The Best Restricted Area Technique for Computing the Convex Hull of a Finite Set of Points in $\mathbb{R}^n$

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Abstract: In this talk, we present an efficient algorithm for determining the convex hull of a finite set of points in $\mathbb{R}^n$ space applying the best restricted area technique. This technique is inspired by the Method of Orienting Curves introduced in [1]. This method was used in [2] to improve the main step of the 3D Gift-wrapping algorithm and achieved good results.

The Gift-wrapping algorithm determines the convex hull conv(P) of a finite set of points P. At the beginning it finds a first edge E of conv(P). The next step is to determine a facet F of conv(P) through E. The algorithm then continues finding the facets of the convex hull containing the edges of F until all the points of the initial set are "packed". Thus the main task of the algorithm is to find a facet of conv(P) through a given edge E. In this talk, the restricted area technique is proposed to improve this step. In each step of "packing", for each edge E, we find a point $p \in P$ such that p and E together create a facet of conv(P). To reduce the number of computations, instead of performing on the original space, the authors in [2] performed on the set of P's projection onto a fixed coordinate hyperplane. To reduce more calculations, our technique is to project P onto each coordinate hyperplane and to select the best one according to a criterion called $the\ best\ restricted\ ratio$.

The best restricted area technique is integrated with the Gift-wrapping algorithm into a new algorithm. The numerical experiments on the sets of random points in spaces show that on average the new algorithm is 1.4 and 1.3 times faster than the original Gift-wrapping algorithm and the algorithm in [2], respectively.

References

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