Comparison of Scattering Coefficients for Tapered Beams Generated Analytically or by Plane Wave Spectrum Decomposition

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1 Abstract

This presentation shows a comparison between the results obtained for computing the plane wave scattering (reflection and transmission) coefficients of a dielectric slab of known permittivity when the plane wave illumination is implemented by three differents methods. The first method corresponds to the infinite plane wave illumination. Its results are obtained analytically from computing the overall scattering matrix of the slab by cascading the scattering matrices for each interface and the scattering matrix for the transmission line representing the intervening dielectric propagation medium between the two interfaces, as per Reference [1]. The two other methods consist of generating an incident tapered beam as the excitation in FDTD simulations. The beam is tapered to avoid illuminating the edges of the slab and thus, to avoid generating diffracted rays which would otherwise corrupt the results. In the second method, the tapered beam is generated analytically throughout the computational domain. The resulting beam corresponds to an ideal tapered beam with uniform polarization throughout the beam and uniform intensity through the slab, but it is non-Maxwellian according to Reference [2]. In the third method, the tapered beam is generated by summing a finite number of infinite plane waves according to the technique of Reference [3]. The resulting tapered beam is Maxwellian but its polarization and its intensity are not perfectly uniform throughout the beam or through the slab, respectively. We want to see if using a non-Maxwellian tapered beam as the excitation in a FDTD simulation could create spurious responses or instabilities. Furthermore, we want to assess how successfully a tapered beam could be used in place of an infinite plane wave illumination for computing by FDTD simulation the scattering coefficients corresponding to the bulk material of the slab. The presentation shows also in detail the technique for carrying out the measurement of the reflection and the transmissions coefficients of the slab by FDTD simulation.

REFERENCES

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[3] J.E. Roy, "Tapering an Incident Plane Wave", submitted to *IEEE trans. on Antennas and Propag.*, January 2003.