(D5)

Rhode Island Oct 1991

Broadband matched-field processing of transient signals in shallow water

by

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Abstract

Range and depth localization of a sound source is possible by matched-field processing of a vertical line array. It is well known that the ocean environment and the receiving system impose theoretical limitations on the detection/localization performance that can be obtained. When applied to real data other limitations are: the mismatch between the assumed and the true environmental/system parameters, the ambient and system noise and the natural time-space variability of the acoustic field. For these reasons reports of successfull matched-field processing experimental results have been rare. Most of the experimental results reported in the literature have used continous wave emitters which allowed for data stabilization through time averaging. Driven by the increasing interest on the analysis of short time records a new matched-field processor has been developed that allows for the localization of sound sources emitting broadband transient type of signals. The basic idea behind that processor is to apply a MUSIC related type of algorithm to match the model predicted acoustic field with the the subspace spanned by the normal modes which are significantly excited by the sound source. Data stabilization is achieved by geometric frequency averaging of the range-depth ambiguity surfaces obtained within the source signal bandwidth. Results obtained on synthetic data show that the performance of this processor is always better or equal than that of the generalized minimum variance processor that itself largely outperforms the conventional matched-field processor. It is also shown that the effect of the frequency averaging is to increase the stability of the source location estimate. Results obtained with this method on short transient pulses collected during the North Elba'89 cruise in a 120 m water depth area and received on a 62m aperture vertical array showed stable and accurate localizations over long time intervals. It is also shown that the sound field received over a given frequency band is relatively stable over time and agrees with the predictions given by a standard normal-mode propagation model.