Learning Consensus in Adversarial Environments

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Abstract

Due to the highly uncertain and dynamic nature of military conflict, enabling autonomous agents to gracefully adapt to mission and environmental changes is a very challenging task. These capabilities are necessary in the asymmetric battles waged against insurgencies, where enemy combatants quickly adapt to Army strategies and tactics. The United States Army, Air Force, and Navy have recently shown interest in the cyber security aspect of UAVs and UAGs, which rely heavily on their on-board autopilots and controllers to function. Most of the currently available autopilot systems were built without cyber security considerations, and are thus vulnerable to cyber attacks. This research provides knowledge to the problem of commanding multiple tactical assets in military and adversarial environments, attending Army's expectations that networked teams will perform in a reliable manner especially when being attacked by advanced and persistent threats.

This work presents a game theory-based consensus problem for leaderless multi-agent systems in the presence of adversarial inputs that are corrupting the measurements. Given the presence of enemy components and the possibility of malicious cyber attacks compromising the security of networked teams, a velocity and position agreement must be reached by the networked mobile team based on environmental changes. The problem is addressed under a distributed decision making framework that is robust to possible cyber attacks, which has an advantage over centralized decision making in the sense that a decision maker is not required to access information from all the other decision makers. The proposed framework derives three tuning laws for every agent; one associated with the cost, one associated with the controller, and one with the adversarial input.

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