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Sound radiation by a circular plate located on a wall of rectangular semi-infinite waveguide

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Abstract:

An acoustic field inside a rectangular waveguide with one outlet closed by a transverse baffle was theoretically investigated. The sound source is a clamped circular plate located on a longitudinal waveguide's wall at the boundary of two regions. The first region is the waveguide's interior and the second one is the half-space bounded by a perfectly rigid infinite baffle. The waveguide walls were considered as perfectly rigid. It was assumed that acoustic waves propagate in the air. The equation describing forced non-axisymmetric vibrations of the plate was solved. The influence of fluid on both plate's surfaces was included. The linear viscoelastic Kelvin-Voigt plate model was employed. The Helmholtz equation was solved to find acoustic field. The sound pressure into the half-space was expressed with the use of the Fourier series and the Hankel transform. To describe sound propagation inside the waveguide, the region was divided into two sub-regions and the continuity conditions were used. The coefficients describing the interaction between the surface of the sound source and the fluid inside the waveguide were calculated based on the series containing the Bessel functions. The obtained solution was used to illustrate and analyze the acoustic field and to formulate some conclusions.