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Sub-Bottom Profiling Using Time-Frequency Analysis

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Sub-bottom profiling using time-frequency analysis

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Abstract

Methods for characterizing the returns from acoustic scatterers can roughly be separated into spectral or imaging methods. If the wavelength of the acoustic signal is small compared to the size of the target (geometrical scattering), the object may be imaged to such a fine resolution that its shape or structure may be revealed. This is often achieved using a wide bandwidth (high temporal resolution) signal. Otherwise, if the wavelength of the acoustic signal is large compared to the target size, spectral methods are deemed superior. These utilize relatively narrowband methods (with good spectral resolution) designed to identify characteristic resonances or nulls in spectra. However, practical factors place sub-bottom profiling systems squarely in the middle of these two domains. Hence time-frequency analysis becomes a viable option for characterization of scattering from buried objects. This study utilized simulated and tank-collected data to demonstrate the utility of Wigner-Ville distributions in analyzing and characterizing specific acoustic interactions. Salient features of scattering are revealed in the Wigner-Ville distributions that are not easily identifiable in either time domain or frequency domain only analysis. [This work was supported in part by the Naval Research Laboratory under program element PE62782N.]

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