Modeling Acoustic Interface Wave Dispersion Using COMSOL Multiphysics®

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Abstract

Measuring geoacoustic parameters of underwater sediments is important for accurate numerical modeling of underwater acoustic propagation. While density and compressional-wave speeds can be easily measured in sediments, shear-wave speeds are difficult to measure due to their high attenuation. However, shear-wave speeds can be indirectly determined through measurement of Scholte ocean-seafloor interface wave speeds. When the seafloor is composed of layers of sediments with different shear-wave speeds, the Scholte wave speed is dispersive. By measuring these frequency-dependent Scholte wave speeds, inversion techniques can be used to infer shear-wave speeds. Scholte wave speeds have been measured in Narragansett Bay, Rhode Island [J. Greene et al., SYMPOL, Cochin, India, 2011]. In this experiment, Scholte waves were excited by dropping a weight onto the seafloor and measured using geophones (figure 1). By using an inversion technique, each layer's thickness, density, compressional-wave speeds, and shear-wave speeds was calculated.

To validate the inversion method, the Acoustics Module in COMSOL Multiphysics® is employed to model the experiment at Narragansett Bay. The Scholte wave is excited by applying a boundary load force on the water-sediment interface. For each frequency, a spatial Fourier transform is implemented on the interface wave to calculate the phase speed. Modeled and measured interface wave speeds will be compared. Once validated, this inversion scheme will be used to classify different ocean environments. These geoacoustic parameters can then be used in COMSOL for accurate numerical modeling of acoustic propagation.

Reference

J. Greene et al., SYMPOL, Cochin, India, 2011

Figures used in the abstract

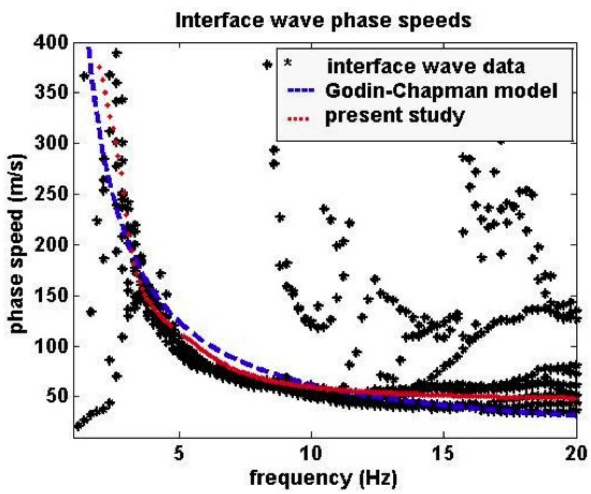

Figure 1