Swarm Defense Strategies through Self-Play in Multi-Agent Reinforcement Learning

Supervisors

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Context

In today's ever-evolving world of autonomous systems, the combination of multiagent reinforcement learning (MARL) and self-play techniques presents a promising approach to tackle complex and dynamic adversarial scenarios. This project proposal aims to use self-play in adversarial contexts, employing MARL to enable a swarm of drones to independently defend a predefined zone against an invading swarm.
Current methods for designing swarming and defence strategies often rely on manually created algorithms, which can be inflexible and struggle to adapt to changing situations.

PhD subject

To solve such an issue, the core innovation of this project proposes integrating MARL, allowing swarming drones to learn and adapt in an adversarial environment.
In this setup, multiple agents will learn to defend against a set of manually crafted strategies. By learning, our approach enables the quick development of new, unseen strategies capable of outperforming most of the strategies in the predefined set.

In the subsequent phase, self-play comes into play, allowing the defending swarm to discover innovative strategies that can adapt to a variety of threats, rather than being constrained by a fixed set of adversary strategies. Self-play should enhance the diversity of training scenarios and encourage the exploration of fresh defence tactics, resulting in more flexible and robust swarm defence strategies.

The expected outcomes of this project include the development of advanced autonomous defence systems that can adapt and evolve their strategies in real-time, ensuring the safety and security of the defended zone.

Condition

The PhD will take place at ISL and at Luxembourg University. The objective is to first test the obtained swarming algorithms indoor with the Crazyflie facility, and then to test the algorithms outdoor.