References

[1] P. Przybyszewski, J. Mielewski, and M. Mrozowski, "A fast technique for analysis of waveguides," *IEEE Microwave Guided Wave Lett.*, vol. 8, pp. 109–111, Mar. 1998.

[2] M. Mrozowski, *Guided Electromagnetic Waves—Properties and Analysis*. Taunton, Somerset, U.K.: Res. Studies Press, 1997.

[3] P. Przybyszewski, J. Mielewski, and M. Mrozowski, "A new class of eigenfunction expansion methods for fast frequency-domain analysis of waveguides," *IEEE Trans. Microwave Theory Tech.*, vol. 50, pp. 558–563, Feb. 2002.

[4] G. H. Golub and C. F. Van Loan, *Matrix Computations*. Baltimore, MD: The John Hopkins Univ. Press, 1996.

Authors' Reply

Alicia Casanueva and J. Luis García

In response to Mrozowski's comments on the above paper,[1] we agree with the general outline and accept that the numerical technique suggested by Mrozowski is more orthodox than the one we used in the above paper given the current state of mathematical research. We recognized the innovative nature of the approach in [1]; however, the same approach was not developed more fully until [2], which, as Mrozowski states, was published four years later. The above paper was also published in 2002, but was actually commenced in 1998 and first submitted at the start of 1999, long before the publication of [2]. Furthermore, far from seeking to discover the most convenient mathematical procedure possible, we tested the algorithm on various different planar structures in order to prove the large potential of the approach in the most diverse situations, e.g., in the analysis of microstrip, suspended microstrip, and finline, all with differing dielectric constants. The general aim, therefore, was to see whether the simplicity of the algorithm was also valid for a wider and more complex range of solutions, which would thus prove that the new approach could be an efficient procedure when the most convenient expansion functions are used.

After reviewing Mrozowski's comments, we have gone back to our original calculations and reworked them in accordance with Mrozowski's suggestions. Some of the results of these new calculations are shown here and they prove that the original results presented in the above paper are in keeping with the new results obtained via the approximation formulated by Mrozowski and the application of the QZ algorithm, as shown in Fig. 1.

The latter mathematical procedure is undoubtedly far more appropriate. Nevertheless, the fact that the algorithm is also valid with the mathematical procedure used in the above paper clearly shows that it is the basic functions used in the approach that give it its real efficiency, rather than the mathematical procedure applied.

As far as the new results shown here are concerned, the following should be noted. Fig. 2 and its inset present β^2 as a function of frequency calculated as approximate (shown by a dashed curve) and as accurate (shown as a continuous curve). In Fig. 2, different modes have been used at the same frequency. In Fig. 3, on the other hand, a TEM mode and modes near the cutoff frequency have been applied. We can observe that the approximate results in Fig. 3 are closer to the accurate results than in Fig. 2, which is due to the fact that, for microstrip structures, in general, the use of a TEM mode and modes near the cutoff frequency is more efficient. All the above is in complete agreement with the theory and data presented in the above paper.

Moreover, we would like to conclude by stressing that Mrozowski's proposed algorithms are valid for planar transmission lines when both the spectral-domain approach and the singular-value-decomposition technique have been implemented to obtain an accurate set of basic functions.

