An iterative method for solving the inverse medium scattering problem with limited aperture measurements

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ABSTRACT

This work is concerned with numerical solution of an inverse medium scattering problem which reconstructs the refractive index of an inhomogeneous medium from measurements of the far ¯eld pattern of the scattered ¯elds. The inverse problem arises naturally in various applications, for example, medical imaging, non-destructive testing, and geophysical imaging. In many practical applications, the wave ¯elds can only be measured in a limited aperture. Our goal of this paper is to solve the two-dimensional inverse problem by using only limited aperture data. It is assumed that the data may be collected at multiple frequencies. The problem is challenging since without full aperture measurements, the nonlinearity and ill-posedness of the inverse problem become more severe.

The forward scattering problem is ¯rst formulated as the Lippmann-Schwinger integral equation and solved by a fast numerical solution method based on the algorithms GMRES and fast Fourier transforms. An e±cient regularized iterative linearization method (recursive linerization with respect to the wave number) is developed for solving the inverse problem. The convergence of the iterative method is examined by a number of numerical examples. The examples in the case of noisy data will also be presented in both one and two-dimensional con¯gurations.