Exact 2D Scattering Analysis of a slot backed by cavity and covered by a multilayer diaphragm

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A semielliptical channel flush-mounted under a metal plane and slotted along the interfocal distance of its cross-section is separated from the half space above by a multilayer diaphragm. The cavity, the multilayer diaphragm, and the half space are all isorefractive to each other. This is a two-dimensional geometry where the source is invariant with respect to the axial variable. The resulting electromagnetic boundary-value problem is solved exactly in terms of Mathieu functions, when the excitation source is either a plane wave or a line source. For plane wave incidence, the polarization is with either the electric or the magnetic field parallel to the axis of the structure and the direction of incidence is arbitrary in a plane perpendicular to the axis. For line source excitation, the polarization is with either the electric or the magnetic field parallel to the axis of the structure and the source is arbitrarily located.

The expansion coefficients in the series are determined analytically by imposing the boundary conditions, thereby leading to a canonical solution of the boundary-value problem. The technique is an extension of that used by Uslenghi (*IEEE Trans. Antennas Propagat*., vol. 52, June 2004) and by Valentino and Erricolo (*Radio Science*, Vol. 42, Dec. 2007) .

The exact solution of this complicated problem, which involves sharp metallic edges, a cavity, and curved surfaces separating different penetrable media provides a challenging test for the validation of frequency-domain codes. Numerical results based on the evaluation of the series of Mathieu functions are provided for the fields inside the cavity, for the surface currents on the metallic boundaries, and for the radar cross section of the cavity.