University Of Utah Electromagnetic Modeling Capability For MCM and Undersea Sensor Systems

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LONG-TERM GOAL

The long-term goal is to develop low frequency electromagnetic models and apply these models to Navy specific problems and research.

OBJECTIVE

The objective is to improve the Navy's EM forward modeling and data interpretation capability in a cost effective manner using academic resources and leveraging industry and other agency development efforts. These research efforts support the Organic Mine Countermeasures (MCM) and Littoral ASW Future Naval Capabilities (FNC) for both ONR and NRL projects with innovative EM numerical tools.

APPROACH

Participate in the University of Utah consortium on EM modeling and Inversion under the direction of Dr. Zhdanov. Selected algorithms and software modules will be installed, tested and integrated into NRL's EM modeling effort to support advanced numerical predictions for MCM and ASW systems. The models will become part of a Navy low frequency EM modeling capability that NRL has developed. NRL will manage the project and link Navy relevance for ONR research to the Organic Mine Countermeasures and Littoral ASW FNCs. As a member of the University of Utah consortium, NRL provides input to direct consortium research of model development in directions that are beneficial to the Navy.

WORK COMPLETED

The University of Utah consortium meets annually to review the progress and developments of the previous year. During the previous year a group of nine graduate students and four professors produced eighteen papers detailing the results of new methods in EM model development. New model developments have included:

- Improved integral equation and finite difference 3-D EM forward modeling capability

- 3-D induced polarization and time domain EM inversion using a quasi-linear approximation technique

- Fast imaging and inversion of frequency and time domain EM observations

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The long-term goal is to develop low frequency electromagnetic models and apply these models to Navy specific problems and research.

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NRL has utilized EM forward modeling techniques to quantify the impact of STRATAFORM research on MCM sweeper systems in support of the Organic Mine Countermeasures (MCM) FNC. One paper has been accepted for publication in JUA on the impact of anomalous bottom electrical properties for undersea surveillance systems. A second paper describing the impact of this research for MCM sweepers is in progress.

RESULTS

NRL has determined that anomalous bottom electrical properties like those discovered in the STRATAFORM area off the coast of California should have a minimal impact on undersea surveillance systems. In contrast, these same anomalies can have a very significant impact on MCM sweeping systems.

IMPACT/APPLICATION

This work emphasizes the importance for ONR and NRL research to identify environmental variability prior to use of future organic MCM systems like OASIS. OASIS is an organic MCM system currently under development at the Coastal Systems Station, Panama City, FL.

TRANSITIONS

Models from this work have been transitioned to the NRL Multiple-Influence Detection task and used by NRL to evaluate MCM sweeper parameters in coastal areas.

RELATED PROJECTS

Related projects include the NRL Multiple-Influence Detection task, which has investigated the effects of the environment on data fusion of different sensor types for ASW applications.

PUBLICATIONS

Avera, W. and Wayne Kinney, Effects of an Inhomogeneous Electrically Resistive Bottom on Nonacoustic Detection (U), Accepted for publication in Journal of Underwater Acoustics (JUA).

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Wannamaker, Philip, George Jiracek, John Stodt, T. Grant Caldwell, Victor Gonzales, J. Donald McKnight and Allen Porter. Fluid Generation and Pathways Beneath an Active Compressional Orogen, the New Zealand Southern Alps, Inferred from Magnetotelluric Data, CEMI 2001 Annual Meeting.

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