Adaptive Multi-Agent Path Planning for Distributed UAV Systems

CS 229 Autumn 2017 Final Project
Category: Physical Sciences

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Project Proposal

In recent years, unmanned aerial vehicles (UAVs) have become increasingly prevalent in the modern world. These systems are used for a wide variety of applications, from recreation and entertainment to warfare and espionage. Generally speaking, UAVs are favored for their low cost and low risk, not to mention their ability to execute tasks in environments which might be inaccessible or dangerous to humans.

In tactical scenarios, there is an increased demand for the use of cooperative, distributed systems of UAVs which enable more complex and larger objectives. Oftentimes, these systems require the use of centralized, human-in-the-loop control approaches to accomplish their goals which may be slow, inaccurate, and computationally intensive. As a result, autonomy and decentralization are desirable traits for any such system of UAVs.

The need for these decentralized learning techniques has been identified as an area of need by Area-I, a UAV startup. In this work a learning based path planning will be created and then compared to a more traditional scoring based optimization planning algorithm currently used by Area-I.

The goal will be to for the UAVs to learn how to navigate in a contested environment that is unknown to the UAVs initially. It is proposed to use reinforcement learning to train these UAVs over thousands of simulated missions. Missions will contain different surveillance target layouts and the UAVs will learn from their experiences across this range of scenarios. The UAVs' path planning will be rewarded for surveillance information returned to the controller and penalized for loss of UAVs.

To generate relevant mission data, the ATE2 simulation platform developed by the USAF will be used [1]. This simulator can programatically generate tactical scenarios within which simulated UAVs can interact and learn. In addition, this environment can simulate entire missions, including all the relevant jamming, observation, and performance information of the UAVs and targets.

References

[1] U.S. Air Force. Air Force Materiel Command. (2017). Resilient Autonomous Systems (RAS) (Solicitation No. BAA-AFRL-RIK-2016-0005). Rome, NY