Chapter 53
New Approach to Optimize Cooperation Mobile Robots for Ideal Coverage with an Architecture Designed with Multi-Agent Systems

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ABSTRACT

Mobile Robotics have taken an ever increasing role in everyday life in the past few years. The main objective often reflected in research is to try to have an optimal cooperation between the different robots to achieve a given objective. This cooperation allows one to have optimal solutions for sharing and resolving conflicts. This article proposes a solution to solve the problem of the coverage in environment with obstacles and the cooperation between several mobile robots. The authors developed a heuristic algorithm to optimize the coverage in a multi-robot system, while maintaining the connection between the robots. The proposed algorithm is based on the propagation of the robots as a function of the expansion of a wave in a uniform manner. The authors also integrate a self-reorientation approach to failure if a robot becomes out of race. Finally, this approach is modelled with the ADMs.

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PROBLEM STATEMENT

Recent advances in the field of mobile robotics has led to many interesting results on the uses of robots in several areas, regardless of their number in each mission. Using one or more robots is relevant to the task. However, recently the multi-robots have highly experienced increased attention because of their performance compared to a single robot. Cooperation and coordination between the different members tend to improve their performance. Many applications use the multi-robot: rescuing survivors during natural disasters, surveillance in several environments and monitoring in areas contaminated by nuclear or chemical waste, etc.

Concerning the above-mentioned tasks, the coverage is the common problem with each other. In order to have optimal coverage area, the proposed method needs to reach two important questions: Maximizing Team coverage area of robots and maintaining connectivity between robots. In the first problem, the team members deployed randomly, they cooperate to maximize network coverage. The robots communicate to achieve the most appropriate positions, reducing the distance travelled and optimized network deployment. In the second issue, the authors expect to maintain connectivity of botnet in the hedging process and construction of the optimal network connected robot, even if there are robot failures.

The authors have attempted to find a solution to both problems. Initially, mobile robots deployed randomly. Each autonomous robot reacts to navigate; it communicates and cooperates to specify the next destination.

The main contribution of this paper is to address the problem of coverage and maintaining connectivity. The solution envisaged is to maximize the coverage area using multiple robots and maintain connectivity. Moreover, it is necessary to have optimal deployment in less time and less movement. These two features are very important in these cases: the search and rescue missions, etc. and maintaining connectivity between mobile robots during their redeployment guaranteed, the authors have also presented a solution in case of failure robots. This document in addition provides an efficient algorithm that minimizes general messages related to:

- Local calls of each robot;
- Each mobile robot executes the process once.

The results of the simulation, which includes one method and comparison to other methods, the solution validate and prove the efficiency of the algorithm proposed.

RELATED WORK

Various searches were performed in the literature considering the multi-robot cooperation issues, particularly the problem of coverage but also for exploration Baglietto et al. (2002) and Yuan et al. (2010). On the topic coverage problem, many researchers show how to increase the coverage area and how to maintain connectivity. The authors of Mathews et al. (2012) decompose existing solutions of this problem based on force Voronoi and behavior. The research presented by Mathews et al. (2012) simulates the behavior of a swarm of fish that remain as a group. In Mathews et al. (2012), three rules used to determine strengths: the separation force, the cohesive force and the alignment force (neighbours).

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