Chapter 6
Cost Minimization of Sensor Placement and Routing in Wireless Sensor Networks:
Placement and Routing Issues in a Random Plane

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ABSTRACT

Wireless Sensor Nodes (WSNs) are small in size and have limited energy resources. Recent technological advances have facilitated widespread use of wireless sensor networks in many real world applications. In real life situations WSN has to cover an area or monitor a number of nodes on a plane. Sensor node’s coverage range is proportional to their cost, as high cost sensor nodes have higher coverage ranges. The main goal of this paper is to minimize the node placement cost with the help of uniform and non-uniform 2D grid planes. Authors propose a new algorithm for data transformation between strongly connected sensor nodes, based on graph theory.

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INTRODUCTION

While increasing the usage of wireless sensor networks in various applications, data collection and transmission towards Base Station (BS) are important factors. Effective cost of the sensor placement is to be minimized by proper node deployment. Sensors that can accurately detect targets at longer distances have higher cost. However, use of these expensive, long-range sensors may be prohibitive in terms of total placement cost. On the other hand, if only small range sensors are used, effective surveillance can only be achieved with a large number of these sensors. Therefore, efficient sensor placement strategies are necessary to minimize cost and yet achieve mandated levels of surveillance accuracy. Amongst all the topology schemes proposed, grid-based topology management is more effective in terms of energy efficiency and extending network lifetime. Grid-based scheme can be of a uniform grid structure or a non-uniform grid structure. Uniform grid-based routing can be modified to fit in various environments. In comparison, non-uniform grid-based routing is more energy efficient than uniform grid-based routing.

Sensor placement problem is an important not only from the point of view of cost minimization but also in terms of sensor node coverage and connectivity. In this chapter, in contrast to other attempts made in the past, a more realistic non-uniform grid placement for sensor nodes is considered.

LITERATURE REVIEW

The concept of sensor networks which has been made viable by the convergence of microelectro-mechanical systems technology, wireless communications and digital electronics. First, the sensing tasks and the potential sensor networks applications are explored, and a review of factors influencing the design of sensor networks is provided (Akyildiz, Su, Sankarasubramaniam, & Cayirci, 2002). Intuitively, a denser infrastructure would lead to a more effective sensor network. It can provide higher accuracy and has a larger aggregate amount of energy available. However, if not properly managed, a denser network can (Tubaishat & Madria, 2003). The proposed approach is aimed at optimizing the number of sensors and determining their placement to support distributed sensor networks. The optimization framework is inherently probabilistic due to the uncertainty associated with sensor detections. The proposed algorithms address coverage optimization under the constraints of imprecise detections and terrain properties. These algorithms are targeted at average coverage as well as at maximizing the coverage of the most vulnerable grid points. (Dhillon & Chakrabarty, 2003). Asymptotic optimal strip-based pattern, which is
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