Numerical Analysis of Electromagnetic Scattering from Complex Conducting Objects on the Ground

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Abstract

The electromagnetic scattering from complex conducting objects on the ground is numerically analyzed in this paper. The air-ground environment is modeled as a half space, where the half-space Green's function is invoked in the electric field integral equation. The half-space multilevel fast multitpole algorithm is employed to accelerate the computation and reduce the memory requirement. To improve the condition of the system, the recently developed Calderon preconditioner is extended to the half-space case. Numerical examples will be presented to validate our method.

1. Introduction

Numerical analysis of electromagnetic scattering by complex conducting objects on the ground is of great importance in the near-surface object identification. Since the working wavelength is much smaller than the curvature of the earth, the air-ground composite can be modeled as a half-space with planar interface. Therefore, the half-space Green's function can be adopted as the kernel of the electric field integral equation (EFIE) in the method of moments (MoM) [1, 2]. However, the direct MoM implementation results in a full matrix, which is expensive to store and solve. Meanwhile, extra complexity arises in the evaluation of the Sommerfeld integrals, which is extremely time consuming [3]. Fast algorithms are indispensible for large complex problems. To this end, the half-space multilevel fast multipole algorithm (MLFMA) [4] is employed to accelerate the computation. On the other hand, the convergence of the EFIE system is normally unacceptable due to the undesired spectrum, especially when dense discretization is required. To improve the convergence, the recently developed Calderon preconditioner is extended to our half space simulation. Different from its free space counterpart, the Calderon identity in inhomogeneous medium shall be re-derived and utilized [5]. Detailed information and numerical results will be provided in the presentation of this article.

2. Acknowledgments

This work was supported in part by NSFC 61201002, 61231001, 61271033, in part by 111 Project B07046, and in part by IRT1113.

3. References

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978-1-4673-5225-3/14/$31.00 ©2014 IEEE