An asymptotic factorization method for detecting small objects using electromagnetic scattering

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Abstract

We consider the inverse problem of localizing a collection of finitely many small perfectly conducting objects within an unbounded homogeneous background medium using near-field measurements of time-harmonic electromagnetic fields. Therefore we first investigate the direct scattering problem in detail and rigorously derive an asymptotic expansion of the scattered field in terms of the incident field, the centers of the inhomogeneities and their geometry, as the size of the inhomogeneities tends to zero. Similar formulas have recently been derived formally by Ammari et al. and they have subsequently been successfully applied to reconstruct the centers of inclusions using a MUSIC-type method. Inspired by the factorization method we also use the asymptotic formula as the basis of a direct (i.e. noniterative) reconstruction algorithm closely related to linear sampling methods and also to MUSIC-type methods. The viability of this method is documented by numerical examples.