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Ghasemalizadeh, Hossein; Razzazi, Mohammadreza

An improved approximation algorithm for the most points covering problem.

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Summary: In this paper we present a polynomial time approximation scheme for the most points covering problem. In the most points covering problem, n points in $R^2, r > 0$, and an integer $m > 0$ are given and the goal is to cover the maximum number of points with m disks with radius r. The dual of the most points covering problem is the partial covering problem in which n points in R^2 are given, and we try to cover at least $p \leq n$ points of these n points with the minimum number of disks. Both these problems are NP-hard. To solve the most points covering problem, we use the solution of the partial covering problem to obtain an upper bound for the problem and then we generate a valid solution for the most points covering problem by a careful modification of the partial covering solution. We first present an improved approximation algorithm for the partial covering problem which has a better running time than the previous algorithm for this problem. Using this algorithm, we attain a $(1 - \frac{2\varepsilon}{1+\varepsilon})$-approximation algorithm for the most points covering problem. The running time of our algorithm is $O((1+\varepsilon)mn + \epsilon^{-1}n^{4\sqrt{2}\epsilon^{-1}+2})$ which is polynomial with respect to both m and n, whereas the previously known algorithm for this problem runs in $O(n \log n + n\epsilon^{-6m+6} \log(\frac{1}{\epsilon}))$ which is exponential regarding m.

Keywords: geometric covering; most points covering; partial covering; approximation algorithm; computational geometry
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