

Model-Based Detection in a Noisy Shallow-Water Environment

Dr. Edmund J. Sullivan

Principal Scientist, OASIS Inc.
sullivan@oasislex.com 401 849 0356

Dr. James V. Candy

Chief Engineer, Lawrence Livermore National Laboratory
candy1@llnl.gov 925 422 8675

Dr. William M. Carey

Professor of Mechanical Engineering, Boston University
Kerrygrp@ctol.net 617 353 7706

Abstract: A previous study (JASA 112, 5, pt. 2 Nov. 2002) treated the detection of a weak target in a noisy shallow-water environment with ambient noise and “known” interfering ships by applying a model-based adaptive (recursive) technique. The shallow-water environment and noise sources were represented by a normal-mode model directly incorporated into the model-based processor, thereby allowing their effects to be removed from the decision function prior to target detection. This previous work also assumed that the propagation model was exactly known. In reality, this approach would be severely limited by the so-called “mismatch problem.” As in the previous work, the decision function is the “Weighted Sum Square Residual” (WSSR), which evolves directly from the innovation

sequence of the model-based processor. However, in the present work, the model parameters themselves (modal functions and modal amplitudes) are included as unknowns by “augmenting” them directly into the processor. This not only permits the interferers to be removed as in the previous work, but also allows the model parameters to be recursively updated. Thus the processor not only adapts to the presence of the interferers, but also adapts the model itself. This is an important advance, since the mismatch problem continues to be a serious limitation in the Matched-Field form of Model-Based processors. An example is shown for a low level sound source in ambient noise with a strongly interfering ship.