

ABSTRACT

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“Findings and Lessons Learned about Trustworthiness and Trust in
Autonomous Multi-Agent Systems from NASA’s ATTRACTOR Project”

Bootstrapping Multi-Agent Unmanned Aerial Vehicle (UAV) System Integration Using Ground-Based Assets: Lessons Learned

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The highly dynamic nature of UAVs imposes significant challenges when conducting initial testing ranging from safety risks posed by high-capacity lithium batteries and spinning propellers to rigorous timing demands on controllers and the consequences of failures mid-air. Flight testing of a single vehicle is time and labor intensive due to these challenges and more, and the complexity increases exponentially with the number of vehicles. While simulations and hardware-in-the-loop bench testing can provide adequate environments for preliminary validation, differences in system deployment architecture, software interfaces, and hardware infrastructure between simulation and a fleet of real UAVs create a sizable gap that must be navigated carefully during system integration. In support of the Autonomy Teaming and TRAjectories for Complex Trusted Operational Reliability (ATTRACTOR) project, which had the goal of establishing a basis of certification of trust and trustworthiness in multi-agent autonomous systems, this gap was tackled from two directions. First, a novel mixed-reality simulation environment was engineered to blur the transition from simulation to flight hardware. Second, a fleet of Unmanned Surface Vehicles (USVs) was developed as a test and evaluation platform that more closely represented the final aerial fleet while eliminating many of the risks associated with air vehicles. This paper delves into the second element, analyzing the efficacy of the USV platform in performing system integration testing for the UAV system.

In this paper we present the USV fleet and its role in reducing the aforementioned gaps in deployment architecture, software interfaces, and hardware infrastructure when moving from simulation to flight. An overview of the hardware and software onboard the vehicles will be provided along with supporting infrastructure. The system integration process will be documented including results in supporting both the overarching design reference mission (DRM) of ATTRACTOR and individual research efforts conducted during the project. Finally, we will discuss some of the practical lessons learned regarding the testing, deployment, and operation of multi-agent autonomous systems.

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