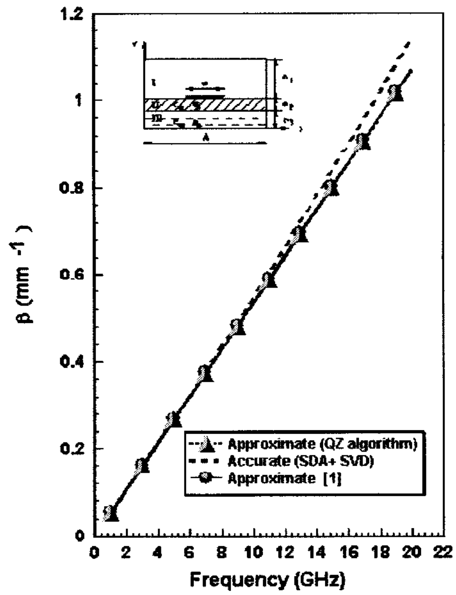

Fig. 1. Accurate and approximate data of propagation constant β versus frequency in a shield microstrip line. Parameters: $h_1 = 3$ mm, $h_2 = h_3 = 0.3175$ mm, $w = 0.56$ mm, $A = 5$ mm, $\varepsilon_{r2} = \varepsilon_{r3} = 10$, $\sigma_2 = \sigma_3 = 0$. Basic functions: ($\beta_1 = 0.532991729\text{E-01}, 0.0, \text{Freq}_1 = 1.00$ GHz), ($\beta_2 = 0.305018254\text{E-001}, -3.231, \text{Freq}_2 = 17.0$ GHz).

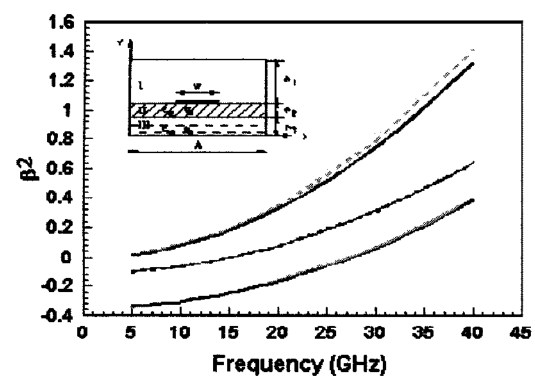

Fig. 2. Comparison of β^2 of the first three modes in a shield microstrip line between accurate and approximate data. Parameters: $h_1 = 5.751$ mm, $h_2 = h_3 = 0.3175$ mm, $w = 0.953$ mm, $A = 9.52$ mm, $\varepsilon_{r2} = \varepsilon_{r3} = 10$, $\sigma_2 = \sigma_3 = 0$. Basic functions: ($\beta_1 = 2.8872\text{E-001}, 0.0, \text{Freq}_1 = 10.0$ GHz), ($\beta_2 = 0.0, 2.4841\text{E-001}, \text{Freq}_2 = 10.0$ GHz), ($\beta_3 = 0.0, 5.5224\text{E-001}, \text{Freq}_3 = 10.0$ GHz).

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[1] A. Casanueva and J. L. García, *IEEE Trans. Microwave Theory Tech.*, vol. 50, no. 1, pp. 36–40, Jan. 2002.

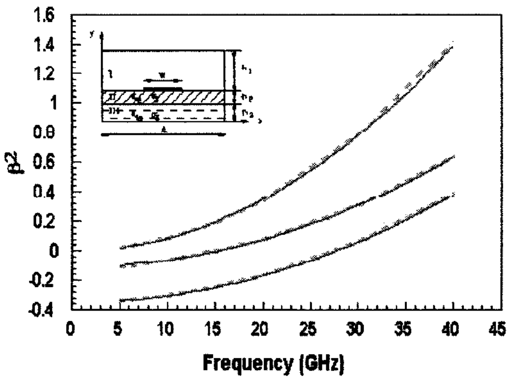

Fig. 3 Comparison of β^2 of the first three modes in a shield microstrip line between accurate and approximate data. Parameters: $h_1 = 3$ mm, $h_2 = h_3 = 0.3175$ mm, $w = 0.56$ mm, $A = 5$ mm, $\varepsilon_{r2} = \varepsilon_{r3} = 10, \sigma_2 = \sigma_3 = 0$. Basic functions: ($\beta_1 = 0.28709$E-01, 0.0, Freq$_1 = 1.0$ GHz). Near cutoff frequency: ($\beta_2 = 1.0644$E-001, 0.0, Freq$_2 = 16.04$ GHz), ($\beta_3 = 1.9356$E-001, 0.0, Freq$_3 = 29.20$ GHz).

References

[1] P. Przybyszewski, J. Mieleweski, and Mrozowski, “Fast technique for analysis of waveguides,” *IEEE Microwave Guided Wave Lett.*, vol. 8, pp. 109–111, Mar. 1998.

