**A Study of Sensor Movement and Selection Strategies for Strong Barrier Coverage**

 Intruder detection and border surveillance are some of the many applications of sensor networks. In these applications, sensors are deployed along the perimeter of a protected area such that no intruder can cross the perimeter without being detected. The arrangement of sensors for this purpose is referred to as the barrier coverage problem in sensor networks. A primary question centering such problem is: “How to achieve barrier coverage?” On the other hand, sensor nodes are usually battery-powered and have limited energy. It is critical to design energy-efficient barrier construction schemes while satisfying the coverage requirement.

 First, we studied how to achieve barrier coverage with mobile sensors. We leverage the mobility of sensors and relocate them to designated destinations to form a strong horizontal barrier after the random deployment. Algorithms were proposed to calculate the optimal relocating destinations such that the maximum moving distance of sensors is minimized. Depending on the number of sensors on the final barrier, two problems are investigated: (1) constructing a barrier with the minimum number of sensors on the final barrier, and (2) constructing a barrier with any number of sensors on the final barrier. For both problems, we optimized the barrier location instead of fixing it a priori as other works. We proposed algorithms which first identify a set of discrete candidates for the barrier location, then check the candidates iteratively. Both problems can be solved in polynomial time.

Second, we investigated how to achieve barrier coverage by selectively activating randomly deployed static sensors. We aim to select the minimum number of sensors to be active to achieve barrier coverage under a practical probabilistic model. The system false alarm probability and detection probability are jointly considered, and a $(P\_{D}^{min}, P\_{F}^{max})$-barrier coverage is defined where $P\_{D}^{min}$ is the minimum system detection probability and $P\_{F}^{max} $is the maximum system false alarm probability. Our analysis showed that with the constraint on system false alarm probability, the number of active sensors affects the detection capability of sensors, which brings new challenge to the min-num sensor selection problem. We proposed an iterative framework to solve the sensor selection problem under the probabilistic model. Depending on whether applying decision fusion among sensors, different detection capability evaluation methods are used in the iterative framework.

 Finally, we studied how to achieve barrier coverage in a hybrid network with a mix of mobile and static sensors. A two-step deployment strategy is adopted where static sensors are first randomly deployed and then mobile sensors are deployed to merge the coverage gap left by the static sensors. We aim to find the proper coverage gaps to deploy mobile sensors such that $(P\_{D}^{min}, P\_{F}^{max})$--barrier coverage is achieved, and the total cost of the barrier is minimized. Under the probabilistic model, we solved the problem by iteratively trying multiple assumptions of the number of active sensors, and obtained the min-cost deployment strategy with the help of graph algorithms.