Curve Reconstruction

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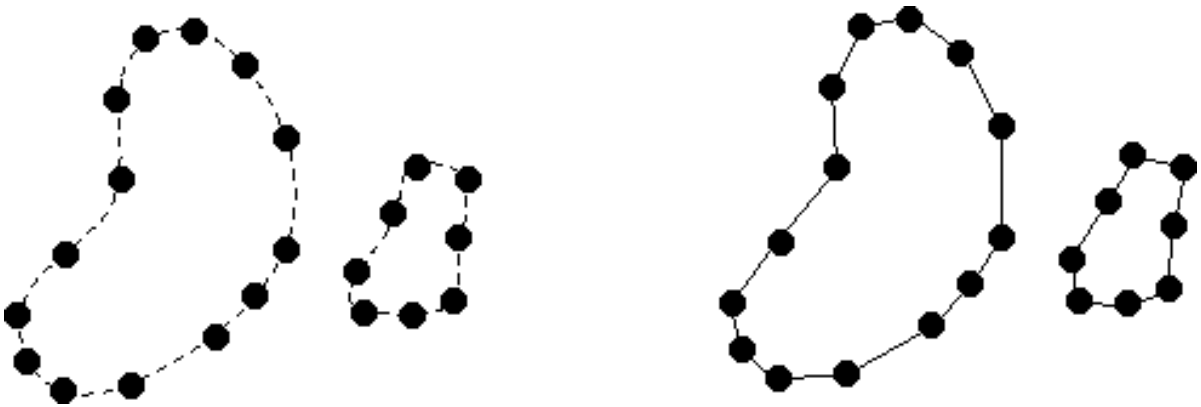
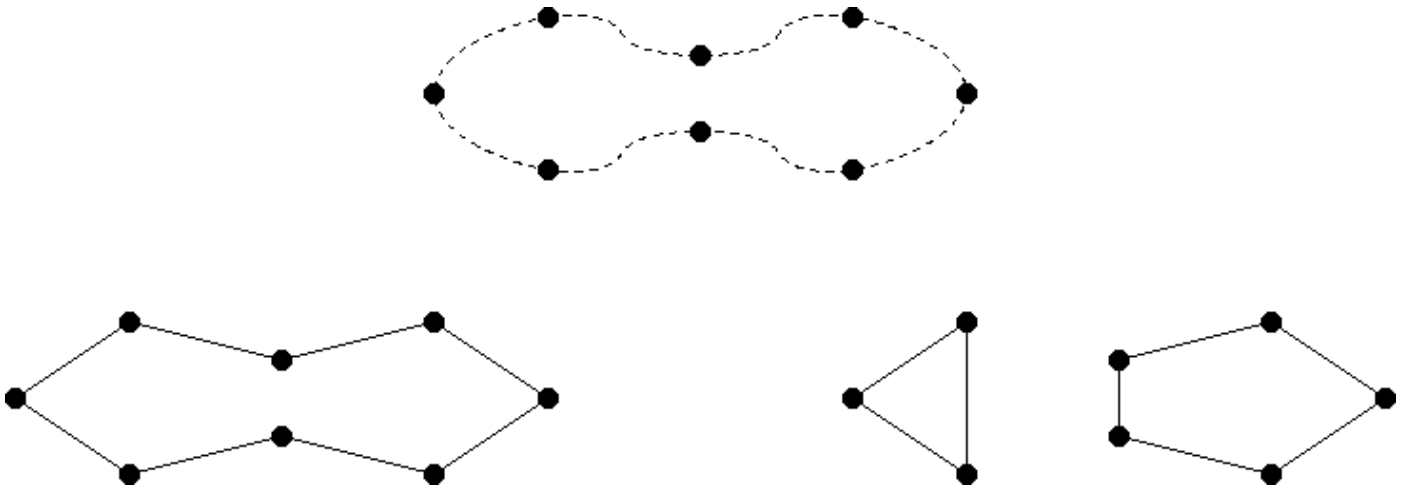
Polygonal Line Reconstruction



The dashed smooth closed curves are unknown. Our goal is to construct the polygonal closed curves on the right to approximate the dashed ones on the left.

