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Plane Wave Diffraction from a Finite Soft Cone at Oblique Incidence

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Abstract

The canonical problem of diffraction of the plane acoustic wave on a finite hollow soft cone in the general case of oblique incidence is solved. The corresponding diffraction problem is formulated as a first-kind boundary value problem for the Helmholtz equation with respect to the scattered velocity potential for each perturbed azimuthal harmonic. The diffracted field is presented as a series of eigenfunctions for the subregions formed by the cone. The pertinent diffraction problem is reduced to an infinite system of linear algebraic equations (ISLAE) for each azimuthal harmonic by using the continuity conditions and the orthogonality properties of the associated Legendre functions. The use of the analytical regularization approach transforms the ISLAE to the second kind and allows to justify the truncation method for obtaining the numerical solution in the required class of sequences. The limiting transition to the disc is considered and the simplified regularization operator for this particular case is derived. The low-frequency approximation of the problem is examined and the analytical solution in the explicit form is derived. By means of illustration, we establish the relationship between the wave size of the cone and the order of reduction of the polar and azimuthal harmonics. We examine the scattering features of a finite soft cone as a function of the incident angle. We validate the obtained results by comparing them to the ones known in literature.

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