

User Manual for Convex Hull Generator

This code is designed for finding the convex hull of a set of 3D points using QuickHull algorithm, which has $O(N\log N)$ time complexity on average and $O(N^2)$ on the worst case.

Usage

Open 3dConvexHull.exe, then enter the name of the data file. The program will begin to compute the convex hull of the points of all the 3D points in the data file.

Data file format

Data file is a .txt file. The data has N rows and 3 columns. Each row represents a data point, and the three columns represent the value of coordinate x,y,z, respectively.

Output format

The program outputs both the intermediate results and final results.

- 'Initial Hull' means the index of four points that construct the initial polyhedron, which is actually a tetrahedron.
- 'Merging points' means that the program is incorporating the new point into the polyhedron. This process will continue until no conflicting points are found.
- 'Result' means the final result of the convex hull of the set of all points. the format is an $N \times 3$ matrix, in which N is the number of points. Each row represents a face of the final convex hull, and each column represents the index of the vertices of the faces.

Example

This section provides a simple example.

Data:

0	0	0
0	0	1

0	1	0
1	0	0
0.6	0.6	0.6
0.1	0.1	0.1

Output and Explanation:

Output

Enter file name:

example2.txt

Number of points: 6

Initial Hull:

3 2 1 0

Merging point 4

target: 3

Merging complete

Result:

2 0 1

1 0 3

0 2 3

3 2 4

2 1 4

1 3 4

Explanation

Enter 'example2.txt', which is the name of data file.

This means the initial polyhedron is constructed by (1,0,0), (0,1,0), (0,0,1) and (0,0,0).

Point (0.6,0.6,0.6) is outside this initial polyhedron, therefore the program merges this point. Point (0.1,0.1,0.1) is in the initial polyhedron, thus the program does not merge this point.

The final polyhedron has six faces. The first one is the triangle formed by (0,1,0), (0,0,0) and (0,0,1), and the second one is formed by (0,0,1), (0,0,0) and (1,0,0), etc.

Another two examples are:

- example1.txt, which shows a cube with three internal points. These internal points are not included in the final convex hull. The outputs are 12 triangles, which constitute the whole surface of the cube.
- example3.txt, which has 100 samples, which follow identical and independently distributed standard normal distribution.