EdgeTech
An Affiliate of ORE Offshore

APPLICATION NOTE

Studies of Fish and Zooplankton with a Full Spectrum Acoustic System

CUSTOMER APPLICATION

- Studies of fish, zooplankton, and turbulence using broadband acousitcs

SOLUTION

- EdgeTech Full Spectrum Chirp Processing Acoustic System

EQUIPMENT

- Underwater Equipment:

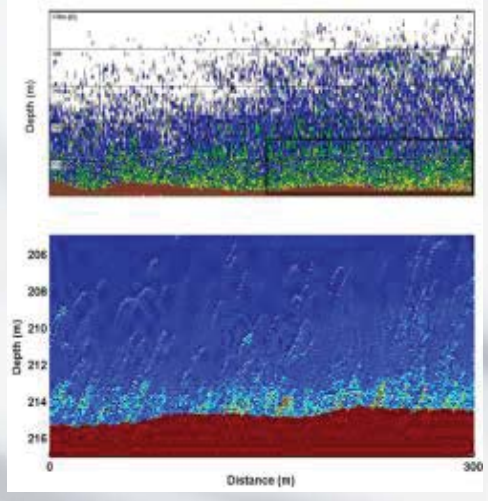
  Modified EdgeTech SB-0512i Towfish operating at 1.5 kHz to 100 kHz

  Modified EdgeTech 2200

  operating at 150 kHz to 600 kHz

- Shipboard Equipment:

  EdgeTech processor running software for aquistion and display



Top image from a narrow band acoustic system. Bottom image, showing fish, from the EdgeTech broadband system.

Scenario

Fish research is an important endeavor for the scientific community and for commercial industries. The tools to "view" or study fish in their normal habitat are limited. Studying fish using traditional acoustic technology available in a device such as an echosounder has notable limitations. The limited acoustic bands often present data to the users that can be interpreted, or misinterpreted, in a number of different ways. The acoustic sound that bounces off a fish to provide an image is often distorted by a number of factors including: fish size, fish orientation and density of fish in an area. In addition the picture can be clouded by other environmental parameters such as microorganisms, water temperature variations and underwater movements or flows.

In the fisheries community many important decisions are made based on the data received and analyzed from shipboard acoustic devices (or even more cumbersome means of physically netting and diving). The value of being able to truly study the fish and other organisms and extract the real data from the noise is extremely important. The need for better research tools and the underlying studies led researchers at Woods Hole Oceanographic Institution (WHOI) to develop a "better fish finder". In fact, this new technology could be likened to the equivalent of replacing the scientist's small AA-flashlight used in a dark lab with that of a stadium spotlight, accompanied by a magnifying glass to study the fine details. Tim Stanton, Andone Lavery and the team at WHOI selected the EdgeTech Full Spectrum Sonar System as their technology platform and went to work with the EdgeTech engineers to implement modifications to suit their application. The result was a broadband technology that provides the fishery and oceanographic researchers a complete and clear picture of the underwater creatures that may be swimming in the once murky and dark waters below.

Studies of Fish and Zooplankton with a Full Spectrum Acoustic System

Solution

WHOI researchers, working with EdgeTech engineers, came up with an approach that would allow the standard EdgeTech Full Spectrum Sonar System to perform over a wider acoustic band than any other system in operation. The modifications increased the bandwidth of the unit so it could operate from 1.5 kHz to 100 kHz. Coupled with the hardware modification was the implementation of sophisticated algorithms that provided the necessary analysis of the broadband acoustic signals that reflected, bounced and scattered in the water column.

The modified system took full advantage of the very broad band of frequencies to maximize the available information to the researchers. Since different frequencies have different characteristics as they make their journey through the water column, it is important to garner the most relevant information from each frequency based on the researchers' intended focus. Utilizing each of these characteristics in the most advantageous way to view fish and organisms in the water was the researchers' goals. The system's wide frequency range provided researchers the unique benefit of being able to use the frequency characteristics in a combined fashion and that information provided a clearer picture of the fish, their size and the numbers in a group. The higher frequencies (in the 1.5kHz to 100kHz range) allow the users to see the fish down to a 3 cm range resolution. The lower frequencies in this wide range allow the users to see the distinct acoustic resonance of the fish swimbladder which allows them to determine the size and type of fish and their relative abundance. The researchers, along with engineers at EdgeTech, have created, not only a "better fish finder", but also a better fish finder, classifier, counter and census tool too.

In addition to the system described above, another EdgeTech unit was modified to operate in a wide acoustic band covering the frequencies from 150 kHz to 600 kHz. Using similar techniques described previously, this system used the varied characteristics of different frequencies and combined that information for optimal data interpretation.

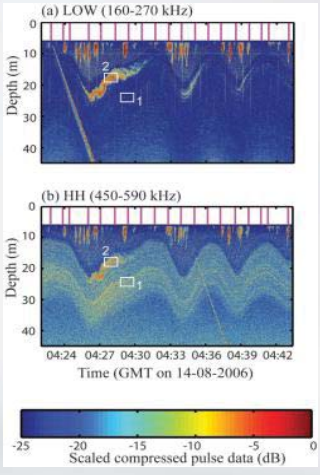
The system was used to study zooplankton and the turbulence in water. As you can see from the figure below the combined information from the lower end and higher ends of the acoustic spectrum provides valuable information and allows one to discern between zooplankton and turbulent flow underwater. These characteristics are also very important to understand the entire subsea picture when researching fish and the entire underwater environment.

Broadband, or wide band, acoustic systems offer researchers and scientists a very unique tool that has previously not been available in the marketplace. Use of these tools will continue to grow as users gain even more experience analyzing the expansive dataset now available from a commercial system. The EdgeTech sub-bottom profiler is a great tool for this operation and it will be exciting to observe the science, research and results that present themselves as a result of this unique system development.

Thank you to Tim Stanton and Andone Lavery in the Department of Applied Ocean Physics and Engineering at WHOI for their valuable work on this project. Pictures courtesy of Woods Hole Oceanographic Institution.

References: Stanton, T.K., D. Chu, J.M. Jech, and J.D. Irish. 2010. New broadband methods for resonance classification and high-resolution imagery of fish with swimbladders using a modified commercial broadband echosounder. ICES J. Mar. Sci. 67: 365-378.http://icesjms.oxfordjournals.org/cgi/content/full/fsp262v1

Lavery, A. C., Chu, D., and Moum, J. N. 2010. Measurements of acoustic scattering from zooplankton and oceanic microstructure using a broadband echosounder. J. Mar. Sci. 67: 379-394. http://icesjms.oxfordjournals.org/cgi/content/full/fsp242?ijkey=vUue3zbzmmxk1qW&keytype=ref



The high frequency broadband sensor discriminated between a region characterized by a patch of zooplankton, rectangle 1, and a region characterized by turbulence, rectangle 2. (Andone Lavery, Woods Hole Oceanographic Institution)