Roundness Algorithms Using the Voronoi Diagrams

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Abstract

The roundness is one of the most important geometric measures for the circular objects. The roundness problem is stated as follows : Given n points in the Euclidean plane, find a center of the concentric circles enclosing all given points between outer and inner circles and minimizing the difference between radii of the outer and inner circles. For this problem, we have never known optimal algorithms whose time complexity is bounded by a polynomial.

In this talk, we present a new optimal roundness algorithm, whose time complexity is bounded by a polynomial. This algorithm is based on the property that the optimal solution for the roundness problem exists only on the vertices in the union of the nearest-point Voronoi diagram and the farthest-point Voronoi diagram. And, we show that the time complexity of this algorithm is $O(n^2)$.

Furthermore, in practical applications, we show that this roundness algorithm can be improved more efficiently by introducing the deletion of the unnecessary points, keeping the optimality. This revised algorithm is based on the idea of the Graham's convex hull algorithm. And, we make it clear that this revised algorithm is very efficient in practical roundness measurements through the computational experiences.