Boundary integral equation method for electromagnetic and elastic waves

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In this thesis, the boundary integral equation method (BIEM) is studied and applied to electromagnetic and elastic wave problems. First of all, the metal strip grating on grounded slab (MSG-GDS) and shielded microstrip lines are studied using the spectral domain BIEM called spectral domain approach. Electromagnetic modal relationships between them are revealed, and some parametric studies are carried out. Secondly, doubly periodic structure in layered media is investigated in the framework of matrix-friendly formulation. A novel approach to evaluate the doubly periodic Green's function for layered medium is proposed, which delivers fast and highly accurate results as well as high order convergence, and also allows fast frequency sweep for calculating Brillouin diagram in eigenvalue problem and for normal incidence in scattering problem. Thirdly, a high order Nystrom method featuring coinciding nodes for interpolation basis and quadrature rules as well as a novel and efficient treatment of singular and nearly singular integrals is developed for elastic wave scattering. Finally, the multilevel fast multipole algorithm (MLFMA) is applied to accelerate the proposed Nystrom method for solving large scale problems. Formulations proposed herein can reduce the memory requirements significantly in MLFMA.