Comparison of Implementations of Thin Layers in the FDTD Grid

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The thin layer technique is a subcell method used to update the tangential electric component inside a thin layer in the Finite-Difference Time-Domain (FDTD) method (Tekbas *et al*, IEEE Trans. Antennas Propag., 278-286, 65, 2017). This is achieved through the use of the integral form of the Maxwell-Ampere equation and the solution of auxiliary equations. The thin layer technique provides accurate results in transverse-magnetic polarisation in the FDTD computational domain with a normal incidence plane wave to a thin layer. However, in the transverse-electric polarisation, an additional process may be required. This is due to the discontinuity of the normal electric component across the physical boundary between the thin layer and the free space. The Moloney and Smith technique is used to update the tangential magnetic field since the normal electric field is split into two parts; an inside and outside thin layer (J. G. Maloney and G. S. Smith, IEEE Trans. Antennas Propag., 323-330, 40, 1992). The split electric field components are then updated based on their relative permittivity. This paper analyses the effect of the Moloney and Smith technique on the way to handle a thin layer varying of incidence plane wave. The oblique plane wave is used as the source excitation to ensure that both normal and tangential electric field components are constituted in the modelling of the thin layer in the computational FDTD domain. The reflected coefficient from the thin layer demonstrates the accuracy of the Moloney and Smith technique in handling a thin layer compared with the theoretically reflected coefficient in the frequency domain. The implementations of the thin layers using the Moloney and Smith technique are shown to result in improved accuracy at the wide angle of incidence plane wave.