3D FDTD Analysis of TE_{01} Mode Propagation in X-Band Rectangular Waveguides

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***Abstract*—Write your abstract text here.**

I. Introduction

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II. Mathematical Model

To model a 3D waveguide *in silico*, the simulation domain must be divided up into regions where specific mathematical relations hold. In this particular system there are three such regions (1) PEC surrounded dielectric, (2) Total Field / Scattered Field (TF/SF) 1-way source, and (3) Mur Absorbing Boundary Condition (Mur ABC). A high level diagram of a PEC bordered rectangular waveguide can be found in Fig. 1(a) and a $\hat{y}$ sliced model where said relations hold can be found in Fig. 1(b). These governing relations are then discretized to formulate time-stepping formulas which allow the system to evolve transiently.

A. PEC Surrounded Dielectric

As seen in Fig. 1(b) the vast majority of the simulation domain is composed of a PEC enclosed dielectric, the governing equations of which are Ampère's and Faraday's Laws respectively. In differential form these, equations take the form

$$\nabla \times \mathbf{H} = \frac{\partial \mathbf{D}}{dt} + \mathbf{J} \tag{1}$$

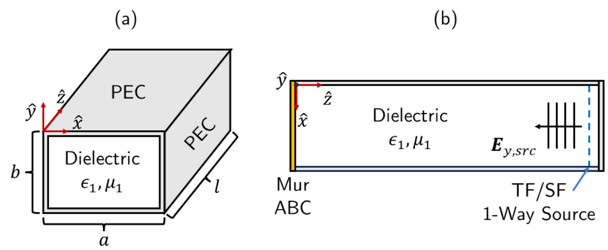

Fig. 1: Diagrams of (a) High-Level PEC Rectangular Waveguide (b) $\hat{y}$-Sliced Model with Labeled Regions

and

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{dt} - \mathbf{M} \tag{2}$$

where

III. Numerical Results

A. Verification and Validation

1) *Propogation Patterns:*
2) *Cutoff Frequency:*
3) *Dielectric Frequency Compression:*

B. Case Study

IV. Conclusion

Overall, this is just a very simple document to get you going in LaTeX. There is a bit of a learning curve, but in my experience it is incredibly worthwhile for every graduate student to learn how to use this tool. There are still some times where I use Microsoft Word because it will be easier, but this is often very infrequent. At this point, I cannot imagine trying to write a journal paper within anything but LaTeX because of how much easier it is to control formatting, produce great looking equations, automatically handle cross-referencing and reference lists, etc.

V. Appendix

A. Code Structure

References

[1] J.-M. Jin, *Theory and Computation of Electromagnetic Fields.* John Wiley & Sons, 2011.
[2] D. M. Pozar, *Microwave Engineering*. John Wiley & Sons, 2011.
[3] J.-M. Jin, *The Finite Element Method in Electromagnetics*. John Wiley & Sons, 2015.