ARBITRARY SHAPED APERTURE/PATCH FSS'S IN PLANAR PHASED ARRAYS. FULL-DOMAIN AND SUB-DOMAIN BASIS FUNCTIONS.

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Abstract

The use of Frequency Selective Surfaces (FSS) is becoming more and more frequent in the design of antennas for complex warship platforms. From the antenna point of view, the main challenge is the capability of designing antennas with high performances, integrated in complex platforms with low Radar Cross Section (RCS) and a high number of different antenna systems mounted on the same support. This clearly requires the capability of improving the frequency and angular selectivity of the antenna, keeping at the same time under control the dimensions and shapes of the antenna itself. The solution to these requirements is the design of array antennas integrated with FSS panels with different frequency/angular filtering behavior.

In previous works, we have already presented an efficient and flexible approach to this kind of problem based on a Multi-mode Equivalent Network (MEN) method (G. Gerini, L. Zappelli, *Conference Proceedings 31st European Microwave Conference*, 2001, pp. 321-324), (S. Monni, G. Gerini, A. Neto, *XXVII URSI General Assembly*, 2002). This technique allows the derivation of an accurate multi-mode impedance matrix representation of the overall structure including array, arbitrary shaped FSS's and radomes placed on the top of the array itself.

A crucial aspect in terms of accuracy and efficiency is the choice of the expanding functions for the unknown electromagnetic quantities. Hence, in order to investigate this aspect, in this contribution we analyze the effects of expanding the unknown electromagnetic quantities in terms of different basis. We have considered both piece-wise sinusoidal expanding functions and full-domain modal representations obtained by the BCMM (boundary contour mode matching) method (F. Giese, J. M. Reiter, F. Arndt, *IEEE MTT'S Digest*, 1995, pp. 1359-1362).

These different expansions have been applied to dual problems like metallic patches and screens of infinitesimal thickness and arbitrary cross-section.

In general, piece-wise sinusoidal functions have a very simple analytical form and offer a great flexibility in terms of shapes that can be analyzed. On the other end, their large spectral content is such that a very large number of terms (proportional to the scalar product of the expanding functions with the Floquet's modes) have to be summed up in the kernel of the integral equation. This would lead to a relatively large CPU time, unless efficient acceleration techniques are applied in the summation of the series. On the contrary, full domain basis functions are less flexible for the analysis of complex shapes and often require the solution of an eigenvalue problem for the eigenmodes determination. Nevertheless, a relatively smaller number of functions are necessary to describe the unknown fields in complex geometries and furthermore their spectral content is such that the kernel of the IE is more rapidly converging.

A comparison between results for the same problem obtained with the two expansion sets will be presented at the conference, together with a detailed trade-off study in terms of accuracy and computing time.