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Scattering by Two Parallel Thin Posts Inside a Parallel-Plate Waveguide

Piergiorgio L. E. Uslenghi
Dept. of Electrical and Computer Engineering, University of Illinois at Chicago, USA
uslenghi@uic.edu

The scattering of a guided mode propagating inside a parallel-plate waveguide by two thin cylindrical posts is studied in the phasor domain, with a time-dependence factor exp(+jωt) omitted throughout. Since the wave equation is not separable in the bi-cylindrical coordinate system [1], this is a two-body problem that involves an infinite number of successive interactions between the posts. However, as originally noted by Twersky [2], an approximate solution may be obtainable in closed form when the interacting scatterers are small. In the present case, the small parameter is the ration of the wires diameter to the wavelength, i.e., ka is very small compared to one, where $k = 2\pi/\lambda$ is the wavenumber and a is the radius of the posts. Such an approximation was implemented to obtain a closed-form solution for normal incidence of a plane wave on two parallel thin cylinders of infinite length [3], and for E-polarization that solution is also the solution for the scattering of the TEM fundamental mode inside the parallel-plate waveguide.

The scattering of a higher-order mode, either TE or TM, requires some additional steps, as was done for the case of a single post [4-5]. First, the incident mode is decomposed into the sum of two plane waves obliquely incident on the two posts, and for each of these waves the solution is obtained from the two-dimensional solution at normal incidence. Second, the method of images is used to account for the reflection at one of the plates. The technique is described in [6]. Lastly, the effects of the two waves are combined to yield the solution to the boundary-value problem.

This novel approximate solution was obtained for the case of metallic (PEC) posts. However, the solution is easily extended to the case of penetrable posts made of a material that is either isorefractive or anti-isorefractive to the surrounding medium.

1. P. Moon and D.E. Spencer,"Separability in a class of coordinate systems," *J. Franklin Inst.*, vol. 254, pp. 227-242, 1952.

2. V. Twersky, "Scattering of waves by two ob- jects," in *Electromagnetic Waves*, ed. R.E. Langer. Madison, WI: University of Wisconsin Press, 1962.

3. P.L.E. Uslenghi, "Scattering by two vertical thin metallic wires truncated by a horizontal metal plane", *Proc. Intl. Conference on Electromagnetics in Advanced Appls. (ICEAA 2018)*, Cartagena, Colombia, Sept. 10-14, 2018.

4. A. Arora, M.D. Poort and P.L.E. Uslenghi, "Scattering by cylindrical posts of various cross sections located inside a parallel-plate waveguide", *URSI National Radio Science Meeting*, Boulder, CO, January 4-7, 2018.

5. A. Arora, M.D. Poort and P.L.E. Uslenghi, "Scattering of a TE mode by cylindrical posts of different cross sections located inside a parallel-plate waveguide", *2018 URSI Atlantic Radio Science Conference (2018 URSI AT-RASC)*, Gran Canaria, Spain, May 28-June 1, 2018.

6. P.L.E. Uslenghi, "Electromagnetic scattering by metallic cylinders perpendicularly truncated by a metal plane", *IEEE Trans. Antennas Propag.*, vol. 63, no. 5, pp. 2228-2236, May 2015.