

Activity Report

CCAUV/October 2013

Underwater Sound Reference Division, United States/ Underwater Acoustic Metrology

Introduction

The Underwater Sound Reference Division (USRD) is the organization sanctioned by the National Institute of Standards and Technology (NIST) to provide traceable underwater acoustic transducer and hydrophone calibrations for the U.S. Navy, industry, research, and education. Initially conceived as the Navy's primary laboratory for the measurement of underwater sound during WWII, the USRD continues to maintain a principal role in the numerous and varied facets of underwater acoustic measurement, calibration and testing. As a government organization, the USRD mission is to ensure the accuracy of acoustic measurements throughout USRD facilities, measurement methodology, and transducer standards. The USRD provides access to measurement facilities and a wide range of calibrated transducer types within the United States. The USRD maintains a complex of six measurement facilities that provide a broad range of frequency, temperature, and hydrostatic pressures. Also maintained is an inventory of calibrated underwater transducers and reference standards that can be used to verify acoustic measurements at different facilities. Ongoing research in underwater acoustic measurement metrology results in added facilities for specific applications and enhanced capabilities to existing facilities. Reference transducers and acoustic sources are updated and modernized as new technologies emerge. The USRD is located in Newport, Rhode Island and continues in its original mission to provide measurement facilities, measurement methodology research, technical consulting, and calibrated transducer standards to a diverse client base.

Current Efforts

Selected ongoing, current and recently completed efforts include:

- Biannual transducer calibrations (e.g., round robin) are conducted among the different USRD facilities to provide a historical reference base and ongoing quality surveillance program. There are four USRD round robin transducers covering various frequency ranges with known acoustic calibrations that include the full range of ocean environments.
- The USRD operates an Electroacoustic Calibration Simulator (ECS) that is circulated among the different calibration facilities on a quarterly basis. The ECS provides a useful tool to maintain uniform (simulated) transducer signals across the test facilities. The ECS is an effective tool used to differentiate calibration equipment uncertainties from those of the reference transducers themselves.
- USRD continues to develop Local Calibration Procedures (LCP) for incorporation into the U.S. Navy's Metrology and Calibration (METCAL) program. An LCP for calibration of the USRD H52 hydrophone up to 2 kHz was completed. Three LCP were developed for calibration of transducers by reciprocal and comparison methods at frequencies ranging from 1 kHz to 2 MHz.

- USRD and the Department of Commerce collaborated in the development of a national survey for the assessment of underwater acoustic and transduction related facilities in the United States. The survey included government, academic and industrial institutions.
- USRD has initiated an effort for accreditation under ISO 17025:2005, General requirements for the competence of testing and calibration laboratories. A pre-audit inspection of USRD processes and documentation was completed by the Navy METCAL program in preparation for formal accreditation.
- The USRD continues to support the CCAUV on behalf of NIST through participation in key comparisons that are relevant to its role in underwater acoustic metrology.

Papers, Publications and Committees Chaired

ANSI/ASA S1.20-2012 American National Standard, Procedures for Calibration of Underwater Electroacoustic Transducers (Workgroup Chair: R.M. Drake, 2012).

S.E. Crocker, J.H. Miller, G.R. Potty, J.C. Osler and P.C. Hines, “Nonlinear Inversion of Acoustic Scalar and Vector Field Transfer Functions”, *IEEE J. Ocean. Eng.*, **37**, pp. 589-606, Oct. 2012.

NAVSEA LCP-NRA-011, Local Calibration Procedure, H64 Hydrophone, NUWC DIVNPT USRD, Apr. 2012.

NAVSEA LCP-NRA-010, Local Calibration Procedure, H52 Hydrophone (Reciprocity Calibration), NUWC DIVNPT USRD, Mar. 2012.

D. Huang and A. Paolero, “Low Frequency Acoustic Sensor or Array Calibration Waveguides of Finite Length,” *J. Acoust. Soc. Am.*, **129**, pp. 2643, 2011.

D. Huang, “Non-Uniform Array Synthesis Concept and Theory,” *J. Acoust. Soc. Am.*, **127**, pp. 1981, 2010.

D. Huang, Breazeale Legacy in Gaussian Acoustics, *J. Acoust. Soc. Am.*, **127**, pp. 1844, 2010.

D. Huang and A. Paolero, “Analysis Models for the Underwater Sound Reference Division Low-Frequency Acoustic Calibration Systems,” *J. Acoust. Soc. Am.*, **126**, pp. 2196, 2010.