**Efficient Calculation of Permeability and Permittivity of Coating Layer on Leaky-Wave Slot Waveguide Antenna**

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Electromagnetic wave characteristic of leaky-wave slot antenna at rectangular waveguide will be discussed in this study. Dielectric coating has been recognized to be useful to control beam pattern of waveguide slot antenna. By introducing dielectric coating to waveguide slot antenna, the sidelobe level and isolation between slot antenna array elements are decreased. In this sense, we will expand this phenomenon on material how permeability and permittivity of coating can affects electromagnetic field.

This problem deals with long leaky-wave slot antenna in rectangular waveguide. The upper plane of waveguide is attached to an infinite ground plane. On the ground plane, one coating layer exists. Material of coating layer is assumed that has arbitrary permeability, permittivity, thickness, and loss tangent.

To analyze the leaky-wave antenna, the internal and external field equations are shown by introducing equivalent magnetic current concept. It is supposed that the equivalent magnetic current generates external fields, and the external field equations are derived with this equivalent current. The theory of continuity of the magnetic field is forced to apply boundary condition from the waveguide, through coating layer, to free-space. In the analysis, the moment method, Kummer transform, contour integration, the method of Steepest Descents are used to accelerate the calculation time and accuracy. Also, both time-dimension and spatial-dimension Dyadic Green's function are derived. After solving fields at internal and external of waveguide, the aperture field and far-field radiation pattern can be calculated using the method of stationary plane.

Based on the theoretical analysis, the result is shown with numerical calculation program. This program figures out the electromagnetic field based on numerical methods which mentioned above, and outputs far-field pattern of this coated waveguide long leaky-wave slot antenna. The magnitude of calculated results will be normalized with the magnitude of main-beam. Also, to verify the results of numerical methods and calculation, the results will be compared with commercial electromagnetic simulation software.

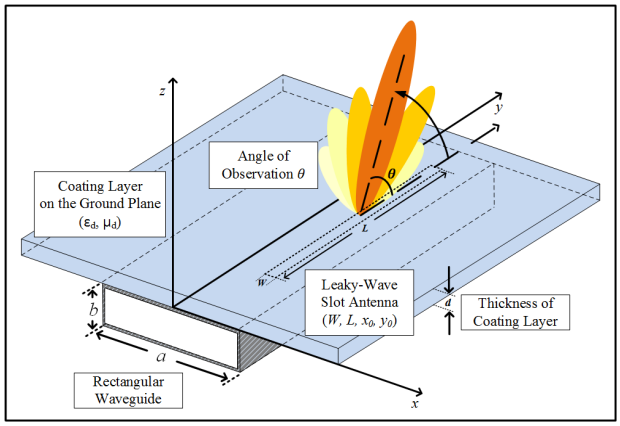


Fig. 1. Perspective View of the Problem

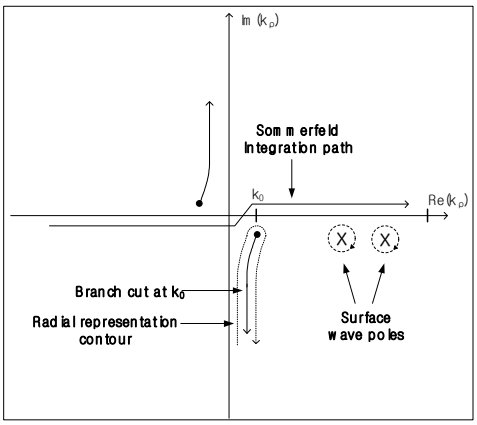


Fig. 2. Integral Path Deformation