Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2020-866

Topic # N152-084
Robust Relative Navigation and Control for Autonomous Ship-Based Landing of Resupply Vertical Take-off and Landing Aircraft
Near Earth Autonomy

WHO

SYSCOM: NAVAIR

Sponsoring Program: DoD SBIR Topic N152-085

Transition Target: MQ-25

TPOC:
(301)757-2035

Other transition opportunities: F/A-18 E/F, EA-18G, F-35, USAF aircraft, commercial aircraft, business jets, rotary wing aircraft, electric and hybrid-electric vertical takeoff and landing (eVTOL)

https://www.navy.mil/management/photodb/photos/190919-O-N0101-150.JPG

Notes: This program will enable autonomous ship-to-ship, ship-to-shore, and shore-to-ship missions in support of Naval logistics. Specifically, this technology targets the MQ-25 Stingray unmanned air system, which provides a critical aerial refueling capability to the carrier air wing. Near Earth's portfolio of products allow aircraft to autonomously take-off, fly, and land safely, with or without GPS. Our work was a 2017 finalist of the Robert J. Collier Trophy, one of the top aviation awards in the world, and won the 2018 Howard Hughes Award, which recognizes outstanding improvements in fundamental helicopter technology. Near Earth was founded by Carnegie Mellon University robotics faculty with decades of success building aerial autonomy systems for government organizations including the Navy, Marine Corps, Air Force, Army, DARPA, NASA, and NSF.

WHAT

Operational Need and Improvement: Future Navy operations call for unmanned aircraft capable of logistics operations between ships and between ship and shore. Near Earth Autonomy is developing an autonomy system to fulfill that need, enabling autonomous vertical take-off and landing (VTOL) of tactical resupply unmanned vehicles on moving ship decks. The system will reduce the need for manned helicopter logistics and expand the types of aircraft available, resulting in a more efficient supply chain and agile Naval force. Near Earth Autonomy develops autonomy solutions to enable aerial mobility and inspection applications in a variety of CONOPS and environmental conditions. Our goal is to integrate and transition the system into government and prime contractor air vehicles to enable autonomous take-off from and landing on ships.

Specifications Required: The Maritime Autonomy system developed in Phase II has been refined and characterized with multimodal sensor fusion, guidance, and control laws, optimized for ship-based landing. In Phase II-E we will optimize the multimodal perception system for real-time operation addressing key parameters including perception range, operational distance, reliability, and landing in degraded visual environments.

Technology Developed: The Maritime Autonomy project developed a custom sensing and computing suite combining existing autonomy capabilities with ship-relative navigation capabilities in a reduced SWaP-C “pod” that can be mounted to most VTOL airframes. This airborne system combined trajectory planning, en route obstacle avoidance, and landing zone evaluation capabilities developed in previous programs with multimodal sensors (long-wave IR, electro-optical, and ultra-wide band ranging radio) for ship-relative detection and tracking. Custom multimodal navigation beacons placed on the ship deck enable safe, accurate landing within degraded visual environments over the last 100-250m of approach.

Warfighter Value: Autonomous unmanned aircraft present several useful characteristics, including no risk of loss of personnel in case of accidents or enemy attack, potential to operate without constant human supervision, and potential to operate beyond line-of-sight. A fleet of such aircraft ranging in size from small to large can revolutionize ship-to-ship and ship-to-shore logistics, delivering packages or pallets according to their payload carrying capacity. This will enable cargo delivery to ships and other craft of various sizes resulting in a more efficient supply chain and, consequently, a more agile Naval force.

WHEN

Contract Number: N68335-20-C-0330

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Simulation Model	Low	Simulator produces realistic world representations and is used to verify closed-loop sensor-based ship landing	6	June 2021
Landing demonstration on Navy ship or boat	Med	Starting about 500m from the ship, the VTOL aircraft locates the ship, tracks the landing pad, and lands autonomously	6	March 2022

HOW

Projected Business Model: Near Earth’s business plan is to enable autonomous aircraft operation, whether the aircraft are totally autonomous or piloted with autonomous pilot assist. Near Earth will package the products developed under this program with other software and hardware products to offer nominal and contingency autonomy capabilities. The products developed under this program allow us to offer a fully autonomous system that enables operations between ships and between ship and shore. These commercial products and software licenses can be combined with consulting, training, and warranty options to provide third parties with products, capabilities, expert help and guidance to perform autonomous flight operations in a safe, compliant and efficient manner.

Company Objectives: Near Earth’s objective is to find government partners and aviation manufacturers who want to equip their aircraft with autonomy capabilities for safe, efficient, on-demand flight in dynamic environments.

Potential Commercial Applications: The commercial market beyond ship-board operations extends to ground-based operations in both the military and civilian sectors. In the military market, availability of onboard landing augmentation or autonomous landing systems would be extremely valuable, particularly in low visibility and GPS-denied environments. In the civilian sector, this technology can support the future drone delivery and urban air mobility markets, which will operate predominately in complex urban environments.

Contact: John Bonanni, Business Development Manager
john.bonanni@nearearth.aero 7246994898