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ACOUSTIC CHARACTERIZATION OF MARINE SEDIMENTS

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LONG-TERM GOALS

The objective of this research is to improve understanding of bottom acoustic scattering at mid- and high-frequencies.

SCIENTIFIC OBJECTIVES

The primary scientific objective is to develop improved theoretical approximations having a wider range of applicability than those presently available.

APPROACH

Previous work by A.N. Ivakin on scattering in layered seabeds, volume scattering in elastic seabeds, and multiple scattering forms the basis for this research. This research is conducted as a collaboration between A.N. Ivakin at the Andreev Acoustics Institute in Moscow and D.R. Jackson at the Applied Physics Laboratory of the University of Washington (separate funding). Relevance of the research to problems of current US interest is promoted by frequent interaction with other US investigators.

WORK COMPLETED

Two papers on the perturbative treatment of scattering by elastic sea beds have been accepted for publication. This perturbation approach has been extended to allow vertical gradients (profiles) in average properties in preparation for comparisons with high-frequency scattering data from the Coastal Benthic Boundary Layer (CBBL) experiment at Key West. The unified approach for volume and roughness scattering has been further developed by Ivakin, and paper on this topic has been accepted for publication.

RESULTS

Initial model-data comparisons for the Key West CBBL data indicate that, while gradient effects are important, they are not responsible for slight oscillations observed in the scattering strength angular dependence. The unified surface-volume approach has made it possible to include both rough interface (including interfaces between sediment layers) and sediment sediment volume scattering in a single formalism. Expressions for the scattering cross-section are obtained involving cross-correlation matrices between the roughness of different interfaces and between the volume fluctuations of sound speed and density. This approach shows that roughness-volume correlations can be important.

IMPACT / APPLICATION

The results of this research will extend sea bed scattering models to previously inaccessible domains, including layered sediments, correlated roughness-volume scattering, and multiple scattering.

TRANSITIONS

The results of this work are being adapted in practical models for sea bed scattering. For example, a high-frequency bistatic scattering model funded by the ONR Torpedo Environments Program (6.2) incorporates the elastic scattering model developed as part of this work.

RELATED PROJECTS

This research is conducted jointly with the separately funded work of D.R. Jackson and comparisons with CBBL data have been carried out in collaboration with Kevin Williams. The unified approach is relevant to acoustic penetration and multiple scattering issues arising within the ONR Departmental Research Initiative on high-frequency sound interaction with the seafloor.

REFERENCES

D.R. Jackson and A.N. Ivakin, "Scattering from elastic sea beds: First-order theory," J. Acoust. Soc. Am. (In press).

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