ABSTRACT

Swarm Intelligence has been proposed based on the observation of social behavior of insect species and birds. The main idea of this collective behavior is to perform a complex task decomposing it into many simple tasks, that can be easily performed by individuals of the swarm. Coordinated realization of these simple tasks while adhering to a pre-defined distribution of execution, allows for the achievement of the original complex task. The problem of task allocation arises from the need of assigning tasks to individuals in a coordinated fashion, allowing a good management of the swarm. Task allocation is a dynamic process because it requires a continuous adjustment in response to changes in the environment, the swarm configuration and/or the performance of the swarm. Swarm robotics emerges from this context of collective cooperation applied to swarms of real robots. In this approach, complex problems are solved by performing complex tasks using swarms of simple robots, with a limited processing and communication capabilities. Aiming at achieving flexibility and reliability, the allocation should emerge as a result of a distributed process. With the decentralization of the problem and the increasing number of robots in the swarm, the allocation process acquires a high complexity. Thus, the problem of task allocation can be characterized as an optimization process that assigns tasks to robots, so that the desired proportion is met at the end of the optimization process, find the desired solution. In this dissertation, we propose two algorithms that follow different to the problem of dynamic task allocation approaches: one is local and the other global. The algorithm for dynamic allocation of tasks with a local approach (ADTL) updates the task assignment of each robot based on a deterministic assessment of the current knowledge it has so far about the tasks allocated to the other robots of the swarm. The algorithm for dynamic task allocation with a global approach (ADTG) updates the allocation of tasks based on a swarm optimization process, inspired by PSO. In ADTG, each robot has a possible solution to the swarm allocation, which is continuously updated through the exchange of information between the robots. The allocations are evaluated for their fitness in meeting the goal proportion. When the allocation of highest fitness in the swarm is identified, all robots of the swarm are allocated to the tasks defined by this allocation. The proposed algorithms were implemented on swarms of different arrangements of real robots demonstrating their efficacy, robustness and efficiency, certified by obtained the results.

Keywords: Dynamic task allocation, swarm robotics, distributed computing, swarm intelligence.