**Fluctuations in High Frequency Acoustic Propagation**

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**Abstract**

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2
FLUCTUATIONS IN HIGH FREQUENCY ACOUSTIC PROPAGATION

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LONG-TERM GOALS

The long-term goals of this work are to understand the influence of environmental variability on fluctuations in the propagation of high frequency acoustic energy with applications to the improvement of acoustic data communications in shallow water.

OBJECTIVE

The objective of this research is to investigate experimentally how the temporal and spatial variability of environmental parameters in shallow water is coupled into fluctuations in the observed propagation of high frequency acoustic energy, the impact these fluctuations have on acoustic data telemetry, and how frequency and spatial diversity might be used mitigate these effects.

APPROACH

The extreme temporal and spatial variability of shallow water environments can yield time-evolving, complex acoustic propagation effects at high frequencies (> 1 kHz). Thus, the observed signal is influenced by a number of environmental effects simultaneously (e.g. time-varying water column sound speed structure, surface waves, and spatial variability in bottom properties). The medium inhomogeneities and variability are embedded in the fluctuations observed in a received signal.

A shallow water, fixed source - fixed receiver, experiment will be conducted to investigate these environmental effects. The experimental work will take advantage of a recently-completed 64-element receive array covering the 0.5-20 kHz band which will enable investigating the spatial structure of fluctuations in acoustic propagation at these frequencies. Coincident environmental measurements will enable us to understand the relationship between fluctuations in the received acoustic field and spatial and temporal fluctuations in the critical water column parameters affecting acoustic propagation.
WORK COMPLETED

Planning and preparations for an early FY98 shallow water experiment have been completed. The experiment will be conducted in ~100 m water over a propagation path of ~6 km. The 64-element vertical receive array will have an aperture of 11.8 m.

RESULTS

Beyond planning for the fixed-fixed experiment described above, some initial work has been done looking into the feasibility of a phase conjugation (time reversal mirror) concept which incorporates naturally the temporal and spatial variability of the shallow water environment into a channel equalization approach for underwater data communications.

IMPACT / APPLICATIONS

The emphasis of this work is on understanding the influence of environmental variability on high frequency acoustic propagation. A specific application area of interest is the impact that these environmentally-driven fluctuations have on acoustic data communications and how best to mitigate their effects.

TRANSITIONS

The measurements made in this project will provide experimental data which can be used for developing models of the fluctuation characteristics of shallow water acoustic propagation in the 0.5-20 kHz band.

RELATED PROJECTS

Related work is being carried out in the project "Environmental Influence on Underwater Phase Coherent Communication" (T.C. Yang, A. Al-Kurd, and M. Orr, NRL).

REFERENCES