Tutorial: Alpha Shapes

The objective of this tutorial is to compute the alpha-shape of a set of points. Some tests will be done to reconstruct a shape from its random discretization as a point pattern (see Figure 1).

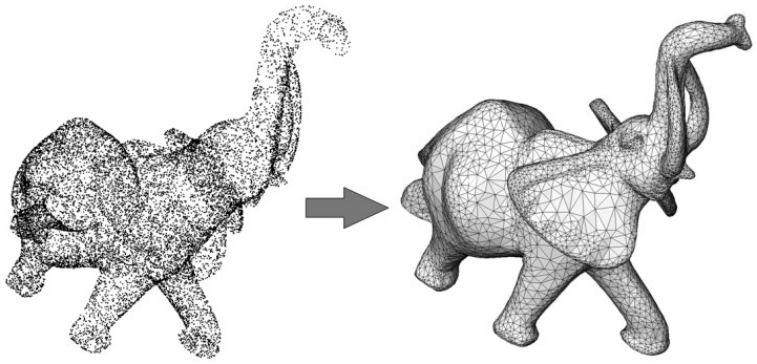


Figure 1: Shape reconstruction from a set of points.

1 Point pattern

From a binary image representing a shape, we need to extract a random set of points (included in the shape). It will define our input data.

(a) shape

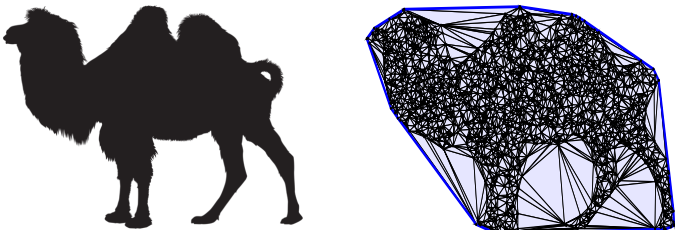
(b) point pattern representing the shape

Figure 2: Shape and random discretization as a point pattern.

1. Load the image 'camel.png'.
2. Discretize the set by using a random (uniform) point process to obtain the initial data. The density of the point process should be a user parameter.

2 Delaunay triangulation

In order to build the alpha shape of a set of points, it is firstly required to compute its Delaunay triangulation.



(a) initial point pattern (b) Delaunay triangulation

Figure 3: Initial point pattern and its Delaunay triangulation.

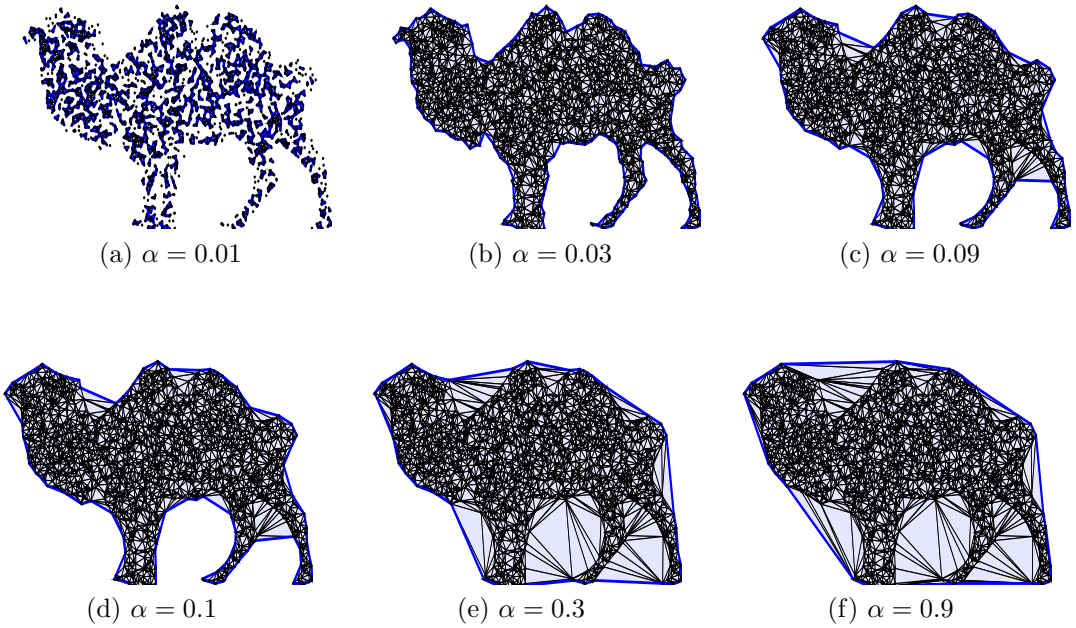
1. By using the initial point pattern, build its Delaunay triangulation.
2. Look at the resulting Matlab object to understand the structure of the triangulation.

You can use the matlab function delaunayTriangulation.

3 Alpha-shape

The alpha-shape corresponds to the union of Delaunay triangles T_{ijk} such that the circumradius C_{ijk} is lower than α.

1. Implement the algorithm.
2. Test this operator with the input data using different values of α.



(a) $\alpha = 0.01$ (b) $\alpha = 0.03$ (c) $\alpha = 0.09$

(d) $\alpha = 0.1$ (e) $\alpha = 0.3$ (f) $\alpha = 0.9$

Figure 4: Alpha-shapes for different values of α.