[2] P. Przybyszewski, J. Mielewski, and M. Mrozowski, “A new class of eigenfunction expansion methods for fast frequency-domain analysis of waveguides,” *IEEE Trans. Microwave Theory Tech.*, vol. 51, pp. 558–563, Feb. 2002.

Comments on “Rigorous Modeling of Packaged Schottky Diodes by the Nonlinear Lumped Network (NL^2N)–FDTD Approach”

Otman El Mrabet and Mohamed Essaaidi

In the above paper,[1] we have found several errors in (1), (3), (4), (6), (9), and (14), and those of the parameters presented in Tables I and II that should be corrected to allow an accurate implementation of the model proposed in the above paper for the modeling of packaged Schottky diodes by the nonlinear lumped-network finite-difference time-domain (FDTD) approach.

Considering the Schottky diode model depicted in Fig. 1(b) in the above paper, we can easily prove that the inductance L_1 should be replaced by L_2 in the expression of the admittance matrix of this circuit given by (1). Consequently, this admittance matrix should be written as follows:

$$[Y] = \frac{1}{D(s)} \begin{bmatrix} L_1Cs^2 + RC's + 1 & -1 \\ -1 & L_2Cs^2 + 1 \end{bmatrix}$$
$$D(s) = L_1L_2Cs^3 + RL_2Cs^2 + (L_1 + L_2)s + R. \quad (1)$$

Equation (3) should be written without the term “1” appearing in the denominator as follows:

$$\hat{Y}_{pq}(z) = \frac{\sum_{r=0}^{M} C_r^{pq} Z^{-r}}{\sum_{r=0}^{M} d_r Z^{-r}}. \quad (2)$$

The left-hand side of all the expressions in (4) and (6) of the above paper should be multiplied by d_0. Therefore, the correct form of these equations should be written, respectively, as follows:

$$d_0 I_1^{n+1} = \sum_{r=0}^{3} C_r^{11} V_1^{n-r+1} + \sum_{r=0}^{3} C_r^{12} V_2^{n-r+1} - \sum_{r=1}^{3} d_r I_1^{n-r+1} \quad (3)$$

$$d_0 I_2^{n+1} = \sum_{r=0}^{3} C_r^{21} V_1^{n-r+1} + \sum_{r=0}^{3} C_r^{22} V_2^{n-r+1} - \sum_{r=1}^{3} d_r I_2^{n-r+1}. \quad (4)$$

The inductance L_1 should be substituted by L_2 in all the coefficients appearing in Tables I and II of the above paper.

Furthermore, the constants q_x, γ_x, and $\alpha_x(\mathbf{r}E_x)$ appearing in (9) of the above paper should be divided by d_0. Thus, the correct expressions of these equations are, respectively,

$$q_x = 1 + \frac{\Delta t \Delta x C_0^{11}}{2\varepsilon d_0 \Delta y \Delta z}$$
$$\gamma_x = -\frac{1}{q_x} \frac{\Delta t C_0^{12}}{2\varepsilon d_0 \Delta y \Delta z}$$
$$\delta_x^n(rE_x) = -\frac{1}{q_x} \left[\frac{\Delta t}{2\varepsilon d_0 \Delta y \Delta z} \alpha_x^n(rE_x) - E_x^n(rE_x) - \frac{\Delta t}{\varepsilon} [\nabla \times H]_x^{n+(1/2)}(rE_x) - \frac{\Delta t}{2\varepsilon} J_{lx}^n(rE_x) \right]. \quad (5)$$

The last error encountered in the above paper concerns two terms of (14), which should be multiplied by d_0. Thus, this equation should be written as follows:

$$2d_0 f(V_2^{n+1}, V_2^n) + \left[C_0^{21}\Delta x \gamma_x + C_0^{22}\right] V_2^{n+1} + \left[C_0^{21} \Delta x \delta_x^n(rE_x) + \beta_x^n(rE_x) + d_0 I_2^n\right] = 0. \quad (6)$$

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[1] G. Emili, F. Alimenti, P. Mezzanote, L. Roselli, and R. Sorrentino, *IEEE Trans. Microwave Theory Tech.*, vol. 48, no. 12, pp. 2277–2282, Dec. 2000.