Anti-submarine Warfare

Dr. Linda Mullen
SSTM
Advanced Technologies Development Department

ASW overview

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Types of sensors:

- Acoustic ASW: detect sound pressure waves underwater
- Non-acoustic ASW: identify various parts of the electromagnetic spectrum (above, on, and below the water surface)

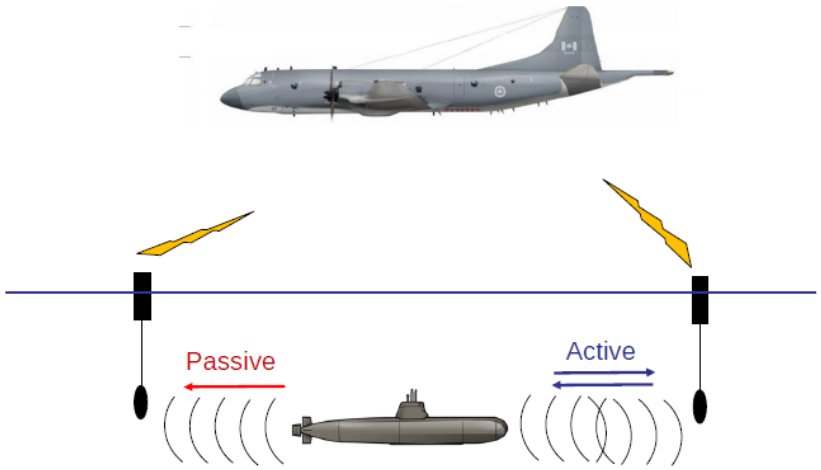
Sensor classes:

- Active: transmit energy and collect any returning signal
- Passive: "listen" to and collect any noise in the environment, which may include an emission from the target

Detection techniques:

- Direct detection: reflection or signal from the submarine
- Indirect detection: changes in the environment due to a submarine

Acoustic ASW



Vincent, Ron "Hunting the Sound of Silence: Non Acoustic Methods of Submarine Detection"

- Acoustic sources/receivers: new materials for extended battery capacity (Persistence) and increased signal-to-noise ratio (Improved Detections at Longer Ranges)
- Tactical Decision Aids: improve the situational awareness of the underwater environment and reduce operator workload.
- Automation for ASW: Implement AI, ML, DL, Data Analytics to improve ASW system performance.
- Modeling and Simulation: Virtually represent the threat and the behavior and performance of payloads, systems and platforms executing the ASW mission.
- Signal Processing: Develop clutter reduction and sensor fusion techniques that are key enablers for wide area searches and target localization.
- Command, Control, and Communications Improvement between Underwater Sensors and Platforms: Develop solutions that enable large amounts of data to be transferred or uplinked from ASW sensors

A-ASW SBIR topics

Acoustic sources/receivers:

- N182-097: Improved Low Cost Directional Frequency Analysis and Recording (DIFAR) Sonobuoy (passive) - Improved target data and resulting detection
- N221-011: Multi Dimensional, High-Sensor Density, Collapsible Arrays - Collapsable Arrays for A-Size Sonobuoys
- N192-060: Multi-Sensor Sonobuoy - Passive Acoustic Sonobuoy enhanced with Electric Field Sensors (acoustic and non-acoustics sensors in A-size sonobuoy form factor)
- N202-102: Low Cost High Performance A Size Sonobuoy Power Amplifier - Sonobuoy Power Amplifier for multiple sonobuoys

Tactical Decision Aids:

- N212-116: Acoustic Tomography Using Tactical Sensors – use sensor data to estimate the ocean sound speed field

Automation for ASW:

- N202-091: Jargon-Aware Artificial Intelligence - Classification algorithms based on operator performance
- N211-011: Disruptive Autonomy Against Reactive Targets (DAART) – deep learning techniques

