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# Scattering of low-frequency sound by infinite fluid and solid cylinder

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TOPICS

- Acoustics
- Dielectrics
- Light scattering
- Scattering theory
- Electrostatics

## ABSTRACT

Wave scattering by obstacles is typically studied assuming plane wave incidence. However, full Green's functions are necessary for problems where the separation of the scatterer from sources, interfaces, or other scatterers is comparable to the dimensions of the scatterer itself. In this paper, the two-dimensional problem of scattering of monochromatic cylindrical waves due to infinite cylinder embedded in a homogeneous fluid is considered. Fluid and solid cylinders are studied, and soft and hard cylinders are revisited. The exact solutions for the Green's functions are expressed as an infinite series of cylindrical functions with complex amplitudes determined by the acoustic boundary conditions at the surface of the cylinder. Here, we derive closed-form asymptotics for the scattered field in the regime when the scatterer dimensions are small compared to wavelength, i.e., Rayleigh scattering. The scattered wave approximation is valid for arbitrary source and observation points outside the scatterer and is expressed as a simple sum of fields due to three image sources. Image source solutions were anticipated due to classically studied electrostatic analog problems involving dielectric cylinders. Image source representation allows physical insight into the scattering physics and suggests simple yet accurate analytic solutions to interface and waveguide scattering problems.