Reconstructing Acoustic Obstacles by Planar and Cylindrical Waves

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Abstract

In this paper, we develop a novel method of reconstructing acoustic obstacles in $\mathbb{R}^2$, which follows a similar spirit of the linear sampling method originated by Colton and Kirsch. The reconstruction scheme makes use of the near-field measurements encoded into the boundary Dirichlet-to-Neumann (DtN) map or the Neumann-to-Dirichlet (NtD) map. Both the plane waves and cylindrical waves are shown to meet the reconstruction purpose. Rigorous mathematical justification of the reconstruction scheme is established. The mapping properties of the newly introduced function operators involved in the reconstruction scheme are established. These results are of significant mathematical interests for their own sake. Moreover, due to the distinct properties of the function operators, the indictor function in the proposed reconstruction scheme exhibits completely different behaviors from those having been established for the indictor function in the original linear sampling method for inverse scattering problems. Numerical experiments are presented to illustrate the effectiveness of the proposed reconstruction scheme.