A wireless sensor network is a network of distributed sensor nodes each equipped with its own sensors, computational resources and transceivers. These sensors are designed to be able to sense specific phenomenon over a large geographic area and communicate this information to the user. Most sensor networks are designed to be stand-alone systems that can operate without user intervention for long periods of time. While the use of wireless sensor networks have been demonstrated in various military and commercial applications, their full potential has not been realized primarily due to the lack of efficient methods to self-organize and cover the entire area of interest.

Techniques currently available focus solely on homogenous wireless sensor networks either in terms of static networks or mobile networks and suffers from device specific inadequacies such as lack of coverage, power and fault tolerance. Failing nodes result in coverage loss and breakage in communication connectivity and hence there is a pressing need for a fault tolerance system to allow replacing of the failed nodes. In this dissertation, a unique hybrid sensor network is demonstrated that uses a host of mobile sensor platforms. It is shown that the coverage area of the static sensor network can be improved by self-organizing the mobile sensor platforms to allow interaction with the static sensor nodes and thereby increase the coverage area. For the hybrid sensor network, its performance will be analyzed for a set of N mobile sensors to determine and optimize parameters such as the position of the mobile nodes for maximum coverage of the sensing area without loss of signal between the mobile sensors, static nodes and the central control station.

A novel approach to tracking dynamic targets is also presented. Unlike other tracking methods that are based on computationally complex methods, the strategy adopted in this work is based on a computationally simple but effective technique of Received Signal Strength Indicator measurements. The algorithms developed in this dissertation are based on a number of reasonable assumptions that are easily verified in a densely distributed sensor networks and require simple computations that efficiently tracks the target in the sensor field. False alarm rate, probability of detection and latency is computed and compared with other published techniques. The performance analysis of the tracking system is done on an experimental test-bed and also through simulation and the improvement in accuracy over other methods is demonstrated.

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The public is welcome to attend.