Preface

Due to the rapid development of wireless communication and hardware technologies, Wireless Sensor Networks (WSNs) are expected to be applicable in a large range of applications such as environmental surveillance (e.g., air pollution surveillance) and security monitoring (e.g., intrusion detection). One fundamental problem in WSNs is the coverage problem, which is about the placement and/or scheduling of sensors to maximize the quality of sensing in a deployment area, e.g., detect or capture interesting intruders. As technologies advance, practical sensors such as motes and smartdust may have small form factors and low cost. It is feasible to deploy a large number of these sensors for area monitoring. Carefully controlled placements of the sensors may be difficult, due to their large numbers or challenges of the geography. Instead, a loosely controlled method to place the sensors is more popular, which will result in random placements of the sensors. Moreover, unattended operation of the sensor network is often desirable or required. Therefore, there is a need to maximize the lifetime of the network before the sensors run out of energy, while the coverage performance is guaranteed. This problem is widely recognized as the *energy-efficient coverage* problem.

Traditionally, area coverage in WSNs requires that every point in the surveillance region be covered by the deployed sensor network. This definition can work for general applications where the surveillance region is of great interest, however, it is conservative and non-scalable. The coverage performance would not be impaired by a coverage hole as long as no interesting information is missed during the time of coverage hole. This also indicates that coverage performance hinges closely on the unique requirements of applications. There is thus a great potential to exploit the intrinsic characteristics of the applications to enhance both the energy-efficiency and coverage performance. An interesting and important application scenario is intruder detection, where a sensor network is deployed to detect stochastic intruders occurring at some points in the region. In such a scenario, different requirements of intruders capturing (e.g., detecting or tracing the intruders) can be leveraged to significantly enhance the performance.

In this book, we present some recent results on area coverage for intruder detection from an energy-efficient perspective. In Chap. 1, we first introduce the background, elaborate on system models such as the formal definition of area coverage and sensing models, and present a range of existing literatures and applications on area coverage. Then we focus on energy-efficient intruder detection under the well-known binary sensing model in Chap. 2, which specifically is devoted to showing how to improve the energy efficiency without impairing coverage performance by exploiting the dynamic nature of stochastic intruders. In Chap. 3, we proceed to investigate the intruder trapping under binary sensing model. Under such a scenario, any moving intruder will be detected by a sensor network when its movement distance is greater than a predefined constant. The network coverage holes act as traps. Once intruders fall into these traps, it can not get out without being detected. We design efficient algorithms to rotate the duty of each sensor to prolong the network lifetime while the intruder trapping performance is ensured. To investigate the impact of different sensing models, we investigate the intruder trapping under the probabilistic sensing model in Chap. 4. We conclude the book in Chap. 5.

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