CS271 Spring 2021 Computer Graphics II
HomeWork 2

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1 2D Delaunay Triangulation

Bowyer-watson algorithm is used to compute delaunay triangulation for a point set.The steps of algorithm is as follows:

1. Find a super-triangle containing all points. In practice, I used a bounding box instead of the super-triangle.
2. Traverse the point set. For a point,first look for triangles whose circumcircle contain the point, and delete the common edges of there triangles. Then connect the point with the vertices of these triagnles to form a new set of triangles.
3. Delete all super-triangle vertices and the relative edges. In my program, the vertices and edges related to the bounding box are deleted.
4. Some triangles calculated by DT are not expected in the skeletonization step, so I delete these triangles by judging the connected domain where the triangles are located.

Result show:

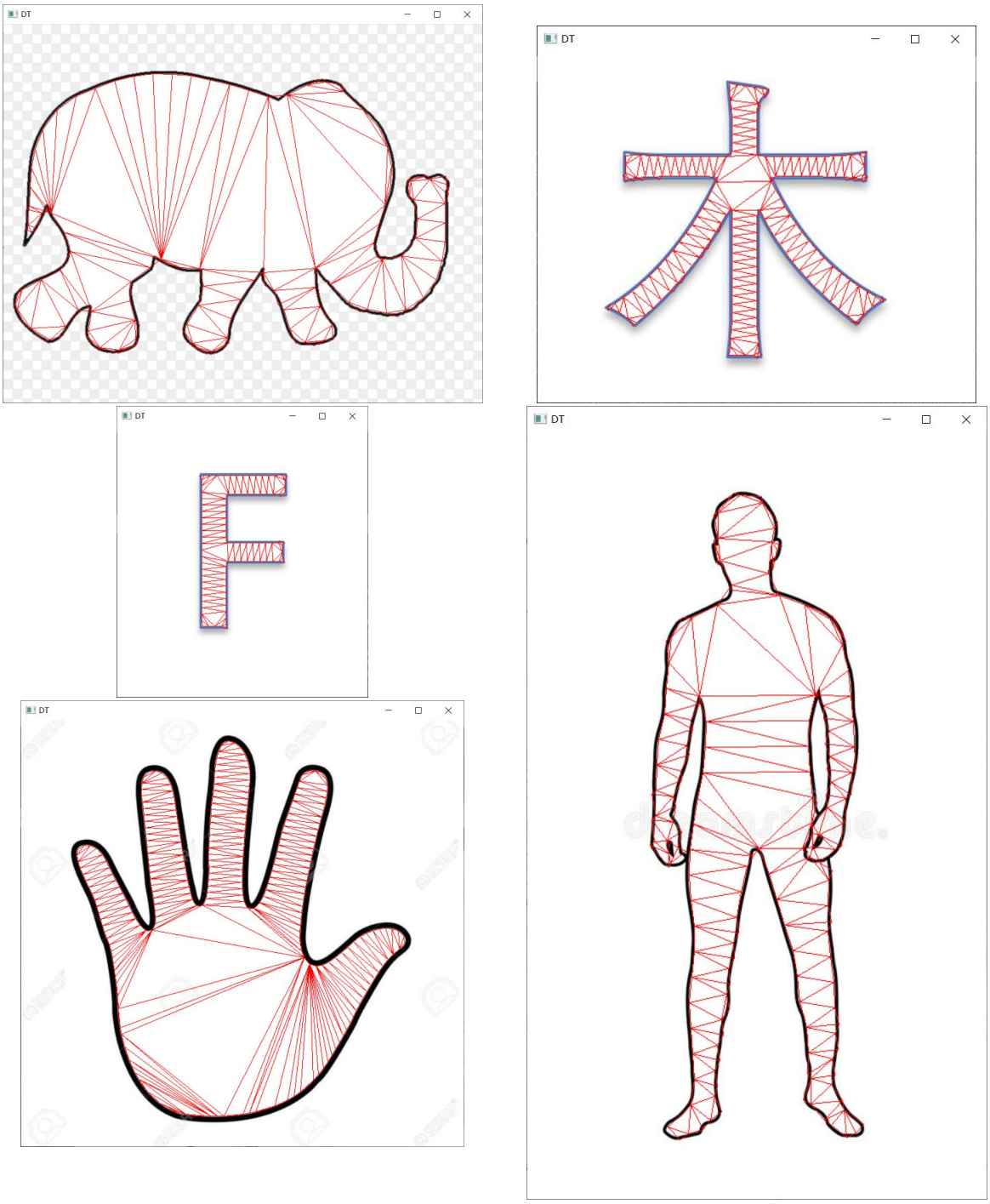


Figure 1: Delaunay Triangulation

2 Chordal Axis Transform

The steps of CAT is as follows:

1. Get the contour points of the image through opencv and sample in these points.
2. Get the 2D Delaunay Triangles for sample points. Traverse the delaunay triangles. For a triangle, consider 2 cases.
   (a) case 1: the triangle only has one edge on the boundary. Compute the mid-points of other 2 edges which are not on the boundary,and connect the mid-points.
   (b) case 2: the triangle has no edge on the boundary. First calculate the center of the circle inscribed in the triangle, that is, the intersection of the three angle bisectors. Then compute the mid-point of each edge. Finally, connect the center with three mid-points.

