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

Multi-agent Energy trading for Unmanned Aerial Vehicles and Mobile Charging Stations

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1 Research Motivation

Drones or Unmanned Aerial Vehicles (UAVs) can be highly efficient in a broad spectrum of applications including surveillance, disaster management, goods delivery, network management, and industrial inspections. Generally, the deployment of multiple cooperating UAVs is more interesting, especially to accomplish complex tasks that are impossible or non-optimal using a standalone UAV. Indeed, these multi-robot platforms are more efficient in performing real-time and scalable tasks.

The deployment of UAV swarm applications mainly depends on their ability to maintain an acceptable battery level while ensuring the continuity of the mission. Several power sources have been considered including solar and hydrogen energy, but rechargeable batteries remain to be the main power sources of drones. Thus, such systems need to be designed in a way to meet specific flight time requirement based on battery recharging strategies.

2 Problem Statement

One of the main constraints related to electrically powered UAVs is their inability to operate for a long time [1, 2]. Indeed, most commercially available aerial vehicles can only achieve up to 33 Km of flight time. The problem is more prominent for applications where the integration of different sensors or robotic arms is needed. These add-ons worsen the battery drain and directly affect the airborne operation time. The limited battery capacity is also correlated to the limitation in terms of battery weight on board. Several authors proposed different approaches to optimize intermediate charging aiming to prolong the UAV mission duration [3].

3 Research Scope

We propose to propose an Ai-powered recharging system, where the UAVs and the charging stations are viewed as a multi-agent system. The goal is for the agents to ensure run the continuity-of-service without the user's involvement in the recharging process. We aim at having a mix of fixed and mobile autonomous relay charging stations that can fulfill special charging needs. The system design needs to take into consideration autonomous flight and adaptation during the recharging process, obstacle detection, and avoidance, and recovering mechanisms to tackle communication loss.

4 Admission Criteria

The PhD position is proposed by the International Center of Artificial Intelligence of Morocco, of the Mohammed VI Polytechnic University. Applicants must be holders of a Master's, an engineering or an equivalent recognized degree in Computer Science, Electrical Engineering or Applied Mathematics. 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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[3] Myounggyu Won. Ubat: On jointly optimizing uav trajectories and placement of battery swap stations. 10 2019.