AFRL/RW University Day Research Topic 2025

RA 17: Weapon Autonomy and Control Technology Research

Research Title: Computationally efficient, intelligent guidance and control algorithms

Academic Area/Field Education Level: Autonomous Systems, Optimal Control Theory, (MS or PhD)

Project Description

Introduction:

AFRL/RW is interested in developing and demonstrating intelligent guidance and control (G&C) algorithms that enable novel agent behaviors in complex environments. Computationally efficient algorithms are required to support large, multi-agent, heterogeneous teams and enable networked, collaborative, and autonomous system concepts. The limited communication in complex environments will require decentralized approaches that enable context-aware reasoning, agent collaboration, graceful performance degradation, and flexible or reconfigurable operation. Approaches with a focus on optimization theory, machine-learning methods, and/or multi-agent guidance concepts are highly desired. Finally, resilient solutions that allow for disaggregated system performance (capability spread across multiple agents that coordinate to deliver desired performance) are also sought.

Proposed Research:

The overall objectives of the proposed research are to (1) gain the engineering knowledge needed to understand and address the technical challenges associated with autonomous operations in complex and unpredictable environments, (2) develop intelligent G&C algorithms capable of safely operating in these environments, and (3) demonstrating algorithm performance in a military and/or public use application. AFRL/RW is looking for approaches that have yet to be considered or examined. An example of a task under this effort would involve surveying existing literature on autonomous system behaviors, developing and documenting the theoretical background for a novel intelligent algorithm, and demonstrating/verifying theoretical performance and computational efficiency guarantees in a relevant environment (i.e., 3DoF/6DoF numerical simulation.) The project could then conclude with future recommendations on maturation paths and additional military/public use applications.