

Topology-oriented Construction of the Voronoi Diagram of Polygons

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Abstract: Voronoi diagram is one of the most fundamental geometric constructs and is well known for its theoretical elegance with diverse applications. Among variations of Voronoi diagram, one for polygon is also of interest with important applications and there were many studies on its efficient construction. However, the algorithmic robustness is hard to achieve for this Voronoi diagram due to the interaction between the inevitable round-off error and topological judgement during the construction. Very few robust codes are currently available. In this study, we introduce a new algorithm to construct the Voronoi diagram of polygon with a higher priority on algorithm robustness followed by numerical accuracy. The algorithm takes advantage of the proven robustness and efficiency of the topology-oriented incremental (TOI) algorithm of disks in the plane. In this regard, we transform a polygon to a set of disks to compute the Voronoi diagram of the disks, say VD-D. Then, we back-transform VD-D to the Voronoi diagram of polygon, say VD-P, by merging some Voronoi cells, inserting and removing some Voronoi edges, and straightening some Voronoi edges. The efficiency of the algorithm depends on the shape of the polygon in that the number of generated disks depend on the shortest edge of the polygon, etc. As the TOI-algorithm for VD-D is proven robust, so is the proposed algorithm for VD-P. The algorithm can easily extend to polygon exterior, disconnected line segments, lines, etc. Polygons may be curved.

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