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Uncertainty Related to Geophysical Sampling

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LONG TERM GOALS

The goals of this research are to define and characterize the variabilities and uncertainties in the components and linkages of the general physical-geo-acoustical system (the *System*) relevant to the support of naval operations, and transfer quantitatively the spatial-temporal environmental variabilities and uncertainties through the System, including coupled interactions, in order to determine uncertainty measures, sensitivities and feedback critical for operational predictions and parameters.

OBJECTIVES

Transfer uncertainties from the geoacoustic environment to the sonar and its signal processing, in order to effectively characterize sonar performance and predictions. Construct, calibrate and evaluate uncertainty and variability models, for the System and its components, to address forward and backward transfer of uncertainties based upon the process of end-to-end data assimilation. Develop generic methods for efficiently and simply characterizing, parameterizing, and prioritizing System variabilities and uncertainties arising from regional scales and processes.

APPROACH

The nature of the horizontal and vertical distribution of the bottom and sub-bottom scales and attributes (attenuation, velocity, density) will also be evaluated using acoustic data, ancillary data (including but not limited to in situ samples and seismics) and stochastic models relating the variable of the various components to observable features. The uncertainty in acoustic prediction will be initially viewed in terms of the mean error in acoustic prediction at N number of source sites caused by the using the i^{th} geoacoustic model of i^{th} source site as the input geoacoustic model to each of the other 1 to N source sites. The variations in geoacoustic models will be correlated with the variations in ancillary data to determine the degree to which surface observables can be used to cue sampling strategies.

The areal variation in scattering strength will be investigated by inverting the acoustic SUS data for scattering strength at each of a number of source locations. From the inversion for geoacoustic

parameters we will have an estimate of the source beam pattern, and a geoacoustic model. Using these as input we can invert for bottom scattering strength as a function of grazing angle, and as function of location. We can then estimate the uncertainty in reverberation prediction (a system function) in the exercise area.

The resulting statistical parameters will be used to quantify sonar-processing performance (signal and reverberation). The *System* Probability Density Function (PDF), a probabilistic description of the environment's intrinsic variability, measurement uncertainty, and impact on the sonar's signal-to-interference ratio, will be developed for fleet applications. These PDFs will be assessed as to their impact on signal processing, including detection and estimation (bearing, range, depth, etc.).

WORK COMPLETED

Shot data from six 10-gram omni-directional SUS charges from the ACT III site were inverted to obtain geoacoustic parameters. Each inversion was performed on the A/D output to insure that uncalibrated data could be inverted successfully. The locations were selected to determine the robustness of the analysis plan, and to verify that consistent inversions could be made when using sources that have unique directional characteristics for each shot.

RESULTS

None

IMPACT/APPLICATIONS

None

TRANSITIONS

None

RELATED PROJECTS

REFERENCES

PUBLICATIONS

None

PATENTS

None.