13
Appendix

Figures

13.1 Finite difference time domain method

13.1.5 Yee cell

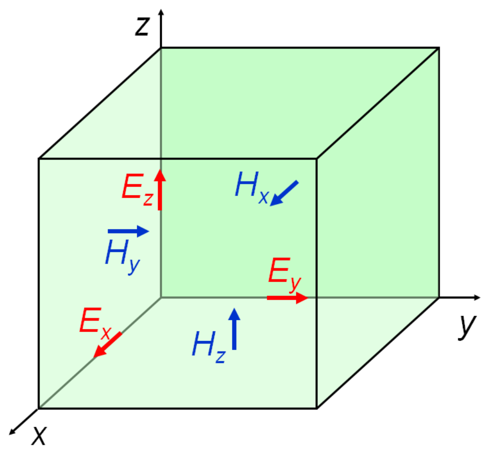

Fig. 13.1. Diagram of the FDTD Yee cell. The Cartesian components of the electric and magnetic fields are located at different points within the Yee cell.

13.1.6 Time step

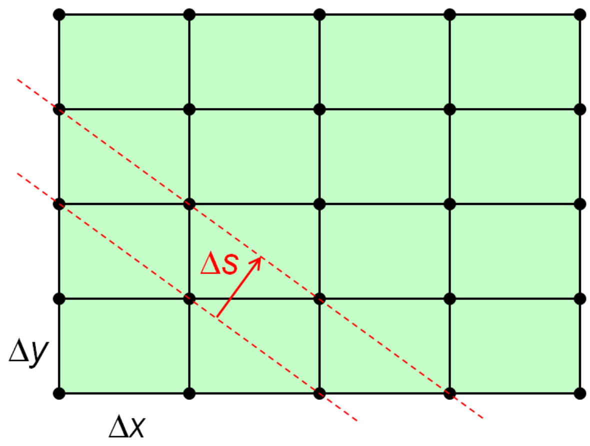

Fig. 13.2. Diagram of a two-dimensional lattice. Each cell has length Δ*x* and height Δ*y*. The dashed lines illustrate the two nearest neighbor lattice planes with spacing Δ*s*. A plane wave propagating normal to these planes at speed *c* would reach the second plane at time Δ*t* = Δ*s*/*c* after the first plane. Δ*t* must be no shorter than the time step for each FDTD update.

13.1.9 Comparison with Mie scattering

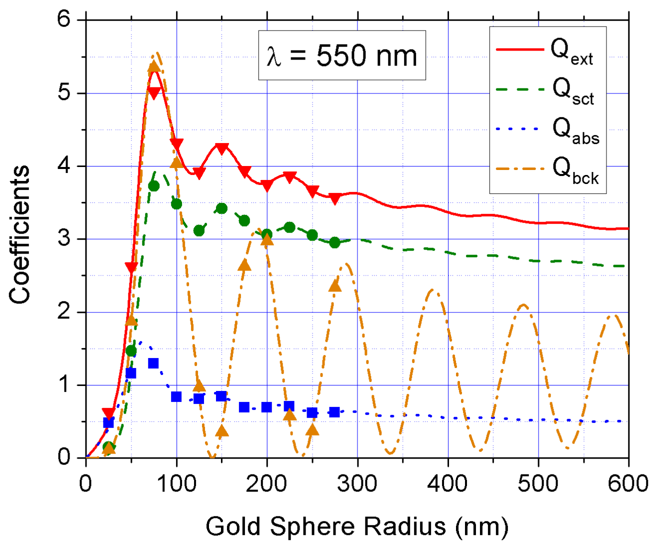

Fig. 13.3: Extinction, scattering, absorption, and backscattering coefficients for a gold sphere in free space as a function of sphere radius for a wavelength of 550 nm. Lines are calculated from Mie theory while data points are calculated from FDTD.

13.2 Poynting vector and local power flow

13.2.2 Poynting vector and static fields

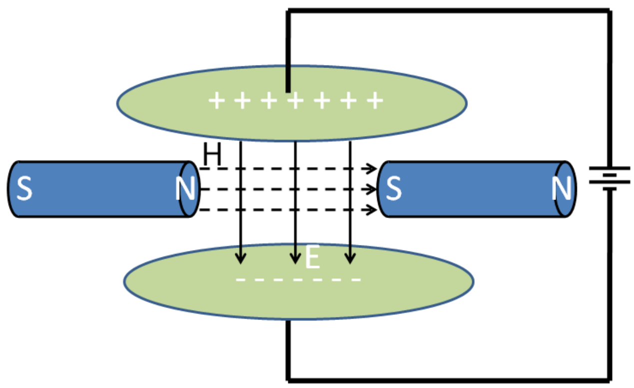

Fig. 13.4. A charged capacitor plate can generate a static electric field and a permanent magnetic can generate a static magnetic field such that there will be a nonzero Poynting vector in the region of space where they overlap.