Result show:

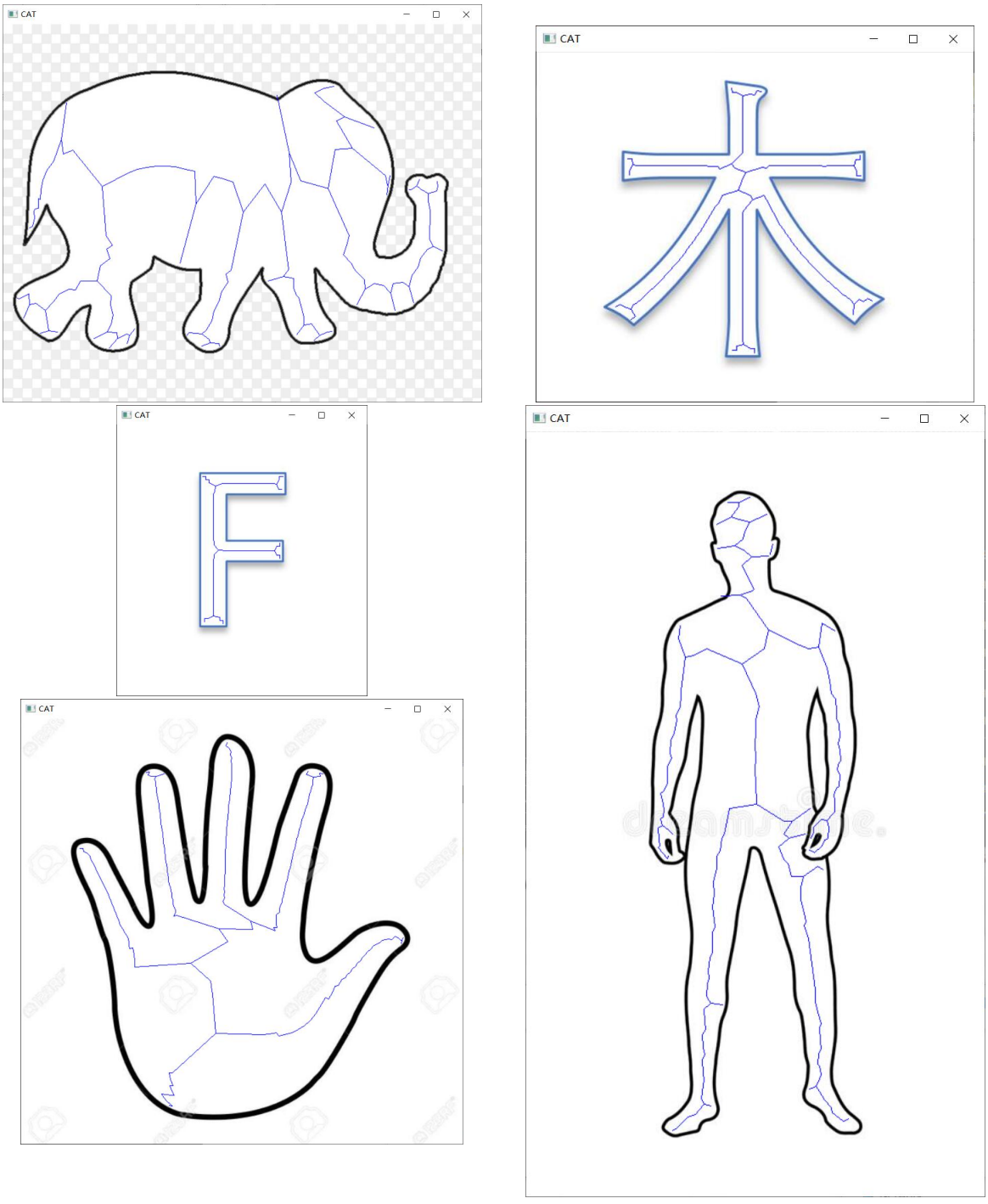
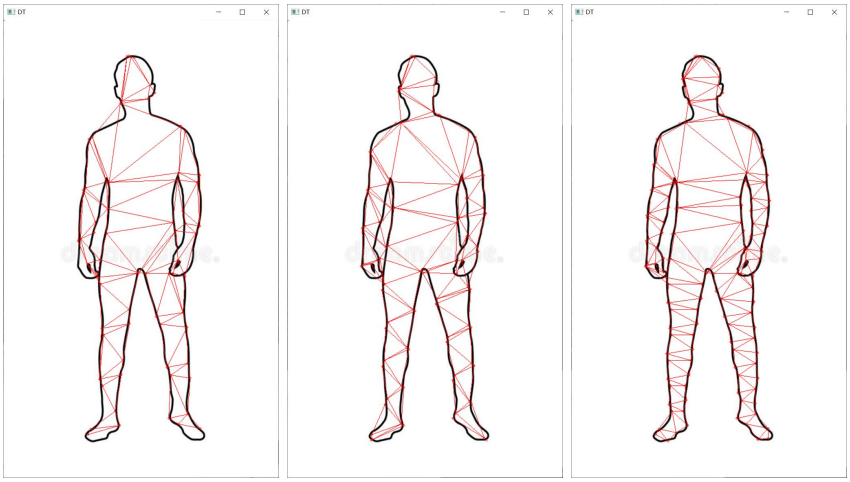


