ABSTRACT

This thesis addresses the problem of using distributed sensing for automatically inferring a representation of the environment, *i.e.* a map, that can be useful for the self-calibration of intelligence systems, such as sensor networks. The information recovered by such a process allows typical applications such as data collection and navigation to proceed without labour intensive input from a human technician. Simplifying the deployment of large scale sensor networks and other intelligent systems will effectively reduce their cost and improve their widespread availability and hence aid their practical application to tasks such as the monitoring of carbon emissions and greenhouse gases.

In our research we focus on algorithms and techniques for recovering two types of information from the immediate environment: topology information that indicates physical connectivity between regions of interest from the point of view of a navigating agent; and a probability distribution function (PDF) describing the position of components of the intelligent system. We consider situations where data is collected from systems that comprise of: a number of stationary network components; stationary network components augmented with a mobile robot; or a mobile robot only. Our approaches are, for the most part, based on statistical methods that employ stochastic sampling techniques to provide approximate solutions to problems for which computing the optimal or exact solution is intractable. Numerical simulations and experiments conducted on hardware suggest that this research has promising real world applications in the area of sensor network self-configuration.