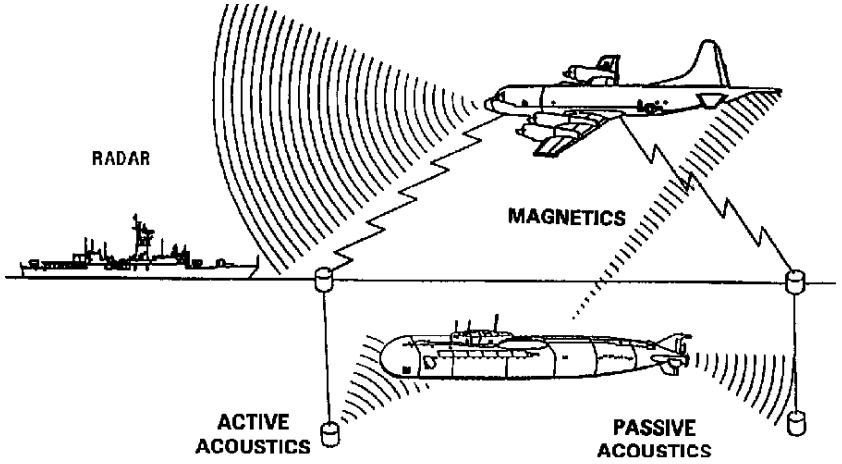
Signal Processing:

- N172-122: Buoy Location and Uncertainty Estimation (BLUE) - Improved Multi-Static Active Coherent (MAC) Target Localization Software
- N182-116: Miniaturization of In-Band Interferers on Airborne ASW Performance - Algorithms for mitigating in-band interferers (environment, sensor noise, commercial sources)

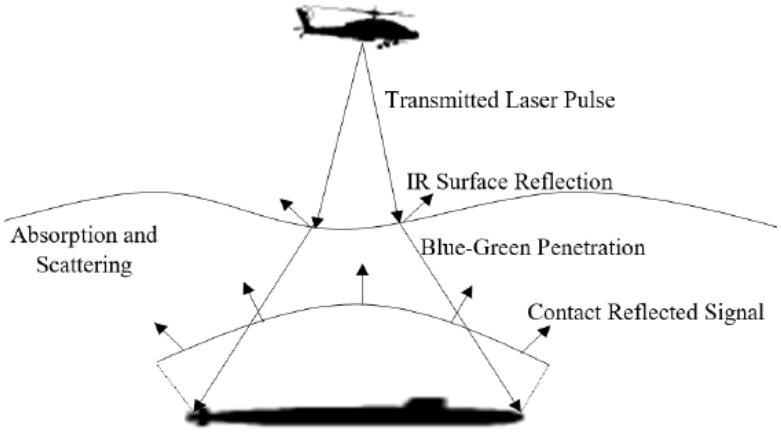
Command, Control, and Communications Improvement between Underwater Sensors and Platforms

- N221-023: Miniature Sonobuoy High Data Rate Tether - Fiber Optic Deployment Module

Non-acoustic ASW



https://www.globalsecurity.org/military/systems/aircraft/asw3.htm



Vincent, Ron "Hunting the Sound of Silence: Non Acoustic Methods of Submarine Detection"

- Interrogate undersea threats using non-acoustic techniques: Develop non-acoustic sensors that are sensitive to changes in the underwater environment and/or are capable of identifying undersea threats.
- Predict Non Acoustic Sensor Performance: Develop performance prediction models that incorporate system and environmental variables. Develop methods to validate the models with controlled laboratory experiments.
- Identify phenomenology associated with undersea threats: Develop in-house expertise of phenomenology and related algorithm development. Identify what phenomenology can be prosecuted with non-acoustic techniques.
- Autonomy/unmanned platforms: Develop sensors that can be operated from unmanned/autonomous platforms and techniques that involve collaboration between unmanned/autonomous platforms.
- Artificial Intelligence/Machine Learning: Integrate AI/ML algorithms into sensors to reduce false alarms and improve detection of subsea threats.