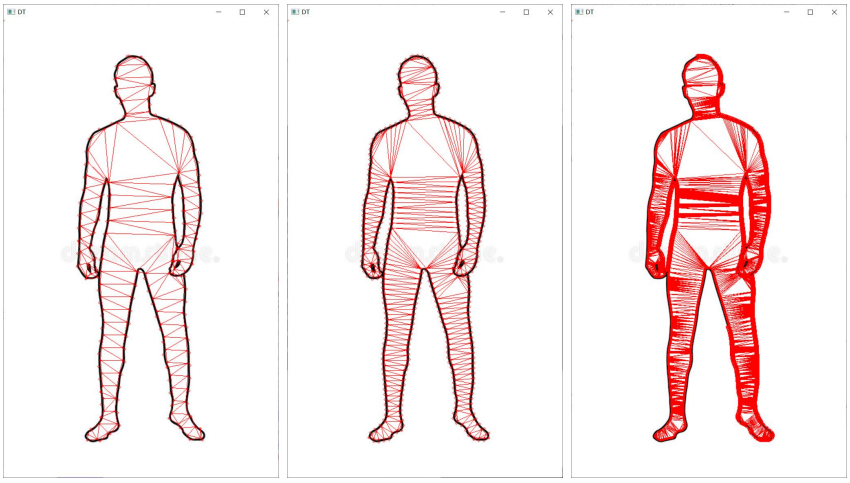
Figure 2: CAT

3 Result analysis

Taking the outline of a human figure as an example, sampling is performed at intervals of 100 points, 75 points, 50 points, 25 points, 10 points, and 1 point. The corresponding Delaunay Triangulation is as the figure 3. The corresponding Delaunay Triangulation is as the figure 3. The corresponding skeleton generated by CAT is as the figure 4. It is obvious that as the density of sampling points increases, the delaunay triangluation covers the original contour more and more perfectly, so the extracted skeleton becomes more and more accurate. Then, there is a limit to the increase in accuracy result from increasing the density of sampling points. For example, the result of sampling every 25 points is very close to the result of sampling every point.

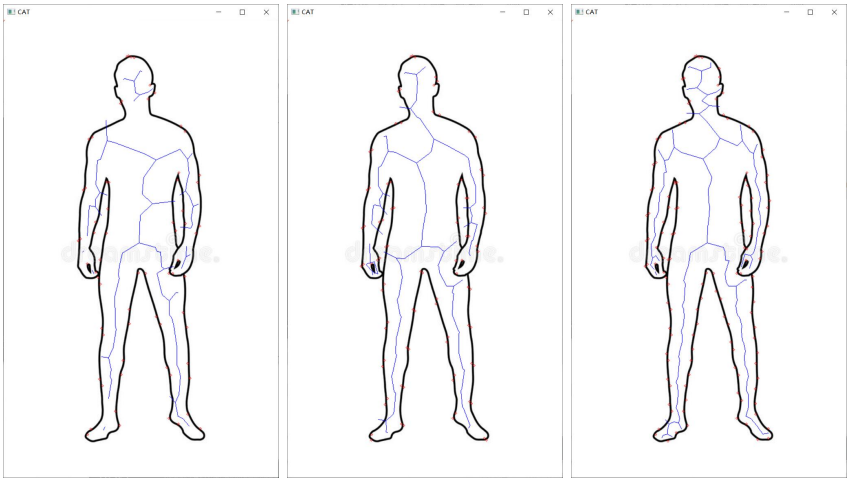


(a) Sampling every 100 points (b) Sampling every 75 points (c) Sampling every 50 points



(d) Sampling every 25 points (e) Sampling every 10 points (f) Sampling every points

Figure 3: DT with different sampling densities



(a) Sampling every 100 points (b) Sampling every 75 points (c) Sampling every 50 points

(d) Sampling every 25 points (e) Sampling every 10 points (f) Sampling every points

Figure 4: CAT with different sampling densities