CUTOFF FREQUENCIES OF DIELECTRIC WAVEGUIDES USING THE MULTIFILAMENT CURRENT MODEL

Z. Altman, H. Cory, and Y. Leviatan
Department of Electrical Engineering
Technion—Israel Institute of Technology
Haifa 32000, Israel

KEY TERMS

Dielectric waveguides, cutoff frequencies

ABSTRACT

A new approach for finding the cutoff frequencies of a dielectric waveguide based on the multifilament current model is presented. In this approach, the boundary conditions on the fields are taken in the cutoff limit. The method is applied to an elliptic dielectric waveguide.

matrix Equation (1) in the cutoff limit, or in other words, to what extent the boundary conditions are satisfied at cutoff for all frequencies. The longitudinal tangential components in the matrix $[Z]$ contain the zero-order Hankel function of the second kind, $H_0^{(2)}(k_{\rho s}R)$, where R is the distance from a filament to a matching point on the waveguide surface. The transverse tangential components contain the first-order Hankel function of the second kind, $H_1^{(2)}(k_{\rho s}R)$. When $s = 2$ we shall make use of the following limits:

$$\lim_{k_{\rho 2}\to 0} H_0^{(2)}(k_{\rho 2}R) = \frac{2j}{\pi}\ln\left(\Gamma j k_{\rho 2}\frac{R}{2}\right) \tag{3}$$

$$\lim_{k_{\rho 2}\to 0} H_1^{(2)}(k_{\rho 2}R) = \frac{2j}{\pi R}\frac{1}{k_{\rho 2}} \tag{4}$$

where $k_{\rho 2}$ is a negative imaginary number and Γ is Euler's constant.

Let $[Z]$ be a $4N \times 4N$ matrix and let $[Z']$ denote this