~~Life: Ants, Dogs, etc~~

3/15/2017

⟨ Wave Eq. ⟩ — Review

- Maxwell Eqs. <u>in Vacuum</u>

$$\begin{cases} \nabla \cdot E = 0 & \text{– Gauss's law} \\ \nabla \cdot H = 0 & \text{– No magnetic monopole} \\ \nabla \times E = -\mu_0 \dfrac{\partial H}{\partial t} & \text{– Faraday's law} \\ \nabla \times H = \epsilon_0 \dfrac{\partial E}{\partial t} & \text{– Ampere's law (revised)} \end{cases}$$

μ_0 : permeability $(4\pi \times 10^{-7}\ H/m)$

ϵ_0 : permitivity $(8.85 \times 10^{-12}\ F/m)$

(i) $\nabla \times (\nabla \times E) = \nabla(\nabla \cdot E) - \nabla^2 E = -\nabla^2 E$

$\rightarrow \nabla \times \left(-\mu_0 \dfrac{\partial H}{\partial t}\right) = -\mu_0 \dfrac{\partial}{\partial t}(\nabla \times H) = -\epsilon_0 \mu_0 \dfrac{\partial^2 E}{\partial t^2}$

$$\therefore \nabla^2 E = \frac{1}{c^2} \frac{\partial^2 E}{\partial t^2},$$

$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}} \quad (\doteqdot 3 \times 10^8\ m/s)$$

(ii) Likewise,

$$\nabla^2 H = \frac{1}{c^2} \frac{\partial^2 H}{\partial t^2}$$

- Light speed in a medium

$$\epsilon_0 \rightarrow K^{-1} \epsilon \quad ; \quad \mu_0 \rightarrow K_m^{-1} \mu$$

$$\therefore v = \frac{1}{\sqrt{\epsilon \mu}} = \frac{1}{\sqrt{K K_m}} c$$

$\rightarrow \dfrac{c}{v} \equiv n = \sqrt{K K_m}$, In most trasparent medium $K_m = 1$