

## An Approximate Green's Function for a Finite Grounded Dielectric Slab

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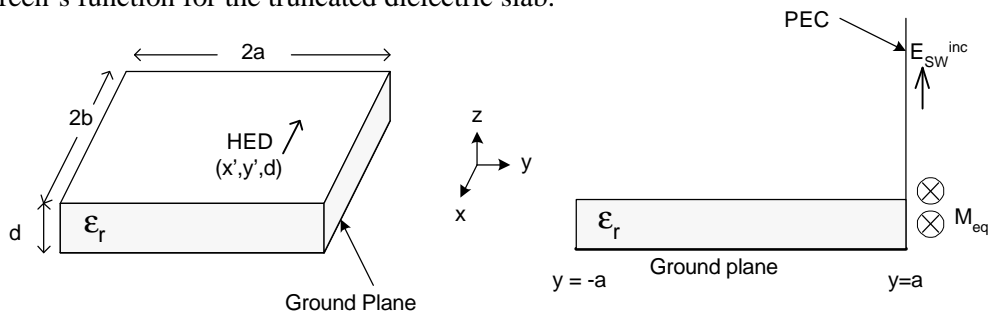
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Especially in applications like mobile communications, the dielectric substrate of microstrip antennas are restricted to small sizes due to the space limitations. In most studies which analyze microstrip patch antennas with finite grounded dielectric slabs, the current distribution on the patch surface and therefore the input impedance of the antenna are assumed not to be affected by the truncation of the ground plane and the dielectric slab. However both the experimental and the theoretical results presented in [1] implies that the input impedance of the antenna could vary up to 50% by changing the size of the grounded dielectric slab. In [1], the transmission line model is modified by including an edge admittance that models the scattering of surface waves from the edge formed by the truncation of the dielectric slab and the ground plane. However this method can be applied to only a certain class of patch antennas that could be analyzed by using transmission line model. In order to be able to analyze general microstrip antenna structures, we propose to modify the Green's function of an infinite grounded dielectric slab to take into account of the scattered surface waves from the edge of the truncated dielectric slab. The procedure used to obtain this modified Green's function can be summarized as follows: 1) Find the Green's function of a horizontal electric dipole on the infinite grounded dielectric slab, 2) by using the incident surface waves define equivalent magnetic currents at the dielectric-air interface ( $y = a, z > 0$ ), 3) place a semi-infinite perfect electric conductor at the dielectric-air interface ( $y = a, z > 0$ ), 4) by using the Green's function of a horizontal magnetic dipole placed on a conducting  $90^\circ$  wedge, find the total field due to the equivalent currents, 5) using the stationary formula given in [1], calculate the position dependent edge admittance, 6) using the edge admittance find the reflection coefficient of the surface waves, 7) repeat steps 3-6 for the other edge ( $x = b$ ), 8) use these reflection coefficients to obtain an approximate Green's function for the truncated dielectric slab.



In [1], the edge admittance is obtained for the 2-dimensional problem; hence it does not include any information about the shape of the edge. However in our formulation 3-dimensional problem is considered and the edge admittance is obtained as a function of position along the edge. Therefore, by using this approximate Green's function, it will be possible to optimize the shape of the dielectric truncation to minimize the surface wave reflections. Numerical results will be demonstrated in the presentation.

[1] A. K. Bhattacharyya, "Effects of ground plane truncation on the impedance of a patch antenna", *IEE Proceedings-H*, Vol.138, no. 6, pp. 560-564, December 1991.