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# Asymptotic Behavior at Infinity of Phaseless Total-Field Operators and Applications to Phaseless Inverse Scattering at a Fixed Frequency

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This paper is concerned with inverse acoustic scattering with phaseless total-field data at a fixed frequency in 2D and 3D cases with plane wave incidence or point source incidence. We propose a general framework for studying this phaseless inverse problem. Define the phaseless total-field operators as integral operators with the kernels given in terms of the phaseless total-field measured on the sphere \pa B_R with a large radius R. By making use of harmonic analysis techniques we establish the asymptotic property in the operator norm from L^2(S^{n-1}) to L^2(S^{n-1}) of the phaseless total-field operators for large enough R, that is, the phaseless total-field operator tends to the corresponding far-field operator defined in terms of the far-field pattern measured on the unit sphere S^{n-1}, as R goes to infinity, where n=2,3. As applications of the asymptotic property, we establish uniqueness results for inverse scattering problems with phaseless total-field data generated by incident plane waves or point sources at a fixed frequency and measured in a small domain. Further, we develop an approximate factorization method to numerically reconstruct both the location and shape of the unknown scatterer from the phaseless total-field data generated by incident plane waves or point sources at a fixed frequency and measured on the sphere \pa B_R with a sufficiently large radius R. Numerical examples in 2D are also carried out to demonstrate the effectiveness of our inversion method.