

Topic: N18A-T002

Daniel H. Wagner, Associates, Incorporated

Detection Rate Improvements Through Understanding and Modeling Ocean Variability

Successful anti-submarine warfare (ASW) requires sophisticated tools capable of adapting to an ever-changing underwater environment. ASSET is a software tool developed to characterize uncertain conditions and recommend optimal mission plans. Wagner Associates has more than fifty years of experience in Navy algorithm development, including development of NAVAIR mission planning tools. They are assisted by the University of Michigan, who have developed a machine-learning-based approach for characterizing uncertainty in underwater environments. These characterizations have been validated in environments of interest, and accurately account for acoustic features that significantly impact ASW success. ASSET's underlying technology could be leveraged in numerous Navy applications involving optimizing passive and active sonar performance, and our goal is to identify prime contractors interested in adding this technology to their ASW support systems.

### Technology Category Alignment:

Command, Control, Communications, Computers, & Intelligence (C4I)

Autonomy

Sensors

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**SYSCOM:** NAVAIR

**Contract:** N68335-20-C-0003

 Corporate Brochure: [https://navystp.com/vtm/open\\_file?type=brochure&id=N68335-20-C-0003](https://navystp.com/vtm/open_file?type=brochure&id=N68335-20-C-0003)

Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2020-847

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WHO

**SYSCOM:** NAVAIR

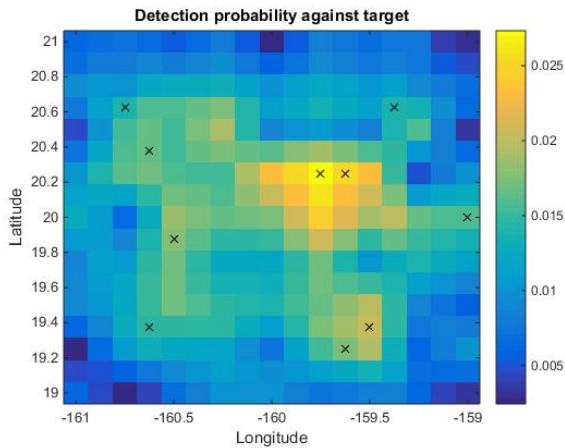
**Sponsoring Program:** PMA-290  
Maritime Surveillance Aircraft

**Transition Target:** MPACT

**TPOC:**  
(301)342-2188

**Other transition opportunities:**  
TacMobile, P-8, MH-60R, Next-Generation Naval Mission Planning System (NGNMPS)

**Notes:** In the adjacent figure, Wagner's ASSET has been used to optimize the cumulative detection probability against a moving target in a given region. Here, a black x denotes the location of a fixed-position sensor, and the position each sensor has been chosen to optimize the cumulative detection probability of the target over the duration of the mission. The colormap shows the instantaneous detection probability of a detection based upon the assumption that the moving target is equally likely to be in any square at the start of the mission.



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WHAT

**Operational Need and Improvement:** Variance in transmission loss (TL) between an acoustic source and a target can have a profound effect on detection performance using low-frequency (50 – 3000 Hz) active acoustics. If this variability can be well understood in terms of the ocean environment then it would allow for a more accurate prediction that will aid mission planning as well as post-mission reconstruction. The need exists to develop a stand-alone software model, based on ocean physics, that takes into account ocean variability and measured TL variance to aid asset placement and accurately estimate detection uncertainty.

**Specifications Required:** Stand-alone software capable of generating predictions of TL variability, and likelihood of acoustic detection.

**Technology Developed:** Daniel H. Wagner Associates is working with the University of Michigan to develop an Active Sonar Statistical Estimation Tool (ASSET) to characterize the effect of uncertain environmental conditions on acoustic detection. ASSET leverages a novel machine-learning-based approach for characterizing uncertainty in underwater environments, and combines this with state-of-the-art models of acoustic detection to accurately predict sonar performance. These characterizations have been validated in environments of interest, and accurately account for a variety of acoustic features that significantly impact detection. ASSET's underlying technology could be leveraged in numerous Navy applications involving optimizing passive and active sonar performance, and our goal is to identify prime contractors interested in adding this technology to their ASW support systems.

**Warfighter Value:** ASSET will significantly improve environmental situational awareness, allowing for improved detection rates and better overall search plans. In particular, ASSET will provide:

- 1) Better detection rates by recommending plans that exploit expected acoustic features.
- 2) Improved understanding of acoustic detection using existing models and databases.
- 3) Better awareness of acoustic conditions over a wide area, supporting better mission effectiveness evaluation and optimization.
- 4) Reduced operator time-on-task through automated mission evaluation and planning tools.

WHEN

Contract Number: N68335-20-C-0003    Ending on: June 17, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Validation of environmental uncertainty algorithm	Low	Validation of model against in-situ data in environment of interest	5	August 2020
Post-mission evaluation prototype completed	Low	Stand-alone software capable of generating post-mission analysis for a recorded scenario	5	September 2020
Validation of post-mission evaluation	Med	Validation of ASSET approach on multiple environments. MoP - accurate prediction of TL uncertainty distributions and detection rates	6	December 2020
Development of mission evaluation prototype completed	Med	Stand-alone software capable of analyzing a mission area, evaluating multiple given plans to provide mission scores, and recommending optimal plans	6	March 2021
Demonstration of final prototype	Med	Validation of all modules for pre and post-mission analysis, reconstruction, and optimization on environments of interest	6	May 2021

HOW

**Projected Business Model:** Initial development of ASSET involves the construction of stand-alone software for demonstration purposes directly for NAVAIR. Transition will initially be aimed at interfacing with an existing Tactical Decision Aid, such as the Multistatics Planning Acoustics Toolkit (MPAcT). Future transitions will be supported through either licensing of the software to prime contractors into existing TDAs, or directly working with prime contractors to integrate the ASSET technology into onboard systems.

**Company Objectives:** Wagner Associates is looking for other DoD applications of the ASSET technology, including other Navy SYSCOMS interested in improving passive and active SONAR systems by leveraging ASSET's enhanced environmental characterizations. We are also looking to team with prime contractors interested in adding this technology to software used in Navy surface ships, aircraft, submarines, and unmanned underwater vehicles.

**Potential Commercial Applications:** In addition to Navy applications, Wagner Associates is interested in non-DoD commercial and research applications of this technology. This technology could be applied to a number of commercial applications, including underwater search and salvage, fishing, and oil exploration. Additionally, this software has a variety of research applications, including the study of marine mammal migration and underwater echolocation and communication.

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