© 2013 FIZ Karlsruhe

io-port 06086357

Hemmer, Michael; Kleinbort, Michal; Halperin, Dan

Improved implementation of point location in general two-dimensional subdivisions.

Epstein, Leah (ed.) et al., Algorithms – ESA 2012. 20th annual European symposium, Ljubljana, Slovenia, September 10–12, 2012. Proceeding. Berlin: Springer (ISBN 978-3-642-33089-6/pbk). Lecture Notes in Computer Science 7501, 611-623 (2012).

Summary: We present a major revamp of the point-location data structure for general two-dimensional subdivisions via randomized incremental construction, implemented in Cgal, the Computational Geometry Algorithms Library. We can now guarantee that the constructed directed acyclic graph $\mathcal{G}$ is of linear size and provides logarithmic query time. Via the construction of the Voronoi diagram for a given point set S of size n, this also enables nearest-neighbor queries in guaranteed $O(\log n)$ time. Another major innovation is the support of general unbounded subdivisions as well as subdivisions of two-dimensional parametric surfaces such as spheres, tori, cylinders. The implementation is exact, complete, and general, i.e., it can also handle non-linear subdivisions. Like the previous version, the data structure supports modifications of the subdivision, such as insertions and deletions of edges, after the initial preprocessing. A major challenge is to retain the expected $O(n \log n)$ preprocessing time while providing the above (deterministic) space and query-time guarantees. We describe efficient preprocessing algorithms, which explicitly verify the length $\mathcal{L}$ of the longest query path. However, instead of using $\mathcal{L}$, our implementation is based on the depth $\mathcal{D}$ of $\mathcal{G}$. Although we prove that the worst case ratio of $\mathcal{D}$ and $\mathcal{L}$ is $\Theta(n/\log n)$, we conjecture, based on our experimental results, that this solution achieves expected $O(n \log n)$ preprocessing time.

doi:10.1007/978-3-642-33090-2_53