Mohammed VI Polytechnic University (UM6P)
International Artificial Intelligence Center of Morocco (Ai movement)

Reinforcement Learning for Collaborative Heterogeneous Swarm in a Partially Known Environment

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1 Research Motivation

Unmanned systems are gaining popularity in a variety of applications including environmental monitoring, space exploration, surveillance, patrolling, search and rescue, and the discovery of natural resources [1]. These systems are often heterogeneous, combining Unmanned areal vehicles (UAVs) and unmanned ground vehicles (UGVs). UGVs are generally deployed to perform on ground operations over a wide variety of terrain scenarios, acting instead of human agents. Instead, UAVs are used to cover large areas searching for targets. This hybrid architecture allows the deployment of complementary sensors to ensure a rich data collection experience[2, 3].

To perform a given task, all vehicles in the system can act as a swarm, collaborating toward a single objective. This artificial swarm intelligence is inspired by biological systems. The challenge nowadays is to develop advanced heterogeneous swarm intelligence systems for different environments.

2 Problem Statement

Performing high-level missions request a judicious task allocation ability among the available vehicles, depending on their characteristics and capacities. This implies that each agent must coordinate with the other agents to successfully execute the excepted mission.

The task is even more complicated in the case of partially known environment, where each agent only have limited knowledge about the environment dynamics. In this case, automated planning is often incapable of formulating optimized solution plans[4].

3 Research Scope

Recent advancements in intelligent ML techniques for robotics have led to improved functionality in robot assemblies, the ability to make informed and coordinated decisions, and an overall improvement in the efficiency of the entire fleet. Thus, a planning process based on a rich learning mechanism can

improve the generation of solution plans and broadcast specific learned information to the entire fleet about the environment dynamics.
During this thesis, we aim at producing a collaborative fleet of mobile robots that can learn the dynamics of the environment and share this knowledge among themselves. The scheme needs to take into consideration potential communication issues and architectural differences between aerial and ground vehicles. To this end, each agent shall enrich its inner model with information extracted from the past experiences of the executions of actions and from the observations and other knowledge shared by the other robots.

4 Admission Criteria

The PhD position is proposed by the International Center of Artificial Intelligence of Morocco, of the Mohammed VI Polytechnic University.

Applicants with excellent cursus must be holders of a Master's, an engineering or an equivalent recognized degree in Industrial Engineering or Computer Science. In addition, they should have skills in Programming (Python and C++) and good communication skills in English. Particular attention will be given to the suitability of this research project with the applicant's background.

References

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