Kent and Ingalls have written several papers about multilayer capacitors that are not documented well enough to be reproduced. Their papers have used single transmission-line models obtained by folding single transmission lines to conform to the geometry of multilayer capacitors. It seems unlikely that a single transmission-line model can be correct when a type-B connection is used because single transmission lines have but one velocity of propagation. The impedance of the multilayer transmission lines and multilayer capacitors depends upon all of the velocities of propagation as well as the exact geometry of the plates and dielectrics. The matrices used in the above paper[1] were the results of field calculations based upon the geometry and the physical properties of the materials used as dielectrics.

Recently, I have made a complete 3-D full-wave analysis of a two-plate multilayer capacitor with a type-B connection, including radiation effects. The results of that investigation show the models presented in the above paper[1] to be accurate in the frequency range used. If transmission line models of multilayer capacitors are as valuable as Kent and Ingalls' comments indicate, it is important to use models of multilayer capacitors based upon Maxwell's equations, geometry, and the physical properties of the dielectrics as a function of frequency.

References

[1] L. A. Pipes, "Matrix theory of multiconductor transmission lines," *Phil. Mag.* vol. 24, sec. 7, no. 159, pp. 97–113, July 1937.

Comments on "A New Reciprocity Theorem"

Akhlesh Lakhtakia

In the above paper,[1] a "new" reciprocity theorem for free space (i.e., vacuum) has been reported. However, it is not new, having been published in 1992 by [1]. This may be ascertained by comparing (24) of the above paper[1] with [1, Eq. (8)]. The "new" reciprocity theorem was extended in 1989 for chiral media (see [2] and [3]).

References

[1] Ya. N. Fel'd, "A quadratic lemma of electrodynamics," *Sov. Phys. Doklady,* vol. 37, no. 5, pp. 235–236, May 1992. (English transl. of a paper that originally appeared in Russian: *Dokl. Akad. Nauk.,* vol. 324, pp. 321–324, May 1992.)

[2] A. Lakhtakia, V. K. Varadan, and V. V. Varadan, *Time-Harmonic Electromagnetic Fields in Chiral Media*, Heidelberg, Germany: Springer-Verlag, 1989, pp. 22–24.

[3] A. Lakhtakia, *Beltrami Fields in Chiral Media.* Singapore: World Scientific, 1994, pp. 140–146.

Manuscript received April 6, 1996.

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Publisher Item Identifier S 0018-9480(97)00887-9.

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Comments on "A New Reciprocity Theorem"

Hristos T. Anastassiu and John L. Volakis

We write this to point out that the result in (28) of the above paper[1] can be derived very easily using a standard identity, thus eliminating the lengthy analysis originally presented. We also note that the factor of 1/2 in (26) is in error and must be deleted.

We begin the proof of (28) in the above paper starting with the identity (Gauss' theorem)

$$\int_V \nabla \cdot (\mathbf{E}_1 \times \mathbf{E}_2 - \eta^2 \mathbf{H}_1 \times \mathbf{H}_2)\, d^3v = \oint_S (\mathbf{E}_1 \times \mathbf{E}_2 - \eta^2 \mathbf{H}_1 \times \mathbf{H}_2) \cdot \hat{\mathbf{n}}\, d^2S. \quad (1)$$

As in the above paper, $(\mathbf{E}_1, \mathbf{H}_1)$ and $(\mathbf{E}_2, \mathbf{H}_2)$ are the fields associated with the corresponding sources $(\mathbf{J}_1, \mathbf{M}_1)$ and $(\mathbf{J}_2, \mathbf{M}_2)$. Also, η is the intrinsic impedance of the medium.

Next, we invoke the standard vector identity

$$\nabla \cdot (\mathbf{A} \times \mathbf{B}) = \mathbf{B} \cdot \nabla \times \mathbf{A} - \mathbf{A} \cdot \nabla \times \mathbf{B} \quad (2)$$

to obtain

$$\nabla \cdot (\mathbf{E}_1 \times \mathbf{E}_2 - \eta^2 \mathbf{H}_1 \times \mathbf{H}_2) = \mathbf{E}_2 \cdot \nabla \times \mathbf{E}_1 - \mathbf{E}_1 \cdot \nabla \times \mathbf{E}_2 - \eta^2 \mathbf{H}_2 \cdot \nabla \times \mathbf{H}_1 + \eta^2 \mathbf{H}_1 \cdot \nabla \times \mathbf{H}_2 \quad (3)$$

which upon using Maxwell's equations can be rewritten as

$$\nabla \cdot (\mathbf{E}_1 \times \mathbf{E}_2 - \eta^2 \mathbf{H}_1 \times \mathbf{H}_2) = \mathbf{E}_1 \cdot \mathbf{M}_2 - \mathbf{E}_2 \cdot \mathbf{M}_1 + \eta^2 \mathbf{H}_1 \cdot \mathbf{J}_2 - \eta^2 \mathbf{H}_2 \cdot \mathbf{J}_1. \quad (4)$$

Substituting the latter expression into (1) yields

$$\int_V (\mathbf{E}_1 \cdot \mathbf{M}_2 - \mathbf{E}_2 \cdot \mathbf{M}_1 + \eta^2 \mathbf{H}_1 \cdot \mathbf{J}_2 - \eta^2 \mathbf{H}_2 \cdot \mathbf{J}_1)\, d^3v = \oint_S (\mathbf{E}_1 \times \mathbf{E}_2 - \eta^2 \mathbf{H}_1 \times \mathbf{H}_2) \cdot \hat{\mathbf{n}}\, d^2S. \quad (5)$$

Finally, as S goes to infinity the right-hand side (RHS) of (5) vanishes and thus the authors obtain

$$\int_{V_\infty} (\mathbf{E}_1 \cdot \mathbf{M}_2 + \eta^2 \mathbf{H}_1 \cdot \mathbf{J}_2)\, d^3v = \int_{V_\infty} (\mathbf{E}_2 \cdot \mathbf{M}_1 + \eta^2 \mathbf{H}_2 \cdot \mathbf{J}_1)\, d^3v \quad (6)$$

which is identical to (28) in the above paper.[1]

Manuscript received April 6, 1996.

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Publisher Item Identifier S 0018-9480(97)00847-8.