Randomized External Memory Algorithms for Some Geometric Problems

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Abstract

We show that the well-known random incremental construction of Clarkson and Shor can be adapted via gradations to provide efficient external memory algorithms for some geometric problems. In particular, as the main result, we obtain an optimal randomized algorithm for the problem of computing the trapezoidal decomposition determined by a set of N line segments in the plane with K pairwise intersections, that requires $\theta(\frac{N}{B} log_{\frac{M}{B}} \frac{N}{B} + \frac{K}{B})$ expected disk accesses(I/O's), where M is the size of the available internal memory and B is the size of the block transfer. The approach is sufficiently general to obtain algorithms for the problems of 2-d and 3-d convex hulls, 2-d abstract Voronoi diagrams and batched point location in a planar subdivision, which require an optimal expected number of I/O's and are simpler than the ones previously known. The results extend to an external-memory model with multiple disks.