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use of symmetry in 3D propagation

Solving propagation in a three-dimensional environment is one of the most challenging problems in computational physics. However, for cases where the environment possesses some kind of symmetry be it rotational or translational, the propagation problem can be simplified considerably. It can be shown that in problems where the environment is translationally invariant, the 3D wave equation can be Fourier transformed along the direction of translational symmetry to reduce it to a 2D equation for each spectral component. The 3D solution can be obtained by solving the 2D wave equation for each spectral component and performing the inverse Fourier transform. In this paper we use translation symmetry to compute propagation in an ideal and a penetrable wedge. For the ideal wedge, the pressure-release boundary condition is applied to both boundaries and for the penetrable wedge, the pressure-release boundary condition is applied to the horizontal surface and the continuity of pressure and normal velocity is imposed on the sloped interface. To obtain a numerically exact solution, we use the virtual source technique to solve the corresponding 2D problems. We use azimuthal symmetry in the framework of boundary element method to compute propagation in a Pekeris waveguide in the presence of conical seamount.

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