CURRENT ON A CONDUCTING CYLINDER IN AN ELLIPTIC CHANNEL EXCITED THROUGH A SLOT IN A CONDUCTING SCREEN BY AN INCIDENT FIELD TE TO THE SLOT AXIS

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The authors determine the current induced by a TE source on a perfectly conducting cylinder in a semielliptic channel behind a slotted ground plane. The edges of the slot in the conducting plane coincide with the foci of the semiellipse (channel wall), and the medium inside the channel and that outside are the same or they may be isorefractive to one another. The excitation may be due to a source either inside or outside the channel, provided the resulting field is TE to the slot axis and axially invariant. If desirable, the conducting cylinder may reside outside the channel.

The electric field due to an axially-directed magnetic line current can be determined in closed form at all points inside and outside the channel (P. L. E. Uslenghi, IEEE Trans. Ant. and Propagat, 52, pp. 1473-1480, June 2004). This electric field, expressed as a series of products of radial and angular Mathieu functions, is adopted as a Green's function of an electric field integral equation for the unknown magnetic surface current on the cylinder in a model of the field outside the cylinder. The forcing function of this integral equation is the tangential-to-the cylinder electric field due to the independent TE source radiating in the present of the channel-backed slotted plane but in the absence of the cylinder. From the solution of this integral equation, i.e., from the surface magnetic current, one can determine the surface electric current induced on the surface of the conducting cylinder. The Green's function and incident field are discussed, and the formulation and numerical solution of the integral equation are described. Also described is the ancillary computation of the electric surface current induced on the perfectly conducting surface of the cylinder from knowledge of the equivalent magnetic current (solution of the integral equation) and the incident field.

Solutions of the integral equation and the electric current induced on the cylinder are obtained for various cylinder locations and cross-sections, for selected excitations, and for specified channel and slot dimensions.

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