

Preface

Wireless Sensor Networks (WSNs) have gained immense popularity due to their low-cost, low-power consumption, light-weight, and advancement in wireless communication and microcontrollers technologies. Monitoring a given Field of Interest (FoI), tracking of the moving objects, and the capture of the events in the FoI are the major applications of WSNs. The sensor nodes autonomously collaborate to track the moving targets, collect the tracking information, process the information, and transmit the information to the destination. This transmission of the information must be energy efficient to prolong the lifetime of the WSNs. This thesis studies the target tracking in a connected WSN with the deterministic deployment of directional sensor nodes.

An important issue of research in WSNs with the regular placement of directional sensor nodes is to minimize the number of sensor nodes required for target tracking in the FoI. Some monitoring applications may require that at least k sensor nodes track a given target and the sensor nodes are m -connected in a WSN, where $k \geq 1$ and $m \geq 1$. The first contribution of the thesis is to solve the k -target tracking and m -connected problem in directional WSNs. We consider equilateral triangle, square, and hexagon deployment patterns, estimate the optimal distance between nodes and tracking direction of the nodes for k -target tracking and m -connectivity of WSNs. We estimate the minimum number of sensor nodes and their locations required for the desired level of target tracking and connectivity. We use the analysis to propose a target tracking system using the proposed analysis for tracking the moving targets in the FoI.

Communication between the sensor nodes in a WSN is another important aspect. The next contribution of the thesis is to solve the problem of estimating the route selection metric, determining a regular sensor node deployment pattern, and locations for tracking the moving targets in an energy-efficient directional WSN. We propose an energy-efficient

routing algorithm by using the estimated route selection metric. The algorithm selects the shortest path for reducing the energy consumption, consider the residual energy for providing the stability of the selected path, and using tracking percent for the maintain the quality of the tracking. The proposed routing algorithm can be integrated with any existing routing protocols.

Finally, we illustrate the impact of the different mobility models on the energy consumption of the network, lifetime of the network, residual energy of sensor nodes in the WSNs. Through simulation analysis, we try to find out the impact of pause time on energy consumption of the network, the impact of velocity on the accuracy of the target tracking system, and impact of direction angle change on the accuracy of target tracking system.