Solution of Large array and Radome Problems using the Characteristic Basis Function Approach

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Abstract

Although the asymptotic methods, such as the GTD or PTD are well suited for computing the RCS of large objects such as aircrafts, they are not very convenient for analyzing antenna arrays, Frequency Selective Surface (FSS) Radomes, or combinations thereof, and it is necessary to resort to numerically rigorous techniques for simulating such problems. There are two major roadblocks to solving large array and radome problems using the MoM, FEM or the FDTD algorithm.

First of all, the number of unknowns that we need to deal with becomes very large, even for isolated array and radome problems, when their size becomes greater than 10 or so wavelength, which is very often the case in practical applications. Analyzing an array-radome composite becomes even more burdensome on the CPU, both in terms of memory and solve time, especially when the antenna is operating in close proximity of the radome and the periods of the two systems are dissimilar.

Since both of the situations are encountered frequently in many practical applications, it is evident that an efficient numerical technique for addressing the large array, radome and composite (antenna + radome) problems is highly desirable.

Our objective in this paper is to present a technique we have developed for both of the problems described above. To solve the large array problem we begin by modeling a moderate-size (say 9x9) problem by using the MoM or the FDTD. We run the simulation wilth all the elements excited simultaneously, and compute the **E** and **H** fields on a virtual surface (Huyghens' box) enclosing the array. We then generate the characteristic Basis Functions (CBFs) corresponding to the center, edge and corner regions. Our next step is to express the aperture field of a larger array, which we wish to analyze, in terms of these CBFs and compute the desired radiation pattern. Some representative results for a 21x21 and a 51x51 of the approach as well as the extension to the composite problem will be presented.

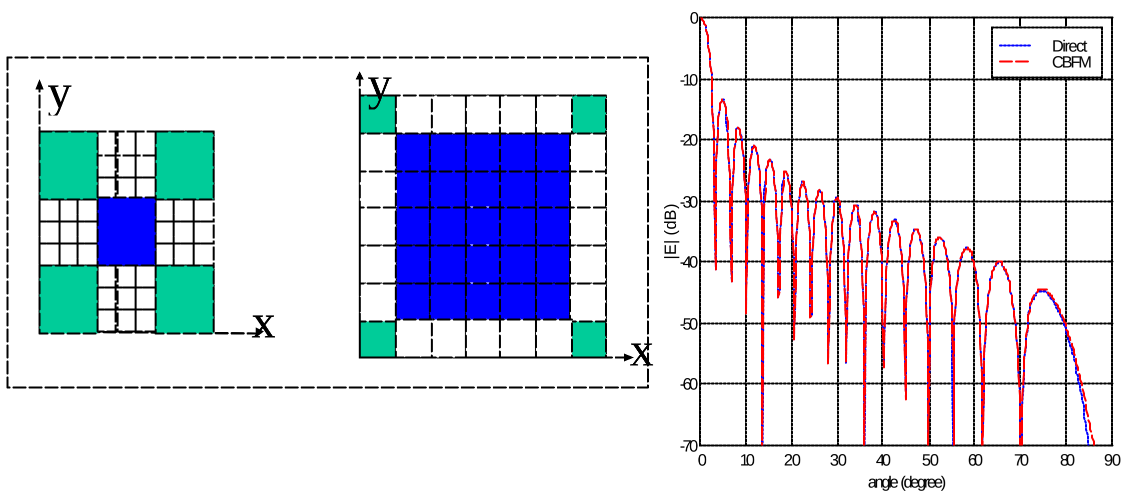

Fig.1. Left: Illustration of the mapping from 9x9 (left) into 21x21(right) sub-surfaces. Clusters of 3x3 are used to fill the center, edge and corner regions. Similar mapping is used for x-z and y-z sides. Right: E-plane far-field pattern of 51x51 array—direct (blue) and CBFM (red).