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Achieving k-Barrier Coverage in Hybrid Directional Sensor Networks

Abstract:

Barrier coverage is a critical issue in wireless sensor networks for security applications (e.g., border protection) where directional sensors (e.g., cameras) are becoming more popular than omni-directional scalar sensors (e.g., microphones). However, barrier coverage cannot be guaranteed after initial random deployment of sensors, especially for directional sensors with limited sensing angles. In this paper, we study how to efficiently use mobile sensors to achieve (k) -barrier coverage. In particular, two problems are studied under two scenarios. First, when only the stationary sensors have been deployed, what is the minimum number of mobile sensors required to form (k) -barrier coverage? Second, when both the stationary and mobile sensors have been pre-deployed, what is the maximum number of barriers that could be formed? To solve these problems, we introduce a novel concept of weighted barrier graph (WBG) and prove that determining the minimum number of mobile sensors required to form (k) -barrier coverage is related with finding (k) vertex-disjoint paths with the minimum total length on the WBG. With this observation, we propose an optimal solution and a greedy solution for each of the two problems. Both analytical and experimental studies demonstrate the effectiveness of the proposed algorithms.