



Critical Challenges, Critical Solutions: Guest Editors' Introduction

Bruce K. Newhall and Christina J. Myles-Tochko

This issue of the *Digest* is in recognition of the 25th anniversary of the founding of the Submarine Technology Department. Despite the anniversary opportunity to look backward, our main emphasis here is on current work and future trends. In particular, we focus on the department's long-established work in undersea warfare (USW) and touch on the rapidly increasing growth of efforts beyond our core mission areas. Future issues will address APL-wide activities in security technologies for the counterproliferation of chemical and biological weapons, counterterrorism, and biomedical applications. Given the growth in these new areas, the department has recently been appropriately renamed the National Security Technology Department (NSTD), reflecting our work in USW (including submarine security) as well as the other newer areas of national security applications.

During the past 25 years, USW has at times been one of the Navy's highest priorities. Even though many technological advances have been made, the Navy recognizes that USW remains a critical challenge. A field of inexpensive mines or a few relatively inexpensive diesel-electric submarines equipped with modern torpedoes could seriously damage or destroy the Navy's high-valued assets and cause significant loss of personnel. For anti-mine warfare, the significant challenge is to locate modern nonmetallic stealth-shaped mines. For anti-submarine warfare (ASW) using passive sonar, the challenge is to detect diesel-electric submarines when submerged, operating under the quiet power of electric batteries. Their need to occasionally surface and operate their loud diesel engines to recharge batteries mitigates this challenge somewhat; however, the emergence of air-independent propulsion technologies makes this a much greater challenge for the future. The diesel-electric submarine is also a challenge for active sonar. When compared to larger nuclear submarines, the smaller size generally produces lower target strengths. The generally slower speed and near-coastal shallow-water operation also confound the use of Doppler for discrimination against bottom reverberation. Furthermore, these factors reduce the potential for nonacoustic ASW detection of wake effects. The potential of air-independent propulsion to greatly increase the time submerged also increases the challenge for other nonacoustic ASW technologies, which generally work better for surfaced or shallow periscope-depth submarines.

NSTD brings its technical skills, capabilities, and processes to the Navy to help them meet these critical USW challenges. In particular, the department has developed two significant processes which are complementary in providing solutions. First, since its

inception, NSTD has participated in activities to assess the applicability of new technologies to USW for the SSBN Security Program. This process evaluates applicability through physical understanding gained from a combination of physical modeling and sea testing. As the physical processes of the ocean are usually not well measured and sometimes not even well understood, sea testing is a vital component of the process to ensure that a realistic understanding of technology potential is obtained. NSTD has developed a unique capacity to conduct these complex scientific exercises. Physical modeling is also a vital component of the approach; without it, test results could not be interpreted or understood. Only after the first principles of the fundamental physics behind a technology are understood can system development proceed intelligently.

Second, in recent years, NSTD has helped the Navy develop a revolutionary paradigm for system development—the Advanced Processor Build (APB) and Acoustic Rapid COTS (commercial off-the-shelf) Insertion (ARCI) process, which allow the very latest hardware and software to rapidly become incorporated onboard our operational submarines. The Navy’s traditional approach to systems design and acquisition would often take a decade or two from initial concept to Fleet use. This resulted in custom signal processing hardware that was extremely expensive and outdated in its capabilities compared to current COTS hardware. APB/ARCI

substitutes a bottom-up evolutionary approach for the traditional top-down systems design. A yearly upgrade process allows regular insertion of the latest hardware and software. Large numbers of potential new processing techniques are quickly evaluated through a rigorous four-step testing methodology. At each stage in the process, many failed techniques may be dropped or returned to the developer for refinement; only the fittest survive all the way through for Fleet implementation. This approach not only greatly facilitates the very fast incorporation of the latest techniques, but also allows the Navy great flexibility in rapidly adjusting to new requirements as submarine use evolves in our ever-changing world. While initially confined to submarine sonar signal processing, the success of the APB is now extending the process to apply to combat control and other submarine and surface ship systems development.

This *Digest* issue is introduced with a department overview by G. Daniel Tyler and a commendation letter from the Commander Naval Submarine Forces, ADM John J. Grossenbacher. The remaining articles are organized into two major sections, each giving examples of current NSTD work and reflecting the two processes described above. The first section, introduced by P. Donald Hartman and Arthur E. Turriff, deals with USW systems engineering and assessment. The second section, introduced by Ralph H. Brown and Bruce K. Newhall, concerns ocean engineering and technology assessment.

THE AUTHORS



BRUCE K. NEWHALL received a B.S. (1974), an M.S. (1975), and a Ph.D. (1980) in mathematics from Rensselaer Polytechnic Institute, with a Ph.D. thesis entitled *The Effects of Random Ocean Current Fluctuations on Underwater Sound*. He joined APL in 1980, and is currently Supervisor of NSTD’s Acoustics and Electromagnetics Group. His research interests include propagation in random media, low-frequency underwater acoustic scattering and reverberation, and the signal and noise performance of long towed hydrophone arrays. His e-mail address is bruce.newhall@jhuapl.edu.



CHRISTINA J. MYLES-TOCHKO is a member of APL’s Senior Professional Staff and serves as Assistant Group Supervisor of the NSTD’s Business Systems Group. She received a B.S. in biology from Centenary College of Louisiana and an M.S. in zoology/marine ecology from the University of Connecticut. Ms. Myles-Tochko joined APL in 1981 and has been involved in sonar evaluation, environmental effects on underwater acoustics, tactical oceanography, and environmental assessments. She served as project manager for the Submarine Security Program Environmental Support System from 1989 to 1999. Her e-mail address is chris.myles-tochko@jhuapl.edu.