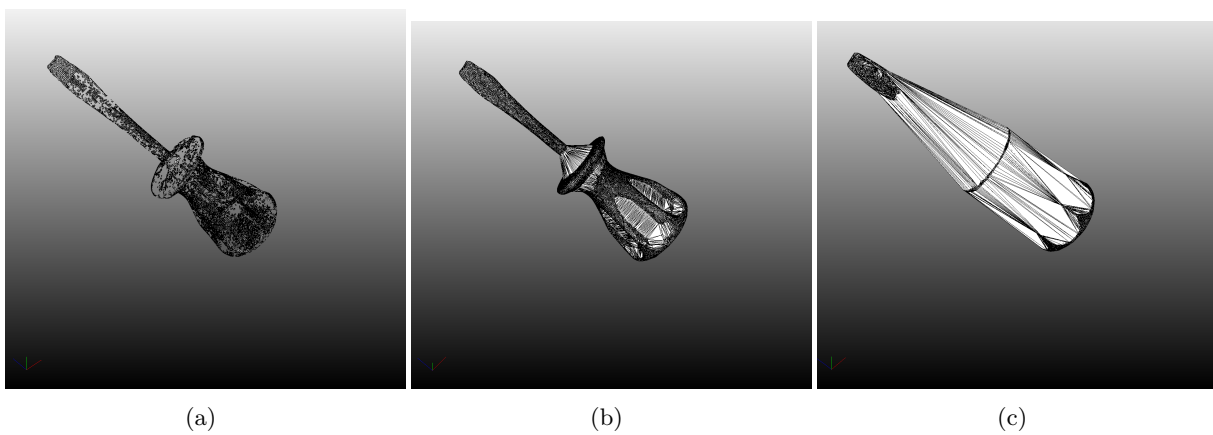


Figure 10: A screwdriver example

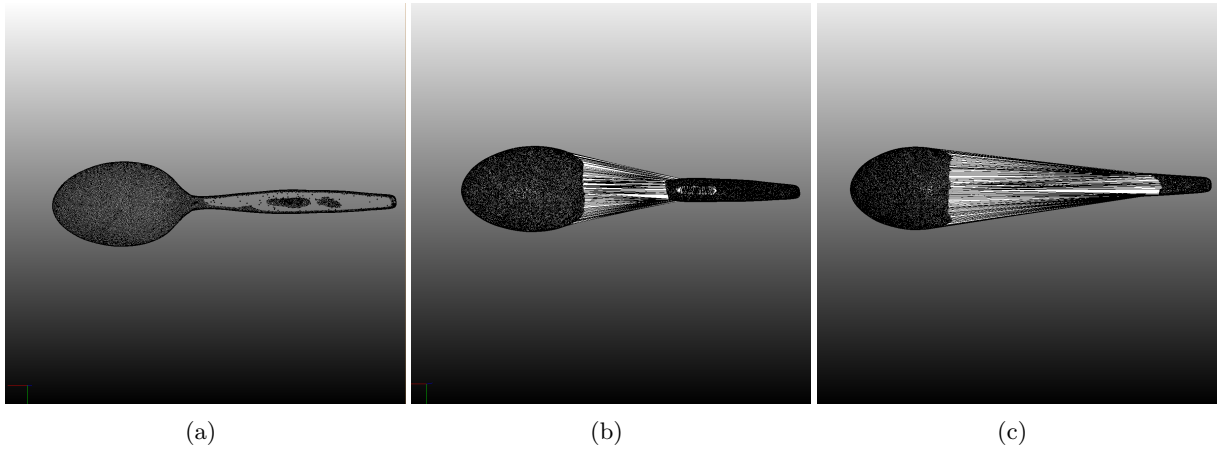


Figure 11: A spoon example

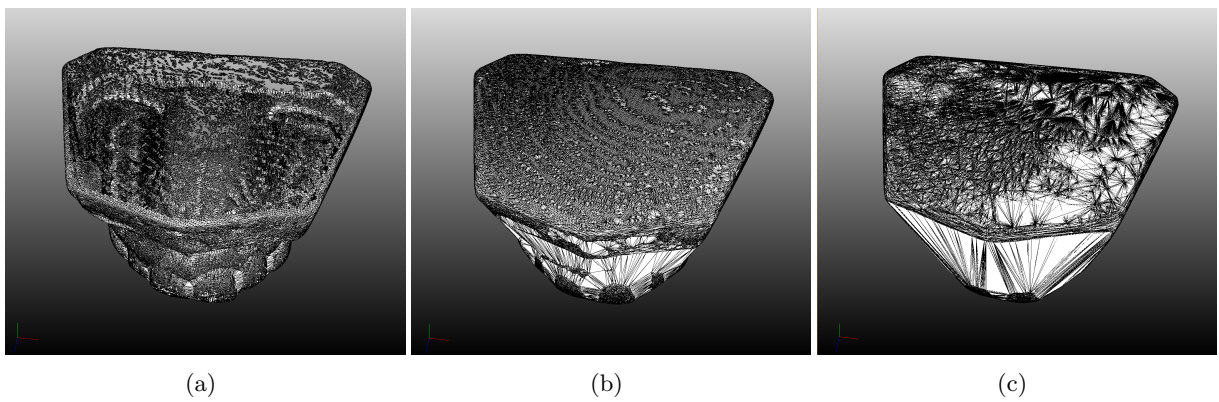


Figure 12: A teeth example