Analysis and Visualization of Fields and Waves inside a PEMC Waveguide

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The PEMC medium is a special type of metamaterial which is a generalization of the well-known concepts of PEC (perfect electric conducting) and PMC (perfect magnetic conducting) media. Perfect electromagnetic medium is characterized by an admittance-type parameter $M = \cot \vartheta$, and the choices of $\vartheta = 0$ and $\vartheta = \pi/2$ give the PEC and PMC cases, respectively. For the basic properties of PEMC media, see [1–3].

The effect of the PEMC boundary is that the field that is incident on it will suffer a rotation in polarization. Hence it is a non-reciprocal actor in the electromagnetic problem. (In fact, the suggested realizations of PEMC elements require gyrotropic materials; either ferrites or magnetized plasma -type antisymmetric material parameter responses.) As the ordinary metal waveguide serves as a structure where longitudinal propagation is combined with reflection resonances in the transverse direction, we can expect interesting effects to be found in the behavior of electromagnetic fields that are transmitted through a waveguide with walls made of PEMC material.

We have analyzed the electric and magnetic fields in PEMC waveguides for propagating modes. The field structure is obviously dependent on the M parameter and it can be seen to approach uniformly the well-known fields of waveguides with PEC or PMC walls. The effect of finite value of the PEMC parameter M is that the transverse fields are no longer orthogonal, at the walls the electric field has a tangential component and both electric and magnetic fields have longitudinal components, forming paired loops. In the presentation we shall visualize these effects in various ways.

REFERENCES

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