Fast methods in 3D inverse obstacle scattering

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Numerical research on acoustic inverse obstacle scattering problems has focused mainly on two-dimensional problems so far even though three–dimensional problems are more important in applications. Since the numerical solution of the forward problem is already a challenging task, which has to be performed a large number of times in iterative regularization methods, this poses restrictive demands on the efficiency of both the forward and the inverse solver.

We use a wavelet based boundary element method for the solution of the forward scattering problem and discuss both the implementation of the derivatives with respect to the domain and the characterization and implementation of the adjoints. A preconditioned regularized Newton method is employed to solve the inverse problem. Numerical experiments show that the method yields very accurate reconstructions for exact data and performes reasonably well in the presence of noise.