Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2021-0467

Topic # MDA12-T001

Mine Target Reacquisition for Next Generation Mine Neutralization Systems (Sonar SLAM)

Physical Sciences Inc.

WHO

SYSCOM: NAVSEA

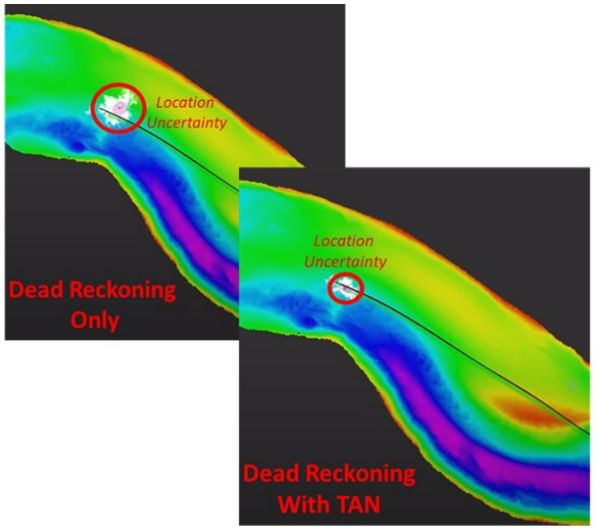
Sponsoring Program: PMS 495

Transition Target: Barracuda

TPOC:
(850)230-7311

Other transition opportunities: Potential applicability to PMS406 and PMS 408 UUV fleets (Swordfish, Sandshark, Kingfish, Knifefish, Razorback, Snakehead, and Orca)

Notes: Using terrain-aided navigation (TAN), sea floor features provide opportunities to constrain the location of the vehicle. These navigation resets result in bounded localization error and uncertainty as a function of mission time, marking a significant improvement over dead reckoning approaches.



WHAT

Operational Need and Improvement: Unmanned underwater vehicles (UUV) operate in a GPS-denied environment making accurate navigation challenging. This problem is typically addressed using some form of dead reckoning based on odometry data, resulting in unbounded vehicle location error over time. Methods are needed to improve the navigation accuracy to improve mission outcomes without significantly increasing vehicle size, weight, power or cost.

Specifications Required: Size (<4 in x 2 in x 2 in), power (<10W) and cost (<$1K) compatibility with small, expendable UUV. Real-time operation from an embedded processor to provide actionable navigation resets as the vehicle passes over sea floor features.

Technology Developed: A terrain-aided navigation (TAN) algorithm has been developed to identify the most probable vehicle path through the mission area on the basis of both dead reckoning and depth information (compared to a bathymetric map of the mission area). The resulting algorithm produces bounded vehicle location error and is computationally efficient enough for real time operation from a UUV-compatible processor. Initial demonstrations show the potential to reduce vehicle error by a margin of greater than 3x as compared to dead reckoning alone.

Warfighter Value: Enhanced navigation performance will result in improved UUV mission outcomes, including higher probability of success, reduced time to mission completion and enhanced safety for Navy personnel and assets by enabling vehicle launch from a longer standoff.

WHEN

Contract Number: N68335-19-C-0535 **Ending on:** August 18, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Simulation based TAN demonstration	Low	Reduced vehicle localization error with respect to dead reckoning in a simulation environment	3	September 2021
Data-driven TAN demonstration	Low	Reduced vehicle localization error with respect to dead reckoning using real data from Barracuda sea trials	5	August 2022
Algorithm deployment on embedded processor	Med	Real-time execution from a UUV-compatible processor	6	September 2023

HOW

Projected Business Model: PSI seeks to collaborate with undersea vehicle manufacturers/Prime Contractors to develop integrated Sonar SLAM processors for their UUV's.

Company Objectives: PSI is using the Forum for SBIR/STTR Transition (FST) event to explore new transition opportunities (e.g. PMS 406) and to assess potential applicability of the TAN algorithm in other markets (i.e. navigation of drones in GPS-denied environments). During these discussions, PSI would also want to explore opportunities for their high energy density batteries that are relevant for these platforms.

Potential Commercial Applications: The developed TAN algorithm has potential application to a wide range of UUV missions spanning mine clearing, environmental monitoring and oil pipeline survey, among others. An analogous algorithm could also be possible for the navigation of drones in GPS-denied environments using an altimeter and a terrain map. While other TAN algorithms have been developed, the particular advantage of this implementation is the reduction in computational complexity supporting real time execution with significantly reduced processor power requirements over image-based techniques.

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