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6. AUTHOR(S)
Prof. M. J. Beran

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Prof. M. J. Beran
Electrical Engineering Department
The Catholic University of America
Washington, DC 20064

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9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Dr. J. Simmen
Ocean Acoustics
Office of Naval Research
800 North Quincy St.
Arlington, VA 22217-5000

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13. ABSTRACT (Maximum 200 words)

Methods of solution were considered for solving the generalized coherence function when there is a general bottom impedance condition. In this case the equation contains a diffusion term. Three types of solution were considered: (1) a multi-scale solution, (2) a quasi-equilibrium solution and (3) a numerical marching procedure. Work on the numerical solution has begun using a simplified Gaussian form for the index-of-refraction fluctuation correlation function. In addition the bottom impedance condition has been compared with a formulation which includes a water-bottom interface and it is shown that the latter approach can be incorporated in the present formulation.

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Principal Investigator: Prof. M.J. Beran
The Catholic University of America
E-mail: beran@cua.edu

To: Dr. J. Simmen
Ocean Acoustics
Office of Naval Research
800 North Quincy St.
Arlington, VA 22217-5000
E-mail: simmenj@onrhq.onr.navy.mil

Date: June 30, 1996

During this report period only Mr. T. Barnard, the Ph.D student was supported by the contract. His work, however, was closely supervised by the principal investigator.

The following topics were studied during the report period:

1) Combined volume and surface scattering in a channel, using a modal formulation.

2) Spatial spectral analysis of scattering in a random media. Single-frequency and two-frequency formulations.

3) Data analysis to determine vertical and horizontal correlation lengths of the random index-of-refraction fluctuations in a channel.

4) The effect of random fluctuations on the two-frequency coherence function in a shallow channel.

5) Approximate eigenfunctions and eigenvalues for linear sound-speed profiles and a bottom impedance condition. Generalized coherence equation for complex bottom impedance condition.

Topics 1-5 were reported upon in the previous progress reports (Jan. 1, 1994 - Oct. 31, 1994, Nov 1, 1994 - Dec. 31, 1994, Jan. 1, 1995 - June 30, 1995, July 1, 1995 - Dec. 31, 1995)). The progress we have made since these reports is updated in this report. ONR has granted a no-cost extension of the grant until August 31, 1996. A final report will be submitted at the conclusion of the contract. The work of T. Barnard will continue under an Aasert award that has been granted by ONR.

1. Combined volume and surface scattering in a channel using a modal formulation.

A paper on this subject has been accepted for publication in the J. Acoust. Soc. of Amer. The proofs have been corrected and the paper should be published in the next few months.

2. Spatial spectral analysis of scattering in a random media. Single-frequency and two-frequency formulations.

In preparation for a spatial spectral analysis of the transverse direction in shallow water channel propagation a spectral spatial analysis was developed for an infinite medium. (This work was performed in conjunction with an investigator not supported by ONR). A paper has been submitted for publication.

3. Data analysis to determine vertical and horizontal correlation lengths of the random index-of-refraction fluctuations in a channel.

No further work was done on the detailed analysis of the horizontal correlation.

4. The effect of random fluctuations on the two-frequency coherence function in a shallow channel.

The two-frequency formulation has been completed and numerical calculations for the two-dimensional problem are continuing. (The doctoral student working on this problem is not supported by ONR).

5. Approximate eigenfunctions and eigenvalues for linear sound-speed profiles and a bottom impedance condition. Generalized coherence equation for complex bottom impedance condition.

This section deals with the Ph.D. work of Mr. T. Barnard.

Most of Mr. Barnard's effort was concerned with solving the generalized coherence function for the complex bottom impedance condition. As we mentioned previously this equation differs from those studied previously in that the modal horizontal wavenumbers are complex and therefore a diffusion term appears in the differential equation for the modal coherence.

As a result of the added diffusion term new methods of solution were considered. First a two-scale solution was

developed for the region where the ratio of the index of refraction fluctuations to the non-dimensionalized absorption was small. Secondly a quasi-equilibrium solution was shown to exist for a certain range of parameters. Last a numerical marching procedure was considered.

At present, work is proceeding on implementing the numerical procedure for a Gaussian correlation function for the index of refraction fluctuations. Considerable simplification occurs for this idealized function and we expect that a numerical solution will be practical. Attention will be focused on obtaining the transfer of energy between modes and thus the behavior of the coherence function need be known only in the vicinity of small transverse separation distances.

Finally, a model due to F. Ingenito was examined which considers attenuation below the water-bottom interface. This model can be incorporated into the scattering model we have been considering. The Ingenito model has a slightly different eigenvalue equation from the model with the general bottom impedance condition. (The two equations become the same when the bottom density becomes infinite).