Penetration through an Aperture Backed by a Channel –Coupled Integral Equation Formulation with Specific Green's Functions

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Penetration through a backed slot in an infinite conducting plane is investigated. Coupled integral equations are formulated which may be solved for the field penetrating into a cavity or channel of arbitrary cross-section. This integral equation method is also applied to the special case of an elliptical-channel-backed slot where the materials interior and exterior to the cavity are isorefractive. Results are compared with data obtained from an analytic solution involving the summation of Mathieu functions [D. Erricolo, M. Lockard, C. M. Butler, this digest]. The general coupled integral equations are also used to analyze channel-backed slotted screen structures which are amenable to analysis by single integral equations with Green's functions specific to the channel geometry and material. Green's functions are developed for magnetic sources in cylinders of circular, sectorial, and rectangular cross-sections. Each Green's function is derived for the case of a magnetic line source as well as for a magnetic line dipole to account for an excitation that is TE or TM to the direction of the slot, respectively. Development of Green's functions with the use of a non-Lorentz gauge for radially-directed line dipoles is discussed and the advantages of such a Green's function are delineated.

The materials in the interior and exterior regions of the structure may be similar or dissimilar for all integral equations considered. Data comparisons are presented for cases of various materials in either region. An arrangement of terms in the coupled integral equations also allows the line source to be positioned in the interior of the channel. Data are presented that illustrate that reciprocity is upheld.