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Algorithms for proximity problems in higher dimensions. (English) Zbl 0855.68110

Summary: We present algorithms for five interdistance enumeration problems that take as input a set $S$ of $n$ points in $\mathbb{R}^d$ (for a fixed but arbitrary dimension $d$) and as output enumerate pairs of points in $S$ satisfying various conditions. We present: an $O(n \log n + k)$ time and $O(n)$ space algorithm that takes as additional input a distance $\delta$ and outputs all $k$ pairs of points in $S$ separated by a distance of $\delta$ or less; an $O(n \log n + k \log k)$ time and $O(n)$ space algorithm that enumerates in nondecreasing order the $k$ closest pairs of points in $S$; an $O(n \log n + k)$ time algorithm for the same problem without any order restrictions; an $O(nk \log n)$ time and $O(nk)$ space algorithm that enumerates in nondecreasing order the $nk$ pairs representing the $k$ nearest neighbors of each point in $S$; and an $O(n \log n + kn)$ time algorithm for the same problem without any order restrictions. The algorithms combine a modification of the planar approach of M. T. Dickerson, R. L. S. Drysdale and J.-R. Sack [Int. J. Comput. Geom. Appl. 2, No. 3, 221-239 (1992; Zbl 0759.68033)] with the method of M. Bern, D. Eppstein and J. Gilbert [J. Comput. Syst. Sci. 48, No. 3, 384-409 (1994; Zbl 0799.65119)] for augmenting a point set to have a linear size bounded degree Delaunay triangulation. Thus, in addition to providing new solutions to these problems, the paper also shows how the Delaunay triangulation can be used as the underlying data structure in a unified approach to proximity problems even in higher dimensions.

MSC:

68U05 Computer graphics; computational geometry (digital and algorithmic aspects)

68W10 Parallel algorithms in computer science

Keywords:

Delaunay triangulation

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References:

[7] Callahan, P.B.; Kosaraju, S.R., A decomposition of multi-dimensional point-sets with applications to \textit{k}-nearest-neighbors and n-body potential fields, (), 546-556
[8] Chazelle, B., New techniques for computing order statistics in Euclidean space, (), 125-134
[10] Dickerson, M.; Drysdale, R.L., Enumerating \textit{k} distances for n points in the plane, (), 159-168


[17] Lenhof, H-P; Smid, M., Enumerating the $k$ closest pairs optimally, (), 380-386 · Zbl 0977.68568


[21] Salowe, J.S., Shallow interdistance selection and interdistance enumeration, (), 117-128 · Zbl 0766.68141


[23] Shamos, M.; Hoey, D., Closest point problems, (), 151-162


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