INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Motivated by the applications in facility location, VLSI design, image processing and motion planning, geometric covering problems have been studied extensively in the literature. In this thesis various geometric covering problems such as covering points with disks, and squares, covering rectangular regions and convex polygonal regions with disks are considered. The problems are investigated by proposing approximation, parameterized and heuristic algorithms. The Discrete Unit Disk Cover (DUDC) problem is one of the well known geometric covering problems. The DUDC problem is a NP-complete problem. We consider the Line-Separable Discrete Unit Disk Cover (LSDUDC) problem as a restricted version of the DUDC problem. We provide a Polynomial Time Approximation Scheme (PTAS) for the LSDUDC problem. Another restricted DUDC problem is called the Within-Strip Discrete Unit Disk Cover (WSDUDC) problem. We propose a $(9+\epsilon)$-approximation algorithm for the DUDC problem ($0<\epsilon\leq 6$) using the proposed PTAS result for the LSDUDC problem, and the current best approximation algorithm for the WSDUDC problem. We also consider another unit disk cover problem, namely the Rectangular Region Cover (RRC) problem. W provide a $(9+\epsilon)$-approximation algorithm for the RRC problem using our algorithm for the DUDC problem. We also consider the RRC problem in a reduced radius setup. We obtain a PTAS for the RRC problem in reduce radius setup using the shifting strategy of Hochbaum and Maass. Discrete Unit Square Cover (DUSC) problem is an L_∞ metric variant (or an L_1 metric variant) of the DUDC problem. We consider a restricted version of the DUSC problem, namely Strip Square Cover (SSC) problem. We first propose an $(1+\frac{2}{k-2})$-approximation algorithm for the SSC problem, then using the result for SSC problem, we propose a $(2+\frac{4}{k-2})$-approximation algorithm for the DUSC problem, where $k (>2)$ is an integer. We also outline a 2-approximation algorithm for the DUSC problem. We consider a constrained variation of the k-center problem for a convex polygon, which is known as the Constrained Convex Polygon Cover (CCPC) problem. For the CCPC problem, we propose $(1+\frac{7}{k}+\frac{7\epsilon}{k}+\epsilon)$-approximation algorithm for an $\epsilon >0$ and an integer $k\ge7$. For the k-supplier problem in $I\!\!R^2$, we propose a fixed parameter tractable (FPT) 2-approximation algorithm, where k is the parameter. We generalize the technique used for developing FPT 2-approximation algorithm to develop a FPT $(1+\epsilon)$-approximation algorithm for the k-supplier problem in $I\!\!R^d$, where d is a positive integer and $\epsilon>0$ is a constant. We also present a heuristic algorithm based on nearest point Voronoi diagram for the Euclidean k-supplier problem in $I\!\!R^2$ and experimentally show that it performs very well. Finally, we make the concluding remarks and indicate a list of future problems.