Synthetic-Function Analysis of Large Printed Structures

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This communication discusses a reduced-complexity approach to the Method of Moments (MoM) analysis that can be applied to structures, like large array antennas, their beam forming networks (BFN), or MMIC circuits, that pose a challenge to an accurate full-wave MoM analysis, both in terms of memory occupation and computation time.

Among the various techniques devised so far to address one or more of these issues, the present work belongs to a class of approaches that end up in reducing the actual size of the final algebraic problem. A large part of these approaches can be traced back to the so-called diakoptic approach (Ooms and DeZutter, *IEEE Trans. MTT*, March 1998, pp. 280 291), originally developed for structures that are naturally or artificially broken down in sub-structures interconnected by ”ports”. One (or two) ”macro-basis” functions are introduced per each port, related to the solution of the sub-structure in isolation, and these are used to compact the MoM matrix. Various versions exists of the technique, with improvements of the above basic idea, e.g. (Suter, and Mosig, *MOTL*, vol. 26, no. 4, August 20, 2000, pp. 270-277).

The work reported here also employs a few, ”global” basis functions: they are termed ”Synthetic Functions” (SF) and the overall scheme Synthetic Function eXpansion (SFX). The SF are defined on portions of the structure; their generation has been considered via the original electromagnetic problem and based on its properties, rather than on MoM matrix direct operations. In its different implementations (e.g.: Vecchi et Al., *Int. J. MIMICAE*, Vol. 7, No. 6, Nov. 1997, pp. 410-431, Matekovits et Al., *2001 AP-S Int'l Symp.*) the present technique always resorts to a set of basis functions larger than the set of the solutions of the single sub-structures in isolation; in this respect, it strives to correct the shortcomings of the ”basic” diakoptic approach, and is comparable to what is termed a ”two-level” diakoptic scheme, yet via a different approach. One of the advantages of this approach is that it can be performed in a multi-grid fashion, that also reduces the MoM matrix fill-in time.

In this communication advances of the SFX are reported as well as applications. In particular, the impact of multi-scale and multi-resolution approaches on the overall efficiency will be shown.