Simple Performance-characterized Automatic Detection of Marine Mammal Sounds

THE NEED

The Navy is responsible for compliance with a suite of Federal environmental laws and regulations that apply to marine mammals and other marine protected species, including the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA). As part of the regulatory compliance process associated with these Acts, the Navy is responsible for implementing a marine species monitoring program to assess potential impacts from Fleet and Systems Command (SYSCOM) military readiness activities involving active sonar and underwater detonations from explosives and explosive munitions. Passive Acoustic Monitoring (PAM) is a proven means of detecting and classifying vocally active marine mammals, as well as a number of fish species through underwater microphones known as hydrophones. However, interpreting the raw data collected by these methods is not an easy task, and often requires involvement of subject matter experts. There is a need to develop, test, and evaluate new or existing PAM signal processing systems appropriate for users with relatively little or no subject matter expertise.

THE SOLUTION

In order to detect and classify marine mammals, specific characteristics of their signals must be extracted from the audio signal. This project team is creating a database of performance-characterized detectors/ classifiers for many marine mammal species that can be integrated into the current PAM software package, Ishmael, which was developed with Office of Naval Research funding and recently upgraded. When this new software is integrated into Ishmael, a relatively naive user can sit down, choose what species to monitor, and the system will provide both detections and information on detection range and other performance measures for those species.
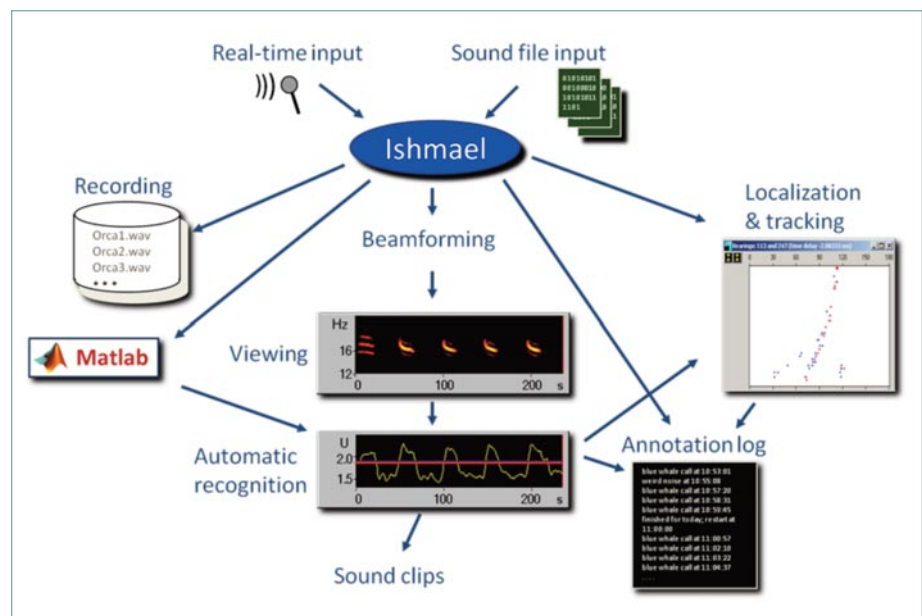
Incoming sound, either real-time or recorded, can be viewed and/or recorded, have detection/ classification processes run on it, or be used to localize the marine mammals making calls.

THE METHODOLOGY

The detectors/classifiers currently in the PAM system database will be characterized and evaluated by testing them against sound files found in MobySound.org, a publicly accessible archive of sound recordings of over 35 marine mammal species. MobySound recordings have been annotated to indicate where (in time and frequency) each call occurs and what its signal-to-

noise ratio (SNR) is—information crucial to evaluating detector/classifier performance. This broader, deeper and easier-to-use signal processing system will enable any Ishmael user to detect sounds coming from a species or subspecies of interest in a specific area.

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Pilot whale.

THE SCHEDULE

First, the software interface within Ishmael will be enhanced so that it can communicate with MATLAB, a language widely used to easily implement detectors and classifiers. Then, an online database of detectors/classifiers in MATLAB will be built for beaked, sperm, and baleen whales as well as a number of delphinids (small to medium cetaceans, such as pilot whales, dolphins, etc.). These detectors/classifiers will then be tested against the sound files in MobySound. By early 2017, an Ishmael database interface will be created to display detectors and performance data in Ishmael. This will be followed by documentation and training on the new software.

NAVY BENEFITS

Having a system for marine mammal detection that is both straightforward to use and well-characterized will make adoption of acoustic monitoring faster, easier, and therefore more widespread within the Navy. This new software will also enable efficient analysis of large archival acoustic datasets from which species composition, seasonal distribution and abundance can be gleaned. This will enable better and easier Navy compliance with marine mammal monitoring requirements.

TRANSITION

Once the Ishmael software upgrade is complete, the project team will offer training courses to all Navy personnel and private (contractor) marine mammal observers as well as regulators who are involved in the Navy's marine species monitoring program. This will be done by adding a module to Bio-Waves's existing training course for Passive Acoustics Technicians. Stand-alone training on the new software will also be available, and a manual and tutorial will also be produced.

For more information about Ishmael, visit www.bioacoustics.us/ishmael.html.

ABOUT THE PRINCIPAL INVESTIGATOR

Since 2000, Dave Mellinger has been an associate professor and researcher at Oregon State University. He is a specialist in marine mammal acoustics and developing algorithms and software for digital bio-acoustic signal processing. Dr. Mellinger has a Ph.D. in computer science from Stanford University.