Unmanned Surface Systems Collaborative Experimentation

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Abstract
Lockheed Martin Advanced Technology Laboratories has been performing collaborative unmanned surface and unmanned air vehicle (USV and UAV, respectively) experiments in cooperation with the U.S. Navy. This multi-domain collaborative research focused on extending unmanned vehicles into useful partners in maritime security utilizing intelligent onboard behaviors, collaborative control, and efficient human-system interfacing in situations involving narrow and medium communications mediums.

This experimentation based research provided the ability to command unmanned assets from various user locations and transition control between distant users. This has been combined with advanced onboard autonomy allowing high-level complex missions to be executed without human intervention. The Unmanned Surface Vehicles (USVs) started their life as commercial boats and were quickly adapting for autonomous operations based on similar approaches that were used in the DARPA Urban Challenge event. The USVs are capable of adaptable missions, reacting to obstacles in their environment, and providing video-based imagery of objects in the environment. The USVs are capable of carrying out their missions with or without communications from the command center. This paper discusses the lessons learned on the components of the collaborative unmanned surface operations.

Motivation and Objectives
USV research has two foci: enhancing technology for autonomous surface operations and influencing the concept of operations for the use of USV operations with limited or—preferably—no human intervention. This involves the increase in USV capabilities to perform autonomous mission operations through low-level decision making, coupled with well-structured experimentation that will collect a set of operational metrics to validate operational utility and progressively increase performance of the USV system. Another objective is reduced manpower required for operating the USVs. We pursue this objective by incorporating in our experimental methodology elements that enable us to gauge the required manpower relative to current systems.

These objectives are supplemented by the desire to explore the edge of the envelope in current single and multiple USV operations. Because much of this area is still unexplored from an operational perspective, operational users were brought in to keep the research and experimen-
tation relevant to today’s and tomorrow’s concepts of operations that can utilize unmanned surface vehicles as part of a manned / unmanned teaming operation. These users not only provide feedback on the operational utility of the USV system but also provide input in areas where technology and capabilities could be enhanced to improve operational utility. Further, incorporating these users allows them to explore the possibilities for new operational concepts that are opened up by advances in technology. This “double helix” effect of intertwining development of technology with development of new concepts of operation is a central element of Lockheed Martin’s experimentation-based approach to unmanned systems development.