Aperture Excitation Of A Transmission Line In A Cavity

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Under consideration is the excitation in terms of currents and voltages of the two loads of a two-conductor straight transmission line system inside a rectangular cavity due to an external source of plane waves. The electromagnetic fields propagate from the source to the transmission line system through a rectangular aperture on the cavity wall facing the source. The problem is solved by applying the equivalence theorem: the aperture is replaced by a rectangular perfectly electric conductor and an equivalent magnetic surface current density is introduced. The problem is therefore split into an internal problem and external one.

The equivalent magnetic surface current density is strictly dependent on the value of the tangential component of the electric field on the aperture. The imposition of the continuity of the tangential magnetic field in the aperture allows to derive an integral equation to be solved using the method of moments (MoM).

The MoM is reduced to the evaluation of the admittance matrix of the aperture (R. F. Harrington, J. R. Mautz, IEEE Trans. Antennas Propagation, vol. AP-24, pp. 870-873, Nov. 1976). In this evaluation, the admittance matrix is split into two parts. One part does not consider the external scattering; the other part is a correction term recently introduced for taking into account the contribution of the external scattering. While the first part is easily obtainable and largely spread in literature; the evaluation of the second one exploits a heavy numerical technique, involving the use of the "generalized impedance matrix" (T. Wang, Ph.D. dissertation, Syracuse Univ., Syracuse, NY, 1989).

In the internal problem, the coupling between the cavity and the transmission line, in terms of radiation produced by the transmission line, may be either neglected in first approximation, or included in the formulation increasing the computational complexity of the MoM. If it is neglected, in order to overcome the previous approximation, the perturbation approach of the MoM may be applied, assuming that the problem under consideration is only slightly different (perturbed) from the one to be solved exactly. The perturbation approach reaches its end when it converges within an arbitrary tolerance. When the electromagnetic fields inside the cavity are known, the extended BLT equations may then be used. They provide the tool to solve the transmission line system problem to find the required excitation at the loads. Innovative elements of the present research are: the use of the above solving procedures for a cavity containing a transmission line and the application of the BLT equations inside a cavity.