ACOUSTICS2008/876
A comparison of methods for approximating acoustic uncertainty in underwater sound channels

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The accuracy and reliability of acoustic field calculations are often determined by uncertainty in environmental parameters. There are currently several approaches for predicting calculated-acoustic-field uncertainty arising from environmental uncertainties. This presentation outlines the current development of a method for predicting acoustic uncertainty based on correlations between variations in an uncertain parameter and spatial shifts within a calculated acoustic field. The results of this technique are compared with several other modern methods for predicting acoustic uncertainty such as direct sampling of environmental parameters, linearization and higher-order finite difference approaches, the adjoint method for approximating derivatives of the acoustic field with respect to environmental parameters, and polynomial chaos methods. The advantages and limitations of each technique are presented for range-independent shallow-ocean sound channels at nominal ranges of 1 to 10 km and frequencies from 100 Hz to 1 kHz. Comparisons of accuracy, computational speed, and applicability to particular uncertain parameters and field prediction routines are provided. Emphasis is placed on identifying the types of sound channel properties and environmental uncertainties for which each technique performs most reliably, as well as identifying situations for which current techniques are not yet adequate. [Sponsored by the Office of Naval Research, Code 321OA].