A DFT Based Accelerated Generalized Forward Backward Method for the Fast Analysis of Two Dimensional, Large Printed Arrays with Arbitrarily Shaped Elements

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Fast and accurate analysis of electromagnetic radiation/scattering from large, planar, printed arrays over grounded dielectric slabs is of interest to researchers due to their highly flexible commercial as well as military applications. However, majority of these methods suffer greatly from storage requirements and computing time if the analyzed arrays are electrically large.

In this paper, various planar arrays consisting of finite number of printed, arbitrarily shaped patches over grounded dielectric slabs are investigated using a generalized forward backward (GFB) method. Previously, GFB method has been applied to rough surface scattering (M. Pino *et. al.*, *IEEE Trans. Antennas and Propagat.*, **6**, 961-968, 1999). In this method the conventional forward-backward (FB) approach is combined with the Method of Moments (MoM), where only a single arbitrarily shaped patch is solved using a conventional MoM procedure. The solution is then found through an iterative procedure which resembles to the FB method in general concepts, though it exhibits some significant differences. In the FB method, the current computation is swept cell by cell (each cell corresponds to a basis function) whereas, the GFB method sweeps the current computation element by element (each element corresponds to an arbitrarily shaped patch). A simple MoM procedure with few unknowns is employed to obtain the forward current and its backward correction on the selected element. Consequently, sophisticated shaped array elements can be treated accurately. A similar approach was reported previously (H. T. Chou and H. K. Ho, *IEEE AP-S Int. Symp. and USNC/URSI Meeting*, 40, 2001) for linear arrays of elements with arbitrary cross-sections. In this paper, this work is extended to planar arrays.

The computational complexity of this method, which is originally $O(N^2)$ for each iteration, can be reduced to $O(N)$ (N being the number of array elements), assuming that elements are identical and periodic. This is achieved using a DFT based acceleration algorithm which divides the contributing elements into “strong” and “weak” interaction groups for a receiving element in the GFB method. The contributions from the strong group are obtained by conventional element-by-element computation to assure the fundamental accuracy. On the other hand, contributions coming from the weak region are obtained based on a DFT representation of the array current. In general, only a few significant DFT terms are sufficient to provide accurate results due to the fact that they provide minor corrections to the solution in contrast to the dominating strong group.

Various sized periodic arrays with arbitrarily shaped printed patches will be considered and results will be compared with the conventional MoM results to assess the accuracy of this method.