

Passive Acoustic Marine Mammal Monitoring Technology for Navy Ranges

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Abstract

The Office of Naval Research (ONR) program, Marine Mammal Monitoring on Navy Ranges (M3R), has leveraged the infrastructure of U.S. Navy undersea ranges to develop a set of tools for passive detection and localization of marine mammal calls. Widely-spaced, bottom mounted omni-directional hydrophones are used to monitor animal calls over broad spatial and temporal scales. The tools are designed for use with diverse calls including clicks, sweeps, and whistles. Call frequency can vary from 50 Hz to 50 kHz. Calls are detected, precisely time-tagged using a GPS reference, and detection reports generated. Calls are divided into 2 broad classes, clicks and "everything else." The Time Difference of Arrivals (TDOA) between a master hydrophone and those surrounding are calculated. For clicks, this is done directly using a data association algorithm. For all other calls, a 2-D spectrogram cross correlation is first performed. A hyperbolic tracking algorithm is then used to localize the calls. 3-D tracks are obtained for repetitively vocalizing animals. Included in the tool set are real-time displays that allow simultaneous monitoring of all range hydrophones. For installations such as the Atlantic Undersea Test and Evaluation Center (AUTEK), up to 82 hydrophones covering an area of over 500 square nautical miles are utilized. Displays for receiver detection statistics, individual receiver output spectrograms, and X-Y geo tracking displays are provided. The current detection algorithm runs on a massively parallel Digital Signal Processor (DSP). A replacement processor based on commodity Linux cluster technology is under design. This processor will reduce the cost of hardware by up to a factor of 10, making the tools affordable for a diverse set of applications.