Topic: N151-034

ARiA

Doppler-Clutter-Mitigation Processing

Performance of detection and classification of targets in active sonar systems may be degraded in the presence of stationary clutter, ownship motion-induced clutter, and active interference. Applied Research in Acoustics' (ARiA) sparse estimation algorithms estimate and separate targets, reverberation, and mutual interference signals from a cluttered signal and enable novel classification features to be computed from sparse representations. Integration of ARiA's advanced signal and information processing enables automated and semi-automated sonar signal detection and classification, thus reducing operator workload. ARiA's signal and information processing enhancements are targeted for the AN/SQQ89A(V)15 Integrated Undersea Warfare (USW) Combat System Suite's pulsed active sonar (PAS) function segment (PASFS) echo tracker classifier (ETC). However, the developed algorithms are suitable for integration into most active sonar or radar platforms.

Technology Category Alignment:

Acoustic, Seismic and Magnetic
Synthesis/Analytics/Decision Tools
Machine Perception, Reasoning and Intelligence
Undersea Weapons
Test, Evaluation, Validation, and Verification

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SYSCOM: NAVSEA
Contract: N00024-17-C-4003

Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N00024-17-C-4003

Department of the Navy SBIR/STTR Transition Program

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WHO

SYSCOM: NAVSEA

Sponsoring Program: PEO IWS 5.0 Undersea Systems

Transition Target: AN/SQQ89A(V)15 Integrated Undersea Warfare (USW) Combat System Suite's pulsed active sonar (PAS) function segment (PASFS) echo tracker classifier (ETC)

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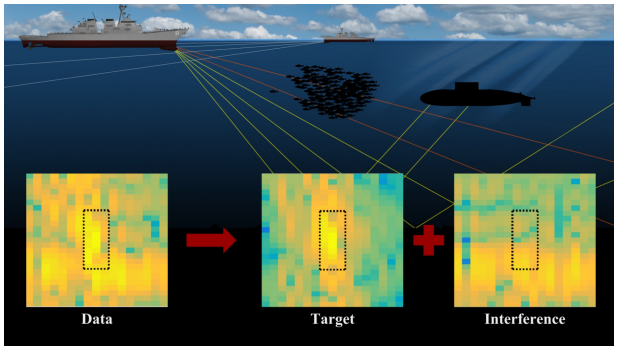
(860)694-3857



Other transition opportunities: Sonar signal processing for: Arleigh Burke (DDG) class destroyers, Ticonderoga (CG) class cruisers, fitted with the AN/SQS-53C mid-frequency active (MFA) hull array and the AN/SQQ-89A(V)15; Littoral Combat Ship (LCS)/Fast Frigate (FF) ASW Mission Package (MP); and Coherent Multistatic Acoustic Processor (CMAP) on the P-8A Poseidon.

Notes: Performance of detection and classification of targets in active sonar systems may be degraded in the presence of stationary clutter, ownship motion-induced clutter, and active interference. Applied Research in Acoustics' (ARiA) sparse estimation algorithms estimate and separate targets, reverberation, and mutual interference signals from a cluttered signal and enables novel classification features to be computed from sparse representations. Integration of ARIA's advanced signal and information processing enables automated and semi-automated sonar signal detection and classification, thus reducing operator workload. The developed algorithms are suitable for integration into most active sonar or radar platforms.

WHAT

Operational Need and Improvement: Navy mid-frequency active sonars, such as the AN/SQS-53C, are adversely affected by spatially spreading Doppler induced clutter. Spreading due to beamformer side-lobes, beam width, motion-induced Doppler spread of reverberation, multi-path Doppler spread, and side-lobes from normalization processing can mask slow-moving low signal-to-noise ratio (SNR) targets. The technology gap addressed by this work is the need for enhanced processing before classify-and-track to mitigate the effects of Doppler clutter.

Specifications Required: Signal processing algorithms for mitigating the effects of Doppler clutter should provide a significant improvement in the performance and detection capability of active sonar by unmasking targets hidden by the zero-Doppler ridge and mutual interference. Better-preserved signals provide more information to the classifier to enable better discrimination of targets from clutter, thus reducing the workload of the operator and automation.

Technology Developed: ARiA is developing Doppler clutter mitigation in mid-frequency active sonar by using sparse estimation to separate targets from clutter, reverberation, and various types of interference. Through our signal processing algorithms, we can separate targets, reverberation, and mutual interference from an apparently noisy signal, resulting in a cleaner tactical display for the sonar operator and improved end-to-end classification performance.

Warfighter Value: ARiA's sparse estimation signal processing algorithms improve detectability of targets, particularly near strong spatially-extended Doppler clutter and interference, thus improving discrimination between targets and clutter. Better discrimination enables a reduction in the number of false contacts and operator workload.

WHEN

Contract Number: N00024-17-C-4003 **Ending on:** October 11, 2018

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Prototype Demonstration (ACB21 Step 1)	Low	Demonstrated improved classification performance, few false contacts	4	December 2018
Independent Prototype Evaluation on Recorded Data (ACB21 Step 2)	Low	Demonstrated improved classification performance, fewer false contacts	5	March 2019
Testing & Evaluation of Full Tactical-System Integration in a Laboratory Environment (ACB21 Step 3)	Med	Integrated system, demonstrated reduced FAR, improved classification performance	6	August 2020
At-Sea Testing & Evaluation (ACB21 Step 4)	Med	Successful shipboard tactical integration	7	January 2021

HOW

Projected Business Model: ARiA plans to retain the SBIR data rights for the developed signal processing algorithms, working with Navy and large primes to integrate algorithms into tactical systems for fleet use. ARiA's algorithms are targets for initial transition into the AN/SQQ-89A(V)15 USW Combat System in ACB21 with transition to related tactical systems to follow.

Company Objectives: ARiA's objective is to further investigate and develop Navy and DoD applications of adaptive signal processing algorithms for Doppler clutter mitigation. ARiA intends to integrate these algorithms into the AN/SQQ-89A(V)15 USW Combat System in ACB21 as the initial application of this technology to tactical sonar systems. ARiA is looking for programs and prime partners working with other tactical sensor systems that can benefit from improved detection and Doppler clutter mitigation.

Potential Commercial Applications: The signal processing algorithms that ARiA has developed are applicable to a wide range of sensing modalities including radar and sonar. Algorithms may be adapted most directly to commercial mid-frequency sonars, e.g. for subbottom profiling, single-beam and multiple-beam (swath) bathymetry, and acoustic seafloor characterization.

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