Abstract

Asymptotic and Numerical methods are popular in applied electromagnetism. In this work, the two methods are applied for collimated antennas and calibration targets, respectively.

As an asymptotic method, the diffracted Gaussian beam approach (DGBA) is developed for design and simulation of collimated multi-reflector antenna systems, based upon Huygens principle and independent Gaussian beam expansion, referred to as the frames. To simulate a reflector antenna in hundreds to thousands of wavelength, it requires $10^7 - 10^9$ independent Gaussian beams. To this end, high performance parallel computing is implemented, based on Message Passing Interface (MPI).

In the second part of the dissertation, we study the plane wave scattering from a target consisting of doubly periodic array of sharp conducting circular cones by the magnetic field integral equation (MFIE) via Coiflet based Galerkin's procedure in conjunction with the Floquet theorem. Owing to the orthogonally, compact support, continuity and smoothness of the Coiflets, well-conditioned impedance matrices are obtained. Majority of the matrix entries are obtained in the spectral domain by one-point quadrature with high precision. For the oscillatory entries, spatial domain computation is applied, bypassing the slow convergence of the spectral summation of the non-damping propagating modes. The simulation results are compared with the solutions from an RWG-MLFMA based commercial software, FEKO, and excellent agreement is observed.