ITERATIVE MULTI-REGION TECHNIQUE FOR ELECTROMAGNETIC SCATTERING FROM LARGE SCALE PROBLEMS

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Large-scale electromagnetic problems require large computer memory and long computation time, thus several approaches have been suggested to deal with these problems. One of the approaches to overcome these problems is to divide the computational domain into smaller sub-domains and then combine the sub-domain solutions after introducing the effect of interactions between these sub-domains.

In this study, we present a new technique based on an iterative procedure between the sub-domains to calculate the scattering from multiple objects. Similar iterative procedures based on various methods have been reported before, however our procedure utilizes the advantages of the finite difference frequency domain (FDFD) method. FDFD is an accurate frequency domain technique that can easily model complex structures (non-homogenous, anisotropic, etc.). In this technique, the problem is decomposed into separated sub-domains, each sub-domain containing a scatterer or a group of scatterers. In each sub-domain, the scattered electromagnetic near fields are calculated due to the incidence of a time-harmonic wave, using the FDFD method. Then fictitious electric and magnetic currents on imaginary surfaces surrounding the objects in these sub-domains are calculated using the equivalence principle. Radiated fields by these currents are then considered as incident fields on the opposing sub-domains. The same procedure of calculating the sub-domain field components, the fictitious currents and the radiated fields on the opposing domains is repeated iteratively until a convergence criterion is achieved.

The procedure presented in this study, referred to as iterative multi-region (IMR) technique is found to be efficient in producing accurate results with good saving in the computer memory usage for three-dimensional problems with acceptable computational time relative to that of the full domain problem.