Department of the Navy SBIR/STTR Transition Program

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ONR Approval #43-5839-19

Topic # N17A-T029

Multi-vehicle Collaboration with Minimal Communications and Minimal Energy

Orbit Logic Incorporated

WHO

SYSCOM: ONR

Sponsoring Program: ONR - Office of Naval Research: Division 351, Aerospace Science Research and Division 321, Ocean Sensing and Systems Applications

Transition Target:

TPOC:
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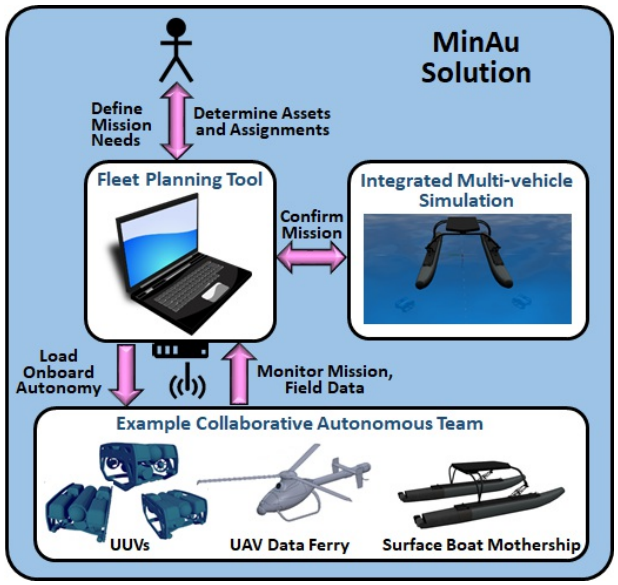
Other transition opportunities: MCM (Mine Counter-Measures), Sea Floor Mapping/Survey, Undersea Search/Repair/Recovery, Port and Hull Inspection, Marine Husbandry (cleaning to improve vessel fuel economy).

Notes: The MinAu solution consists of a Fleet Planning Tool, a simulation environment and Software to run onboard autonomous vehicles of various types.



WHAT

Operational Need and Improvement: Currently the primary impediments to accomplishing naval Unmanned Underwater Vehicle (UUV) missions effectively include; significant divergences of operating conditions from what was expected/predicted at the time of mission composition,and inherent variability/difficulty in exchanging information between the cooperating vehicles due to the challenges of the underwater environment. Both factors can significantly impact the expenditure of energy of the individual assets, at the expense of maximizing mission objectives. The MinAu solution addresses these challenges through the application of intelligent onboard software that can adapt UUV operations to achieve better results in highly dynamic environments.

Specifications Required: MinAu's front-end Fleet Planning Tool runs on Windows PCs, including ruggedized laptops in support of in-field operations. The onboard autonomous software that the Fleet Tool deploys to individual assets is a modular and highly configurable commercial software product solution compatible with the Robot Operating System (ROS) open data messaging standard. This allows straightforward integration with legacy and future systems by the end user, using a translation layer made available with the product.

Technology Developed: The MinAu solution consists of two primary software elements. A pre-mission Fleet Planning Tool allows the user to define mission objectives, then determines a team of cooperating assets that can achieve the mission given pre-deployment assumptions/information. An initial optimized plan is generated, which assigns tasks to each team member to accomplish mission objectives as effectively as possible while minimizing the use of energy and inter-asset communications. The Fleet Tool pushes the software load to the vehicle team in preparation for deployment. On mission, MinAu employs decision-making and re-planning to determine how to best reassign assets to maximize overall mission effectiveness when systems degrade/fail or unanticipated events/conditions are encountered.

Warfighter Value: Fleet Planning Tool facilitates rapid determination and configuration of a vehicle team to accomplish a specific mission need, allowing faster call-up of capabilities in response to needs. Employing collaborative onboard autonomy to execute multi-vehicle missions eases workload of operators, enhances mission effectiveness through asset-level decision making that can adapt mission activities immediately and without the need for operator intervention.

WHEN

Contract Number: N68335-19-C-0076 **Ending on:** October 15, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Year 1 Trials	Med	Single COTS UUV executing primitive commanding and delivering states	4	4th QTR FY19
Year 2 Trials	Med	Multiple COTS UUVs executing nominal plans, adapting to events	5	4th QTR FY20
Year 3 Solution Maturation	Med	Extension of Front-end Tool and onboard software to accommodate additional missions	6	4th QTR FY21
Year 4 Full Verification	Med	Successful Testing of Solution on Team of Operationally Relevant Heterogeneous Assets	7	4th QTR FY22

HOW

Projected Business Model: Orbit Logic will commercialize the MinAu solution in a manner similar to previous products such as our Command Planning Analysis Workstation (CPAW) solution for space missions. Initial releases of CPAW were developed to the requirements of a specific customer's satellite mission planning needs, but it's codebase was implemented in such a way as to be modular and extensible for future build-out. As a result of these up-front architectural design decisions, CPAW is routinely enhanced to meet a progressively larger set of customer needs. This is facilitated by a plug-in architecture, which extends to asset models, interaction of assets with their operating environment, and mission capabilities sets that define how assets are used. MinAu will be marketed through Orbit Logic's extensive contacts within the aerospace, defense and intelligence communities, and via maritime trade shows. Orbit Logic regularly attends and exhibits at aerospace trade shows, and will add maritime trade shows to its marketing schedule

Company Objectives: Orbit Logic is already an industry leader in Mission Planning and Scheduling for the Space domain. Our objective for this development activity is to extend our already mature and trusted solutions into the naval/maritime domain, to gain access to a new market segment for our products.

Potential Commercial Applications: The MinAu solution will benefit use cases involving many assets to achieve a widespread set of mission objectives in a large area with very limited (and highly variable) opportunity to intercommunicate and exchange information. Maritime missions with commercial overlap include hull and port inspections, marine husbandry, seabed survey, mapping, search, repair,and recovery - but the core logic of the MinAu solution is also applicable to other domains. Work being leveraged for this research is already being applied to cooperative satellite autonomy for better situational awareness and protection. Many applications exist in the air domain involving Unmanned Air System support for a wide range of military, commercial and civil use cases. Examples include science data collection, surveys, search and rescue, environmental/agricultural/traffic monitoring, urban operations, disaster response and management, border monitoring, aerial photography, materials delivery to underserved areas, goods delivery commerce, communications support.

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