NA-ASW SBIR topics

Interrogate undersea threats using non-acoustic techniques:

- N17A-T001: Electro-Optic Transmissive Scanner
- N181-011: Fiber-optic Beam Homogenizer
- N191-008: Improved Quantum Efficiency Photo-Detector
- N192-063: High Dynamic Range Real-Time LIDAR Digitizer and Processor
- N212-D05: Yield Increase for High-Performance Optical Interference Filters
- N211-005: Packaged Mid-Infrared Non-Mechanical Beam Steerer

Predict Non Acoustic Sensor Performance:

- N181-012: Low Cost Persistent Environmental Measurement System

Identify phenomenology associated with undersea threats:

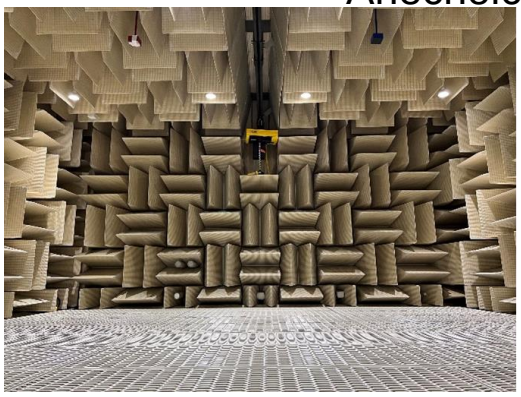
- N00-107: Automatic Wake Detection Algorithms

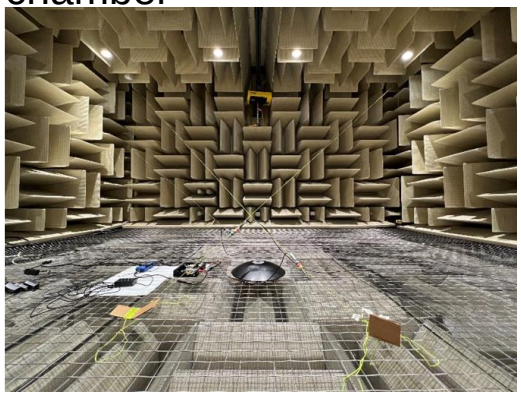
Autonomy/unmanned platforms:

- N17A-T007: Innovative Packaging to Achieve Extremely Light Weight Sensor Pod Systems
- N07-036: Modulated Pulse Laser Sources for Imaging Lidars
- N211-018: Non-Traditional Airborne Anti-Submarine Warfare (ASW) System – UAS-mounted Magnetic Anomaly Detector
- N172-116: Miniature Oriented Tri-Axial Fluxgate Magnetometer Sensor - ultra-low noise level, reduced size and weight

Advanced Transducer Engineering Facility

Anechoic chamber



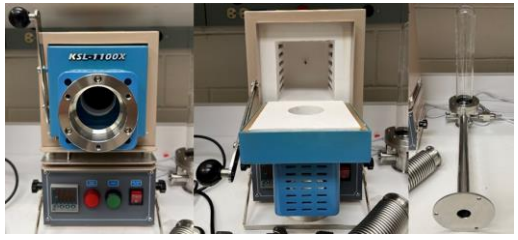


MISSION

- Conduct research, design, development, prototyping and testing of the next generation of Undersea Warfare transducers for use in the airborne Anti-Submarine Warfare (ASW) missions.
- Develop analytic methods and characterization processes that validate novel piezo-ceramic materials for sonobuoy source and receiver applications

COMPONENTS

- Materials Synthesis, Modification, and Characterization of Component
- Engineering Prototyping and Component Assembly
- Acoustic Testing Component



Magnetic shielded room

https://www.magnetic-shield.com/muroom/

Internal Width	4.26 ft. [1.3 m]
Internal Length	4.26 ft. [1.3 m]
Internal Height	6.56 ft. [2.0 m)
Weight	4,630 Lbs. [2,100 kgs]
Wall thickness	7 inches [180 mm]
Construction	Modular
Door Type	Swinging, mechanical latch

