# On the Conductor Loss in Microstrip Reflectarrays

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In the analysis and design of reflectarrays consisting of conducting patches, one uses the dyadic reflection coefficient of an infinite array excited by a plane wave. Previously it was shown that in the moment method solution to the integral equation for the current of a rectangular patch in the unit cell, a single basis function yields a very good solution for moderate substrate thickness (Rengarajan, IEEE Antennas Wireless Prop. Lett., 4, 2005). This basis function has a half sinusoidal variation with edge condition along the current direction and uniform distribution in the transverse direction. For thin substrates and for greater accuracy a set of basis functions exhibiting even and odd sinusoidal variations in both directions with edge conditions was employed.

For thin conductors the loss can be accurately modeled by approximating the patches as sheets with surface impedance (Tuncer and Neikirk, Electron. Lett., 29, 1993) using the standard expression for surface impedance (Ramo, Whinnery and Van Duzer, 2nd ed., Wiley, 1984). This requires an additional term in the impedance matrix elements of the moment method for a unit cell. Based on the well-known cavity model of the patch, the ground plane loss can be accounted for by simply doubling the loss in the patch. The additional term in the impedance matrix element is the intrinsic impedance of the metal times the inner product of a basis function and a test function. The inner product does not converge for the set of basis functions mentioned above for the integral in the transverse direction to the current since the edge condition makes it approach infinity. We avoided this edge current divergence problem by halting the integral in the inner product of currents at a distance just short of the patch edge similar to that in a previous work on microstrip transmission lines (Lewin, IEEE Trans. Microwave Theory Tech., 32, 1984).

For multilayer substrates and superstrates, the spectral domain Green's functions have been obtained in terms of TE and TM mode impedances using a transmission line analogy. The conductor loss in the ground plane is then accounted for by using the reflection coefficient of the lossy ground plane. We will present the conductor loss of reflectarrays computed from the moment method for a range of values of substrate and superstrate material, patch size, and frequency. Our computed results will be compared to those computed from the commercial code HFSS and also to measured results.