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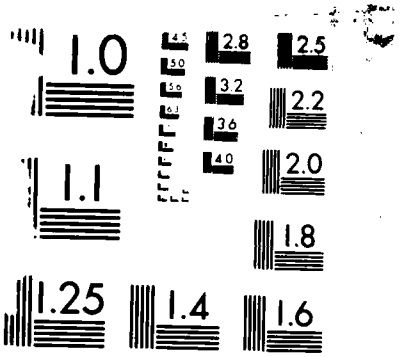

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Science Applications International Corporation

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Report SAIC-86/1586

FINAL REPORT FOR CONTRACT N00014-84-C-0136
LFA DATA ANALYSIS AND EXTENDED MODELING

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20 March 1986

Final Report

Prepared for

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Data analysis and modeling for sea surface and bottom reverberation is summarized in the formal and final report for ONR contract number N00014-84-C-0136.

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FINAL REPORT FOR CONTRACT N00014-84-C-0136
LFA DATA ANALYSIS AND EXTENDED MODELING

1. INTRODUCTION

1.1 Contract Information. This document is the final report for Office of Naval Research Contract Number N00014-84-C-0136, Tasks I and II. The work under this contract was conducted by Science Applications International Corporation (SAIC) during the period from 19 January 1984 through 20 January 1986.

1.2 Reports. The bulk of the work under this contract has been reported to the COTR during the Performance Assessment ("GLUE") Group meetings. Other efforts pertinent to this contract have been documented in SAIC Report Nos. DCN-842189, DCN-842628, DCN-843997, DCN-850411, DCN-852193 and DCN-853957.

2. TASK I - DATA ANALYSIS AND INTERPRETATION

2.1 Statement of Work. "SAIC will process, analyze and interpret data from several Navy experiments to characterize the reverberation environment for low-frequency active systems. Efforts will include evaluation and modification of state-of-the-art LFA models, and specification of critical measurements for follow-on exercises."

2.2 Bistatic Surface Scattering Strengths. SAIC processed data collected during the AAUS and LFA exercises to measure and quantify surface scattering strengths in a bistatic geometry and determine the spectra of the backscattered field.

2.3 Monostatic Sea Surface and Bottom Backscattering. SAIC processed and analyzed data collected during the AAUS and LFA exercises to determine and evaluate the scattering strengths of the sea surface at the convergence zones and spectra of the acoustic field scattered from the sea surface and ocean bottom. This analysis included the modeling of he effects of source/receiver characteristics, data recording system, and platform dynamics during the data collection.

2.4 Scattering Models. The measured scattering strength levels were compared to the predictions of models developed at SAIC and described in the following paragraphs.

2.4.1 Bistatic Scattering Strength Model. In order to interpret and evaluate the measured data in the bistatic configuration, W.D. Kirby of SAIC upgraded the Generic Sonar Model to predict bistatic reverberation.

2.4.2 Surface Backscattering Model. A composite roughness model of surface backscatter was developed; the cut-off wave number for sea surface spectrum partition was determined based on physical considerations. A

good agreement between the model predictions of scattering strength and the measured data was reported.

2.4.3 Bottom Backscattering Model. The experimental data were compared to predictions of a model of bottom backscatter with Lambert's law and parameters derived from the Bottom Loss Upgrade (BLUG) database. Good agreement with the data was reported.

3. TASK II - EXTENDED MODELING

3.1 Statement of Work. "SAIC will extend the present modeling capability to incorporate selective spectral spreads for bottom reverberation and surface-duct environments to achieve a complete system-performance estimation capability."

3.2 Multiple Bounce Forward Scattering Model. SAIC personnel (C.W. Spofford and A.P. Stokes) developed a model to predict the spectrum of multiple-bounce forward scattered signal; the model considers linear as well as non-linear surface wave interaction. This model has a direct application to surface-duct environments.

3.3 Surface Reverberation Modeling. C.W. Spofford directed the activities of a surface reverberation modeling group. The effort concentrated on developing models and evaluating theories of surface backscatter with the objective of gaining understanding on some characteristics exhibited by the experimental data. During this effort models based on Kirchhoff, perturbation, and composite roughness theories were developed and evaluated, and the effects of signal waveform on scattering strength measurements were investigated.

4. OTHER EFFORTS

4.1 Activities. During the contract period SAIC participated in several efforts in support of the LFA program:

4.1.1 Channel Characterization. C.W. Spofford had full responsibility for acoustic channel characterization in the GLUE group. He was responsible for providing estimates of system performance degradation due to channel characteristics, proposing processing methods to minimize the losses, identifying environmental issues that had to be resolved and specifying the required experimental measurements.

4.1.2 Experiment Planning. SAIC actively participated in the planning of LFA Fixed-Fixed experiment. This involvement included the predictions for system performance and overall design to assure the collection of meaningful data with the assets available for the exercise.

4.1.3 Shallow Water LFA Concepts. SAIC took full responsibility for the design of the shallow-water phase of the Fixed-Fixed experiment. This effort included the formulation of an active barrier concept and a measurement plan for concept validation.

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