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Evanescent Acoustic Wave Scattering By Targets And Diffraction By Ripples

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LONG-TERM GOALS

The goal is to develop and test certain ideas relevant to the coupling of sound with small targets buried in the ocean bottom. This is a "Graduate Traineeship Award in Ocean Acoustics."

OBJECTIVES

The main objective is to understand consequences of incident wave evanescence on (existing or under-utilized) scattering observables. It is also planned to explore conditions whereby surface roughness enhances the coupling of sound to simulated buried targets. Resolving these issues should be helpful for discriminating between echoes between real buried targets and background objects.

APPROACH

Simulation experiments will be carried out and the results will be compared with theoretical predictions. Professor Philip L. Marston directs the research (while receiving no financial support from this grant). Curtis F. Osterhoudt is a graduate student supported by this grant at Washington State University.

WORK COMPLETED

This grant initiated 01-JAN-2003.

RESULTS

The principle progress has been the identification of an environmentally friendly liquid mixture that, when placed in contact with water, has the desirable acoustic contrast to facilitate the production of acoustic evanescent waves in a substantial volume of liquid. The mixture does not mix with water and is denser than water. We developed methods for producing tens-of-gallons of the special liquid mixture and relevant stability properties and sound speed were measured.

The speed of sound in the dense mixture is typically 885 m/s. Experiments in a small tank containing less than one gallon of the special mixture in contact with water confirmed that reflection at grazing incidence causes acoustic evanescent waves to be produced. In these small scale experiments (as well as in the larger scale tank experiments planned) the source transducer is placed in the dense liquid mixture which simulates the ocean water column. The water in the tank above the mixture simulates the ocean bottom. Hydrophones to detect and measure scattering may be placed either in the water (the simulated bottom) or in the mixture (the simulated water column). Osterhoudt has also demonstrated an electrical method for exciting ripples on the interface between the two liquids.

IMPACT/APPLICATIONS

This research should eventually improve the understanding of the acoustic signatures of buried targets and the acoustic discrimination of target and background acoustic scattering.

TRANSITIONS

Marston has discussed our general plans to develop a scattering facility (based on our approach using a novel liquid mixture) with various ONR supported researchers for their comments. The researchers consulted have included Kevin Williams (APL/UW) and Ray Lim (CSS/Panama City FL).

RELATED PROJECTS

This Graduate Traineeship Award does not cover the significant materials and supplies costs for an experiment of this type. Those costs are covered in part by the following grant from ONR code 32CM: N000140310585, “Scattering of Evanescent Acoustic Waves by Regular and Irregular Objects.” That grant initiated 15-MAR-2003. Grant N000140310585 currently provides partial support for several other students: J. Stevick and K. Baik (graduate students) and J. Burt (undergraduate student). The nature of the project is such that several people need to be involved at the same time.

HONORS/AWARDS/PRIZES

Curtis F. Osterhoudt received the ASA "Best Student Paper in Underwater Acoustics" second place award (spring 2003).