Direct sampling method with optimal test dipole in inverse electromagnetic scattering 3D problem

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Abstract

Development and analysis of efficient methods and techniques for solving such an inverse scattering problem have been attracting research due to its potential in diverse application such as non-destructive testing [1], and biomedical imaging [2], etc.

Non-iterative method is one of the significant part in these fields because of their many advantages such as low computational cost and/or preliminary information and simplicity of the algorithms, etc. Many of such algorithm, for instance, MUltiple SIgnal Classification (MUSIC), linear sampling method (LSM), and migration-type method (Kirchhoff migration, subspace migration), etc., have been studying and applying under many different conditions. These methods are able to reconstruct the shapes and locations of unknown targets when dealing with enough incident fields [3] but might fail otherwise [4].

To overcome these difficulties the so-called direct sampling method (DSM) was firstly suggested in [5] for 2D inverse acoustic scattering problem and in [6] for 3D inverse electromagnetic scattering problem. According to [5, 6, 7], DSM is a stable, robust with respect to noise and fast – because it doesn't need any matrix operation such as singular value decomposition– method. Contrary to DSM for 2D acoustic problem, DSM for 3D electromagnetic problem have to handle vector formed scattered fields. Therefore, we have to consider the so called dyadic green function, and its polarization. Since the DSM, as defined in [5] needs the definition of an a priori test dipole, the imaging result might fail if the latter is not properly defined. To the best of our knowledge the choice of an optimal test dipole for DSM has not been presented yet because of their complexity of relation between optimal polarization and other parameters. To deal with this issue, DSM with our optimal test dipole (DSMO) is proposed and validated by various results from numerical simulations of non-degenerate and degenerate inhomogeneities.

Keywords: *inverse electromagnetic scattering problem, direct sampling method, non-iterative method, dyadic green function, numerical experiments*

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Biography

Sangwoo Kang is born in South Korea in 1987. He received the Bachelor’s degree in mathematics from Kookmin university, Seoul, South Korea, in 2013 and the Master’s degree in mathematics from Yonsei university, Seoul,

South Korea, in 2015. He is currently working toward the Ph.D. electrical engineering from Université Paris-Sud, France. His Ph.D. is being carried out at GeePs (UMR CNRS 8507, France). His interests include the analysis and simulation of non-iterative methods.