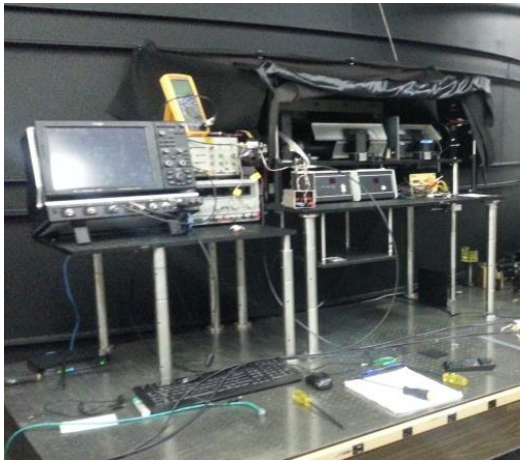
This document certifies that the MuRoom has achieved the following performance within the central 500mm region:

Magnetic Field Frequency, Hz	Required Attenuation	Actual Attenuation
0	<15nT	<6nT
.01	100	496
0.1	300	795
1	2000	2,619
10	5000	11,309
100	5000	15,615
1,000	N/A	26,767

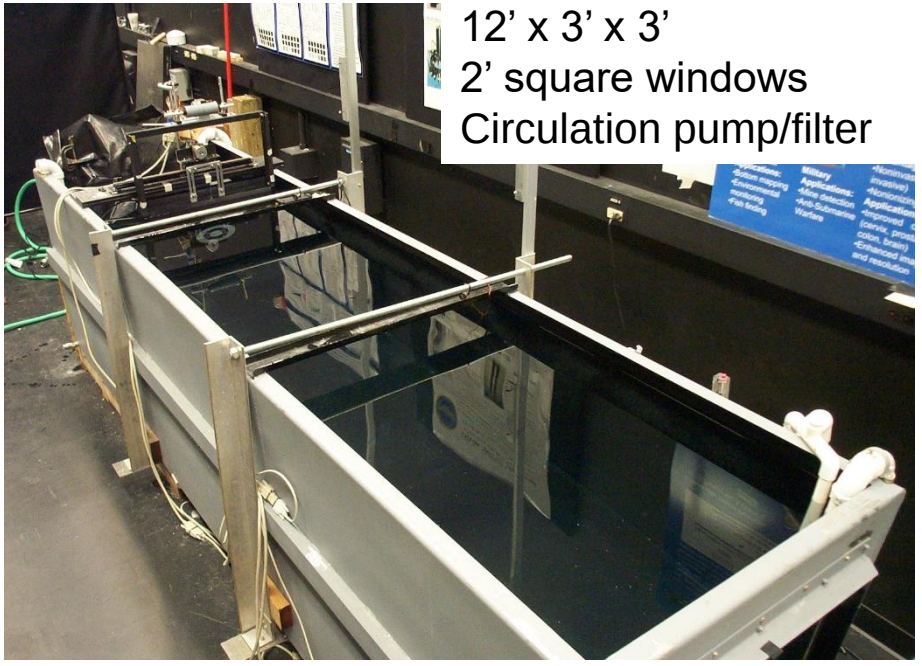
- Environmental shielding for sensitive magnetic sensor measurements
- Interior Helmholtz coil to inject known amplitude/frequency magnetic signals

Water tank facilities

25’ diameter
11’ depth
4 optical ports



12’ x 3’ x 3’
2’ square windows
Circulation pump/filter



Contacts

- Acoustic ASW
  - Mr. Luis Fortuno: luis.a.fortuno.civ@us.navy.mil
  - Mr. Kwame Marshall: kwame.j.marshall2.civ@us.navy.mil
- Non-acoustic ASW
  - Lidar:
    - Mr. Brian Concannon: brian.concannon3.civ@us.navy.mil
    - Dr. Linda Mullen: linda.j.mullen2.civ@us.navy.mil
  - Magnetics:
    - Mr. Tony Brescia: anthony.d.brescia.civ@us.navy.mil
    - Mr. Aaron Pyrah: aaron.d.pyrah.civ@us.navy.mil