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Bayesian approach to signal detection, source localization and ocean environmental parameter estimation

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From a Bayesian perspective, signal detection, source localization and ocean environmental parameter estimation algorithms can be viewed as simultaneous signal processing operation. In these cases, the likelihood function provides a mechanism for incorporating physical models of the ocean environment. In addition, one can incorporate uncertainties of source location and ocean environmental parameters a priori, rather than dealing with them "after the processing", and this approach also provides a posteriori probabilities of these source and ocean parameters as outputs of the processing. In addition to affecting the structure of optimal signal processing algorithms, these uncertainties affect how well one can spatially localize the source of sound, or the accuracy with which one can estimate the ocean environmental parameters. In passive and active sonar detection, these uncertainties, along with the knowledge of the ocean physics that has been incorporated in the likelihood function, determine detection performance. In particular, this paper will illustrate how signal detection theory can provide quantitative upper bounds of sonar detection performance on the receiver operating characteristic (ROC) as a function of the amount of uncertainty in ocean environmental parameters, source location, and signal-to-noise ratio.