ENGN1930B HW3

Name: Kuan-Min Lee

Instructor: Dr. Jonghwan Lee

Problem 1.7.

$f = 100 \, mm$, $z_{img} = 300 \, mm$, $\Delta x_{img} = 10 \, \mu m$

For fulfilling Nyquist Sampling Rate,

$$\Delta x_{samp} = \frac{\Delta x_{img}}{2} = \frac{10 \, \mu m}{2} = 5 \, \mu m$$

$$\Delta x_{samp} = \frac{z_{samp}}{z_{img}} \times \Delta x_{img} = \frac{z_{samp}}{300 \, mm} \times 10 \, \mu m = 5 \, \mu m$$

$$z_{samp} = \frac{1}{2} \times 300 = \boxed{150 \, mm} \quad \looparrowright$$

Same as the position of focal plane.

Problem 2.1. :   Redo

For monochromatic plane wave,

$$\varepsilon(x, y, z, t) = \varepsilon_0 \cdot \cos(k\vec{r} - wt + \delta) \, \hat{x}$$

amplitude: ε_0 , angular freq. $= w$,

$\delta = 0$

$$\varepsilon(x, y, z, t) = \varepsilon_0 \cdot \cos(k\vec{r} - wt) \, \hat{x}$$

$$= \boxed{\varepsilon_0 \cdot e^{i(k\vec{r} - wt)} \, \hat{x}} \quad \#$$

Problem 2.2.

$\varepsilon_0 = 1.0 \; V/m$, $n = 1.7$, $\epsilon_0 = 8.854 \times 10^{-12} \; E/m$,

$c = 3 \times 10^8 \; m/s$

$$J(\hat{r}) = \frac{1}{2} \times n \times C \times \varepsilon_0 \times \vec{E}(\hat{r}) \; \vec{\varepsilon}^* (\hat{r})$$

$$= \frac{1}{2} \times 1.7 \times 3 \times 10^8 \; m/s \times 8.854 \times 10^{-12} \; \chi/m$$

$$1.0 \; V/m \cdot e^{i(ckr + \delta)} \cdot 1.0 \; V/m \; e^{-i(ckr + \delta)}$$

$$\cong 2.258 \times 10^9 \cdot e^0 = \boxed{2.258 \times 10^9 \; W/m^2}$$