Propagation in Lossy Dielectric Medium

Maxwell's equation (3D)

$$\frac{\partial \boldsymbol{E}}{\partial t} = \frac{1}{\varepsilon_r \varepsilon_0} \nabla \times \boldsymbol{H} - \frac{\sigma}{\varepsilon_r \varepsilon_0} \boldsymbol{E}$$

$$\frac{\partial \boldsymbol{H}}{\partial t} = -\frac{1}{\mu_0} \nabla \times E$$

$$\downarrow$$

$$E_x^{n+\frac{1}{2}}(k) = \frac{1-\alpha}{1+\alpha} \cdot E_x^{n-\frac{1}{2}}(k) - \frac{dt}{\varepsilon_r(1+\alpha)\varepsilon_0 \cdot dz}\left[H_y^n\left(k+\frac{1}{2}\right) - H_y^n\left(k-\frac{1}{2}\right)\right]$$

$$H_y^{n+1}\left(k+\frac{1}{2}\right) = H_y^n\left(k+\frac{1}{2}\right) - \frac{dt}{\mu_0 \cdot dz}\left[E_x^{n+\frac{1}{2}}(k+1) - E_x^{n-\frac{1}{2}}(k)\right]$$

$$\alpha = dt \cdot \frac{\sigma}{2\varepsilon_r \varepsilon_0}$$