AN ALGORITHM FOR NETWORK FORMATION AND AN IMPLEMENTATION OF A MOBILE ROBOTIC ROUTER SYSTEM

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ABSTRACT

Evidence of the prevalence of wireless networking devices can be seen everywhere. These days, more and more consumer electronics are being released with the ability to communicate with each other, free from the limitations of wires and restricted only by distance. These advances have also greatly helped with the mobile robotics field as well. Many algorithms can now move from computer simulations to real robotic systems, helping to develop practical applications that solve important problems involving multiple robot.

This thesis explores two problems in networked robotics. Its contributions are organized in two parts.

The first part of this thesis addresses the following problem: imagine a number of robots, with unknown locations, are scattered in an environment. How can a network be formed as quickly as possible? The thesis takes a theoretical approach to this problem of network formation by presenting a novel network formation algorithm and analyzing its performance. The algorithm developed is then contrasted and compared to another algorithm that has a more intuitive, but not necessarily more efficient, approach. The performance bounds of these two algorithms are analyzed and compared from both a mathematical standpoint and in computer simulations. A proof-of-concept implementation on a real system is also presented.

In the second part of the thesis, a networked mobile robot system that provides connectivity services to mobile users is developed. This part of the thesis takes a systems approach and presents the details of a full implementation of two algorithms for connectivity maintanence.

From a high level, it explores the challenges faced when implementing a system to test and run simulated algorithms. It also covers different routing techniques that can be used to control a set of distributed robots. From a low level, it looks at the different networking and development technologies that are needed to develop a working system.

These two levels, when combined, cover every stage of a networking algorithm's development process: from analysis to simulation and even implementation. This thesis also covers the entire application life-cycle of a networked robotics system from the initial network formation to maintaining network connections in order to collectivity accomplish a given task.