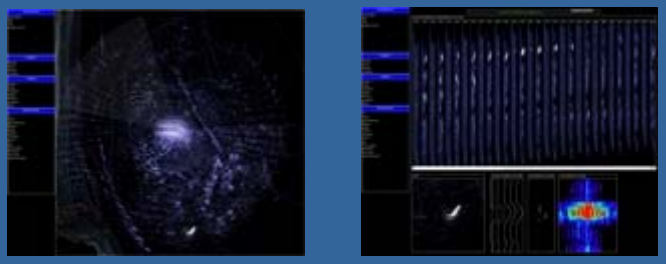
## UNDERSEA WARFARE AND ACOUSTIC INTELLIGENCE

Signal Physics Division (SPD) personnel employ their broad range of expertise in undersea warfare and acoustic intelligence to conduct research in the use of active and passive sensors for both tactical and surveillance systems. SPD's technical strengths include sensor signal and information processing, with a strong emphasis on innovative techniques for detecting, classifying, tracking, and localizing contacts of interest. SPD staff members have also spearheaded efforts to train Navy operators on the tactical employment of active sonar. Since 2004, they have trained more than 400 enlisted Navy operators in courses taught at ARL:UT and at the Fleet Anti-Submarine Warfare Training Center in San Diego.

### ACTIVE SONAR

SPD plays a prominent role in development, testing, and refinement of automated detection, classification, and localization (DCL) systems for the Navy's surface Fleet. Recent achievements include:



Geographic search Analysis

**Acoustic display formats developed by SPD scientists**

- Development and delivery of the active signal and information processing and display system—based on SPD's Advanced Acoustic Analysis Adjunct for IMAT (A4I)—after successful completion of government acceptance testing. This system was integrated into the Scaled Improved Performance Sonar (SIPS), which has been deployed on 26 destroyers and cruisers in the U.S. Pacific Fleet. The key focus of this work is to reduce manning requirements by increasing automation capabilities. This system encompasses:
  - Acoustic displays that show contact information in an intuitive format that greatly enhances the sonar operator's situational and environmental awareness.
  - A portable Echo Tracker Classifier (ETC) processing and display system that facilitates at-sea testing. This system has been deployed on numerous Fleet exercises in order to demonstrate its future capabilities, obtain Fleet feedback, and collect data. Tests conducted by the Navy, using Fleet operators, have demonstrated that this system significantly increases the operator's detection and classification capability. ETC is targeted for transition into the Navy Fleet as part of the AN/SQQ-89 ASW Combat System.
- Participation in numerous ONR and ASTO-sponsored initiatives to improve active sonar capabilities by adapting signal and information processing and multisensor data fusion to environmental conditions. Under this effort, SPD is developing enhanced acoustic displays to make the use of active sonar more effective by increasing operator awareness of environmental effects. These displays enable the operator to validate predictions and explore target hypotheses *in situ*.

- Ongoing participation in analysis, training, and mission planning. SPD's Analysis, Training, and Mission Planning Group (ATMPG) is a critical Navy resource for large-scale Mid-Frequency Active SONAR Analysis, Reconstruction, and Education Development. ATMPG has developed the only ASW-oriented Active Acoustic Analysis program in the U.S. Navy. This program includes education and development of advanced skills for critical human capital—from SONAR Analyst to Sea Combat Commander—through multiple courses of instruction provided at ARL:UT and at several Fleet sites world-wide.

ATMPG has completed the most extensive and detailed active acoustic reconstruction and analysis of large-scale naval operations ever undertaken, analyzing more than 17,000 active transmissions within 90 days of receipt of data. This effort produced key insights across the spectrum of Sea Base Defense, from sensor to watch-stander, across tactics, operations, applications, and mission planning.

**DDG-51 Flight II Class – A4I Enhanced Situational Awareness and Management Display**

ATMPG continues to develop effective and transportable techniques in the classification of active signatures related to biologic, geophysical, hydrodynamic, and mechanical reflectors for critical U.S. Naval systems and personnel.

In addition, SPD scientists lead Sea Base Defense analysis and experimentation, oversee an Active Reconstruction and Analysis Lab, and manage data collection, system development, and multi-media visualization. One of these scientists manages the largest modern Mid-Frequency archive in the U.S. Navy.

**PASSIVE SONAR**

The primary emphases of SPD's Passive Sonar Group include research into acoustic intelligence to help the Navy meet the challenges faced by its Special Operations mission. As part of this effort, SPD has undertaken signal processing research in the areas of higher order statistics and wavelet processing as applied to both stationary and transient signals. This work encompasses:

**Team preparing to deploy SPD-developed autonomous acoustic buoy**

- Development of passive statistical signal processing algorithms for detection, localization, and classification based on an understanding of the physics of the sound-generating mechanisms
- Basic and applied research on structural vibrations and structural acoustics (in support of signal processing work)
- Development of small, persistent, low-power autonomous systems that can operate in adverse ocean environments
- Involvement in ONR's Persistent Littoral Undersea Network (PLUSNet) program, a collaborative effort among University Affiliated Research Centers, universities, and industry. The purpose of this program is to develop a new approach to ASW, involving distributed mobile and/or fixed nodes with the capability to detect and respond to the presence of a submarine in the field area. A SISL staff member serves as system engineer for this program.

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For further information regarding SPD's work in Undersea Warfare and Acoustic Intelligence, please contact:

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