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Reply to the "Comment on 'Transfer Matrix Method for General Bianisotropic Layers': Correction of Explicit Formulations" by Joosun Yun

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ABSTRACT: This reply addresses the comment by Yun [1] regarding the sign errors in the Ω matrix terms for our recent paper on the transfer matrix method for general bianisotropic layers. The comment correctly identifies sign errors, which do lead to non-physical results. In this reply, we present an alternative construction method for Ω that has fewer opportunities for transcription errors over the original formulation. These corrections do not affect the remainder of the formulation. However, they do affect the results of the second example in the original paper, which is corrected here.

1. INTRODUCTION

Recently, Yun [1] identified sign errors in the expanded terms of the 4×4 Ω matrix from [2]. As demonstrated in the comment, these sign errors led to non-physical gainful behavior in a lossless medium. Upon closer inspection, the original paper does contain sign errors, and we have verified Yun's corrections.

The expanded Ω matrix terms are highly susceptible to errors, such as these, especially when transcribing them to numerical algorithms. For this reason, we present an alternative construction method for Ω, which has since been adopted. This approach is equivalent to Yun's corrections and is much simpler with fewer opportunities for mistakes. Using the corrected equations and alternative approach, power conservation was confirmed for the reported cases.

2. ALTERNATIVE Ω MATRIX CONSTRUCTION

From the normalized curl equations of [2], the z-component equations can be written together as

$$-\underbrace{\begin{bmatrix}\varepsilon_{zz} & \xi_{zz}\\ \zeta_{zz} & \mu_{zz}\end{bmatrix}}_{A}\underbrace{\begin{bmatrix}E_z\\ \tilde{H}_z\end{bmatrix}}_{\psi_z}=$$

$$\underbrace{\begin{bmatrix}\varepsilon_{zx} & \varepsilon_{zy} & \xi_{zx}-\tilde{k}_y & \xi_{zy}+\tilde{k}_x\\ \zeta_{zx}+\tilde{k}_y & \zeta_{zy}-\tilde{k}_x & \mu_{zx} & \mu_{zy}\end{bmatrix}}_{B}\underbrace{\begin{bmatrix}E_x\\ E_y\\ \tilde{H}_x\\ \tilde{H}_y\end{bmatrix}}_{\psi} \quad (1)$$

Equation (1) implies an operator of the form $\psi_z=\Omega_{\mathrm{L}}\psi$, where $\Omega_{\mathrm{L}}=A^{-1}B$ converts transverse fields to longitudinal fields. The remaining four equations are reordered and written in the form

$$\frac{d\psi}{d\tilde{z}}=-j(\Omega_1\psi+\Omega_2\psi_z) \quad (2)$$

where Ω_1 and Ω_2 are

$$\Omega_1=\begin{bmatrix}\zeta_{yx} & \zeta_{yy} & \mu_{yx} & \mu_{yy}\\ -\zeta_{xx} & -\zeta_{xy} & -\mu_{xx} & -\mu_{xy}\\ -\varepsilon_{yx} & -\varepsilon_{yy} & -\xi_{yx} & -\xi_{yy}\\ \varepsilon_{xx} & \varepsilon_{xy} & \xi_{xx} & \xi_{xy}\end{bmatrix} \quad (3)$$

$$\Omega_2=\begin{bmatrix}\tilde{k}_x+\zeta_{yz} & \mu_{yz}\\ \tilde{k}_y-\zeta_{xz} & -\mu_{xz}\\ -\varepsilon_{yz} & \tilde{k}_x-\xi_{yz}\\ \varepsilon_{xz} & \tilde{k}_y+\xi_{xz}\end{bmatrix} \quad (4)$$

The final 4×4 matrix is then $\Omega=\Omega_1+\Omega_2\Omega_{\mathrm{L}}$.

3. NUMERICAL VALIDATION

The lossless second example from [1] was simulated using the corrected formulas and the approach outlined above. Both resulted in reflection, transmission, and conservation values of $R\approx66.81\%$, $T\approx33.19\%$, and $C=R+T=100\%$, respectively. The lossy version of this example from [2] was re-simulated, where it was found that $R\approx33.74\%$ and $T\approx0.0095\%$.

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4. CONCLUSION

Yun correctly identified sign errors in the original formulation. The correction was adopted, and an equivalent construction method of Ω was proposed. Other than the second example of [2], the remainder of the bianisotropic transfer matrix method is unaffected.

REFERENCES

[1] Yun, J., "Comment on 'Transfer matrix method for general bianisotropic layers': Correction of explicit formulations," *Progress In Electromagnetics Research C*, Vol. 167, 242–243, 2026.

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