Sampling Density



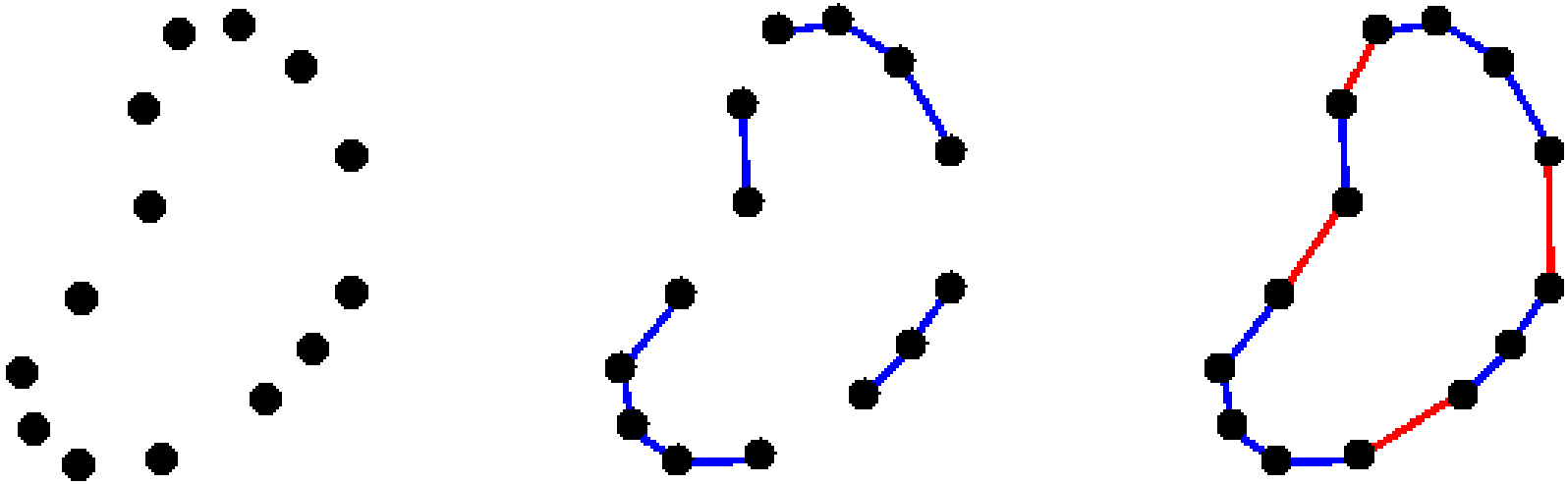
Insufficient point samples can cause ambiguity in the reconstruction process. So we assume that the sampling density is high enough.

Algorithm

NN-Crust(point set S)

1. For each point p in S, connect p to its nearest neighbor. Let N be the set of edges constructed.
2. For each point p in S, if p is incident to only one edge e in N, do the following:
   - Find the nearest point sample q in S such that pq makes an obtuse angle with e.
   - Connect p to q.
3. Let D be the set of edges constructed in step 2. Output all edges in N and D.

Example



Time Complexity

How does the running time vary with the number of input point samples?

Time Complexity

Let n be the number of input point samples in S.

- In stage 1, for each point p in S, we need to scan S again to find sample nearest to p. So for each point p, the number of steps needed is proportional n. Hence, the number of steps in step 1 is proportional to n^2.

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- In stage 2, although we need to perform more calculations for each point p in S, the number of steps needed is still proportional to n. So the number of steps in step 2 is still proportional to n^2.

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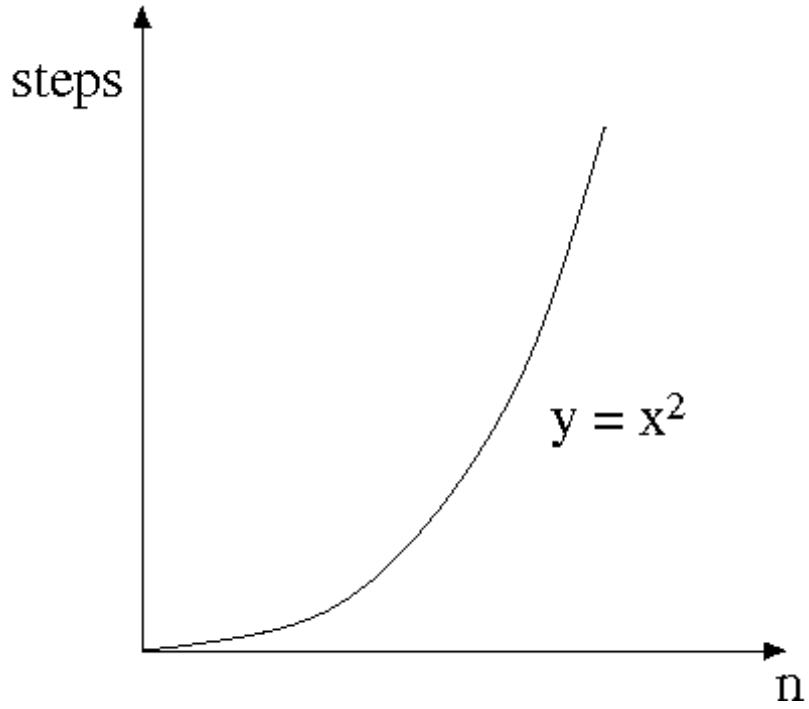
- In stage 2, although we need to perform more calculations for each point p in S, the number of steps needed is still proportional to n. So the number of steps in step 2 is still proportional to n^2.
- Exactly n edges are output in stage 3. So the number of steps needed is proportional to n.

Time Complexity

In all, the total number of steps needed is roughly some constant times n^2.



Open Curves

How do you reconstruct open curves?

Open Curves

Modification of stage 2

For each point p in S, if p is incident to only one edge e in N, do the following:

- Find the nearest point sample q in S such that pq makes an obtuse angle with e.
- If the distance between p and q is at most thrice the length of e, connect p to q. Otherwise, do not connect p to q.