MULTIMODE EQUIVALENT NETWORK FOR THE ANALYSIS OF A RADOME COVERED FINITE ARRAY OF OPEN ENDED WAVEGUIDES

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The effects of the finiteness of an antenna platform plays an important role in phased array applications as well as the radome coverage of the actual antenna. When low side-lobes are required, this implies accurate modeling of mutual coupling and scattering effects in the feed. In this contribution we present a theoretical model for the analysis of finite arrays of open-ended waveguides on top of finite cylindrical supporting structures and/or radome coverages. This model is based on a Multi-mode Equivalent Network (MEN) (G. Gerini, M. Guglielmi, G. Lastoria, *IEEE MTT-S Digest*, vol.3, 1747-1750, 1998) representation of the radiating waveguides with their tuning elements and a high frequency approach for the external region.

The accessible ports given by the multi-mode network connecting the antenna and feeding waveguides offers the possibility of optimizing the structure looking both at the antenna’s radiation characteristics and the matching network inside the waveguides. The effect of the truncated ground plane is derived using a UTD approach (Kouyoumjian, R. G., and P. H. Pathak, *Proc. IEEE* ,62, no.11, 1974, 1448-1461), (Kouyoumjian, R. G., and P. H. Pathak, *Acoustic…and Low Frequency Asymptotics*, vol. II, Varadan and Varadan, Eds. Amsterdam, North Holland. 1986) where the applied ray tracing procedure turns out to be analytical. When also considering a radome coverage, a physical optics algorithm is included in the analysis to quantify the alteration of the multimode impedances.

The first step in the procedure consists in setting up an integral equation that enforces the continuity of the tangential magnetic field on the apertures composing the array. In the waveguide regions, the field is expressed as a superposition of TE and TM modes which can be divided in accessible and non-accessible ones (see ref. MEN). The magnetic current in the apertures can then be conveniently expanded in terms of a set of unknown vector functions weighted by the modal current amplitudes of the accessible modes. We are then left with a set of integral equations where the unknowns are magnetic currents that can be found for each mode assumed to be exciting the structure. Once this set of integral equations is solved with a standard Method of Moments approach, the final multi-mode equivalent network representation can be easily derived by recalling the modal voltage definition based on the orthonormality property of the modes. The magnetic field Green's function used in the integral equations is that of a finite grounded metallic cylinder, that can also operate in the presence of a radome. This Green’s function can be expressed as a superposition of the grounded half space Green's function and two separate contributions, one that accounts for the truncation of the ground plane and one that accounts for the radome reflections. The procedure is similar to the one described in (A.Neto, D. Pasqualini, A. Toccafondi, S. Maci, *IEEE Trans. Antennas and Propagat.*, vol.47, no.10, Oct. 1999) for quantifying the impact on the input impedance of slot elements, due to the reflections inside an elliptical dielectric lens antenna. Detailed analysis of the reults and numerical issues will be addressed during the presentation.