

Analysis of EM Scattering and Radiation Using Characteristic Basis Function Method with Plane Wave Spectrum Approach

X. F. Que and Z.-P. Nie

University of Electronic Science and Technology of China, China

Characteristic basis function method (CBFM) can be used to analyze the electromagnetic scattering and radiation properties of PEC object, especially for periodic structure. Characteristic basis functions (CBFs) are higher level expansion functions for unknown induced current, which can be considered as numerical basis functions for each block. The CBFM reduces the matrix size to a small and manageable level. The most CPU-intensive part in CBFM is to compute the matrix vector product. The couplings between all the discretized elements should be calculated and used twice, one for generating the CBFs and the other for constructing the system matrix, which is an intolerable procedure when dealing with electrically large object of arbitrary shape.

In this paper, the plane wave spectrum (PWS) approach is used to accelerate the matrix vector product. Only near-field interaction will be calculated directly. This method also realizes a saving in the memory requirement. Unlike FMM and MLFMA, no iterative methods are needed because a reduced matrix will be obtained, which is typically 3 orders of magnitude smaller for a moderate size problem when compared to the conventional MoM and can be solved by direct inversion.

We use the CBFM/PWS technique to analyze the large antenna arrays and scattering problems of arbitrary conducting objects. Numerical examples validate the accuracy and efficiency of this method.

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