

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:

Machine Perception, Reasoning and Intelligence

Test, Evaluation, Validation, and Verification

Synthesis/Analytics/Decision Tools

Acoustic, Seismic and Magnetic

Undersea Weapons

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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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NAVSEA #2018-0527

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Doppler-Clutter-Mitigation Processing
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WHO

SYSCOM: NAVSEA

Sponsoring Program: PEO IWS 5.0
Undersea Systems

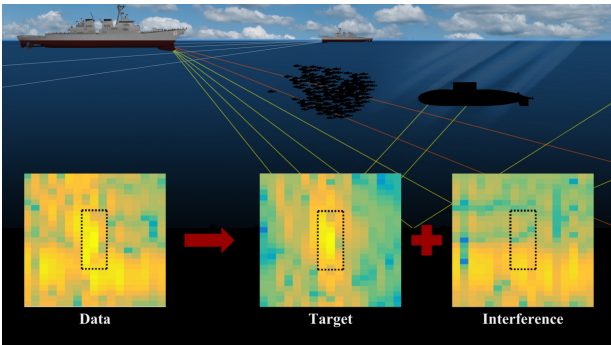
Transition Target: AN/SQQ89A(V)15
Integrated Undersea Warfare (USW)
Combat System Suite's pulsed active
sonar (PAS) function segment
(PASFS) echo tracker classifier (ETC)

TPOC:
(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.



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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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