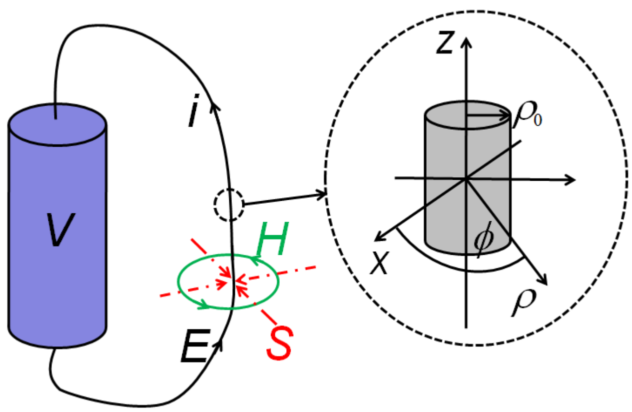

Fig. 13.5. A dry cell of voltage V generates a current i in a wire and delivers a power $P = i\,V$ to the wire.

13.2.3 Poynting vector and guided modes

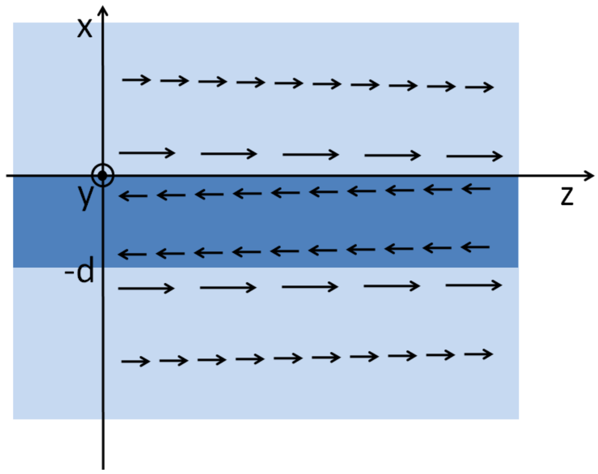

Fig. 13.6. A SP mode guided by a thin metallic film between two dielectric cladding layers. The Poynting vector is in the direction of SP propgation within the cladding but in the opposite direction within the metallic guide.

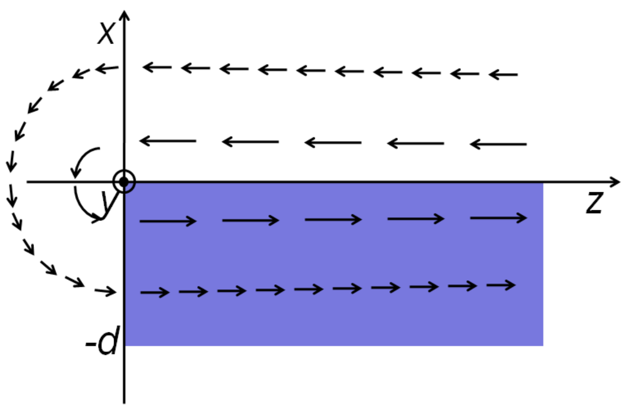

Fig. 13.7. A plot of $\nabla \times \mathbf{G}$ as defined in Eq. 13.56.

References

[1] A. Taflove and S. C. Hagness. *Computational Electrodynamics: The Finite-Difference Time-Domain Method*, 2nd ed (Boston: Artech House, 2000).

[2] K. S. Kunz and R. J. Luebbers. *The Finite Difference Time Domain Method for Electromagnetics* (Boca Raton: CRC Press, 1993).

[3] J. P. Berenger. A perfectly matched layer for the absorption of electromagnetic waves. *J. Computational Phys.* **114** (1994) 185.

[4] R. E. Diaz and I. Scherbatko. A simply stackable re-radiating boundary condition (rRBC) for FDTD. *IEEE Ant. Prop.* **46** (2004) 124.

[5] K. S. Yee. Numerical solution of initial boundary value problems involving Maxwell's equations in isotropic media. *IEEE Trans. Ant. Prop.* **14** (1966) 302.

[6] W. A. Challener, I. K. Sendur and C. Peng. Scattered field formulation of finite difference time domain for a focused light beam in dense media with lossy materials. *Opt. Exp.* **11** (2003) 3160.

[7] B. Richards, and E. Wolf. Electromagnetic diffraction in optical systems II. Structure of the image field in an aplanatic system. *Proc. Roy. Soc. Ser. A* **253** (1959) 358.

[8] E. C. Jordan and K. G. Balmain. *Electromagnetic Waves and Radiating Systems* 2^{nd} ed. (Englewood Cliffs, Prentice Hall, 1968) pp. 169, 170.

[9] J. Wuenschell and H. K. Kim. Surface plasmon dynamics in an isolated metallic nanoslit. *Opt. Exp.* **14** (2006) 10000.

[10] V. A. Markel. Correct definition of the Poynting vector in electrically and magnetically polarizable medium reveals that negative refraction is impossible. *Opt. Exp.* **16** (2008) 19152.

[11] R. Marqués. Correct denition of the Poynting vector in electrically and magnetically polarizable medium reveals that negative refraction is impossible: comment. *Opt. Exp.* **17** (2009) 7322.

[12] V. A. Markel. Correct denition of the Poynting vector in electrically and magnetically polarizable medium reveals that negative refraction is impossible: reply. *Opt. Exp.* **17** (2009) 7325.