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Determination of the Conductor Loss in Microstrip Reflectarrays Using the Impedance Boundary Condition

Sembiam R. Rengarajan(1)
(1) California State University, Northridge, CA 91330 e-mail: srengarajan@csun.edu

In microstrip structures the dissipation in the conducting strips is calculated by using an impedance boundary condition. Theron and Cloete have presented an excellent review paper discussing the errors in such a model wherein the equivalent magnetic current is ignored [1]. In reflectarray analysis and design, an infinite array excited by a plane wave is employed as a model. The induced current in the unit cell patch of such an array is determined by solving integral equations by the method of moments. From the induced current in the patch, one may obtain the dyadic reflection coefficient. In the method of moments the unknowns are expanded in terms of known basis functions and the inner products of the integral equations with weighting functions yield a set of simultaneous equations. An investigation of basis functions used for rectangular patches found that a single basis function without the edge condition across the current flow direction provided very good solutions for substrate thicknesses greater than 1/25 of the wavelength in the dielectric. For thin substrates and greater accuracy, sixteen basis functions are generally required for each current with edge conditions enforced in both directions [2]. For the latter case the terms in the moment matrix containing the surface impedance and the inner products of singular terms diverge.

An approximate method used by Lewin stops the diverging integrals at a distance before the edge [3]. We used a similar approach and studied the loss in the patch using two different methods. In the first method, we assume that the ground plane is perfect and then double the patch loss to account for the dissipation in the ground plane as well. This is justified by the cavity model for the patch in which the amount of loss in the ground plane is equal to that in the patch [4]. In the second method, the ground plane is assumed to be imperfect and the spectral domain Green's functions are derived using the TE and TM to z mode waves in an equivalent transmission line with the reflection coefficient of the ground plane modeled by its surface impedance. We will present results obtained by both methods and compare them with that of HFSS and experiments.

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