An Analysis of the Behaviors of Multiple Robots that Implement Ant Colony Clustering Using Mobile Agents

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Abstract

This paper demonstrates that a framework for controlling mobile multiple robots connected by communication networks contributes energy saving for mobile multiple robots. This framework provides novel methods to control coordinated systems using mobile agents. Instead of physical movement of multi-robots, mobile software agents can migrate from one robot to another so that they can minimize energy consumption in aggregation. The imaginary application is making "carts," such as found in large airports, intelligent. Travelers pick up carts at designated points but leave them arbitrary places. It is a considerable task to re-collect them. It is, therefore, desirable that intelligent carts (intelligent robots) draw themselves together automatically. Simple implementation may be making each cart has a designated assembly point, and when they are free, automatically return to those points. It is easy to implement, but some carts have to travel very long way back home even though it is located close to some other assembly points. It consumes too much unnecessary energy so that the carts have to have expensive batteries. In order to ameliorate the situation, we employ mobile software agents to locate robots scattered in a field, e.g. an airport, and make them autonomously determine their moving behaviors by using a clustering algorithm based on the Ant Colony Optimization (ACO). ACO is the swarm intelligence-based methods, and a multi-agent system that exploit artificial stigmergy for the solution of combinatorial optimization problems. Preliminary experiments have provided a favorable result. In this paper, we demonstrate the total distances of traveling mobile multiple robots can be much shorter than that of a simple multi-robot implementation through simulation. The simulation system consists of mobile software agents and objects as simulated mobile multiple robots. Java multi-threads implement both of them.