Inverse Scattering of Multiple 3D Dielectric Targets using the Level Set Algorithm

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Recently, the level set method has grabbed the attention for electromagnetic inverse scattering problems. The level set method is an implicit representation of a moving interface as a zero level of a higher dimensional function. The topological changes such as breaking and merging of regions are handled without user interference. Multiple objects can be retrieved from a single initial guess. Since a higher-dimensional function is updated in the entire computational domain, the level set method is computationally demanding motivating its parallelization. The level set function is updated by solving a Hamilton-Jacobi-type partial differential equation. Several papers in the literature by the authors and others have addressed the reconstruction of two-dimensional objects using the level set method.

The objective of this work is to demonstrate the capability of the level set algorithm to reconstruct the shape of multiple three-dimensional (3D) dielectric targets. Plane electromagnetic waves are used to illuminate the objects and the scattered far fields are simulated for the reconstruction algorithm.

The forward scattering is solved using the Method of Moments (MoM). The Combined Field Integral Equation (CFIE) is used to calculate the scattered field of the evolving objects during the evolution of level set function.

An appropriate form of deformation velocity, which makes a decreasing cost function, is implemented using the reciprocity theorem. The deformation velocity depends on forward and *adjoint* fields corresponding to different incident directions and frequencies. Numerical results demonstrating the shape reconstruction of 3D multiple homogeneous dielectric objects will be presented in the conference.