Defense Announcement

Boundary Integral Equation Methods for Multiscale Scattering and Inverse Source Problems in Layered Media

Shubin Zeng

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Committee Chair: Dr. Jiefu Chen

Committee Members: Dr. Ji Chen
Dr. Donald R. Wilton
Dr. David R. Jackson
Drs. D. Onofrei & G. Wang

This thesis is mainly focused on the efficient computation of Green's function and electromagnetic scattering problems from multiscale structures in multilayered media as well as the inverse source problem in layered media. The layered medium Green's functions (LMGF), together with various efficient algorithms for boundary integral equation (BIE), are powerful methods to solve electromagnetic scattering problems in layered isotropic/uniaxial media. The interest in such problems arises from application areas that benefit from efficient numerical modeling of multiscale structure in layered media, such as electronics, communication, remote sensing and geophysical prospecting.

A number of efficient algorithms applicable to various problems in these areas are presented in this thesis, including (i) Modeling of scattering problem of vertical/tilted/horizontal thin-wire structures embedded in multilayered isotropic/uniaxial media, (ii) Modeling of coatings on the thin-wire structure in multilayered media without introducing new unknowns, (iii) Modeling of wire-to-surface structure in multilayered media, and (iv) Active control of electromagnetic fields in regions embedded in multilayered media. The thin-wire modeling and BIE make it possible to model multiscale structures in multilayered media more efficiently. Graphics processing unit (GPU) technology is applied to accelerate the generation of the system matrix in BIE. To accelerate the computation of LMGF, interpolation and singularity subtraction algorithms can be applied. For inverse source problem, the cluster computing is used to accelerate the computation.