Slot Coupling Into the Interior of a Wedge

Robert W. Scharstein*[1], Mark A. Waller[2], and Tom H. Shumpert[2]

[1] University of Alabama, Tuscaloosa, AL

[2] US Army Redstone Technical Test Center, Redstone Arsenal, AL

The coupling of a TE_z or hard-polarized wave through a small to moderately-sized slot into the interior of a wedge-shaped waveguide is considered. The equation-of-motion for the aperture field is a Fredholm integral equation of the first kind, derived from single-layer potentials. The kernel of the integral equation is the sum of the interior and exterior Green's functions for the Helmholtz equation, subject to the hard or Neumann boundary condition on the unslotted wedge faces. The excitation is a plane wave or line source in either the exterior or interior regions. In this geometry, the aperture couples two unbounded regions, which are lossy from the perspective of the aperture owing to the Sommerfeld radiation condition.

The focus is on the interpretation of the aperture field in terms of the two dominant, quasi-static slot modes that are derived by modifying independent solutions to Laplace's equation. The philosophy of matched asymptotic expansions is used to derive the first-order correction to the pure static slot modes that include the dynamic effect of radiation. A two-term high frequency asymptotic evaluation (GTD) of the external Green's function provides good accuracy if $kd \gtrsim 10$, and quadrature is used when the slot of Fig. 1 gets close to the wedge apex. When $\alpha = \pi/N$, the use of $2N$ images dispenses with the similar complications that accompany the interior Green's function for general wedge angles. The logarithmic singularity in the Green's functions is explicity treated, as are the edge-conditions in the aperture. This construction of the solution and the numerical results for the basic problem indicated in Fig. 1 is of interest from both a scattering and a coupling outlook.

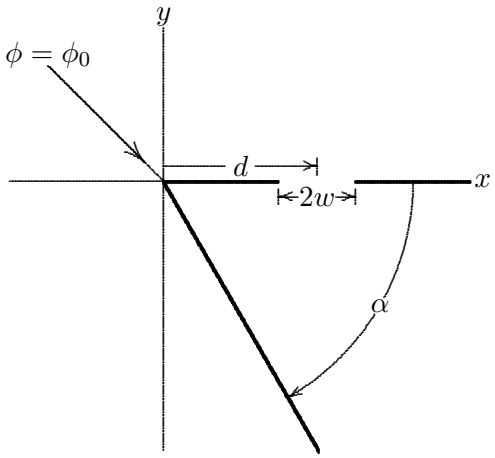

Figure 1: Plane Wave Incident Upon Slotted Wedge