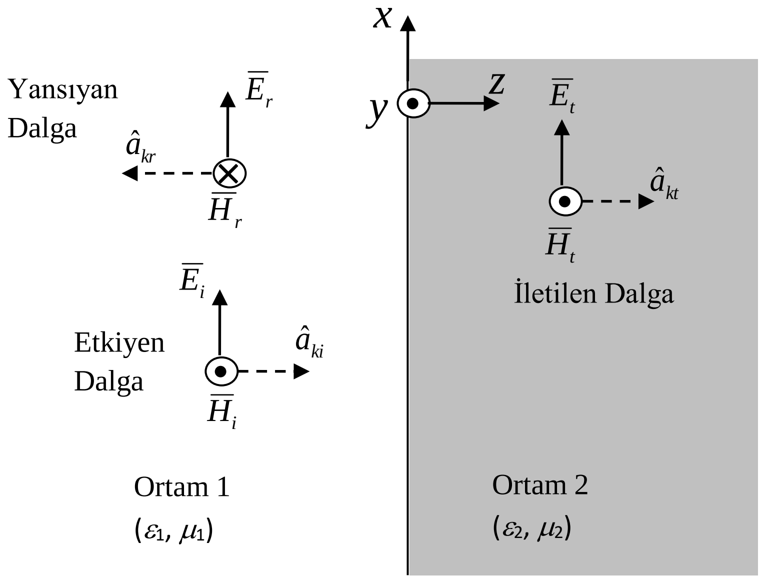
Düzlem Dalgaların Bir Ortam Sınırına Dik Etkimesi:



$$\overline{E}_i(z) = \hat{a}_x E_{i0} e^{-j\beta_1 z}$$
$$\overline{E}_t(z) = \hat{a}_x E_{t0} e^{-j\beta_2 z}$$
$$\overline{E}_r(z) = \hat{a}_x E_{r0} e^{+j\beta_1 z}$$

$$\overline{H}_i(z) = \frac{1}{\eta_1}\hat{a}_z \times \overline{E}_i(z) = \frac{1}{\eta_1}\hat{a}_z \times (\hat{a}_x E_{i0} e^{-j\beta_1 z}) = \hat{a}_y \frac{E_{i0}}{\eta_1} e^{-j\beta_1 z}$$
$$\overline{H}_t(z) = \frac{1}{\eta_2}\hat{a}_z \times \overline{E}_t(z) = \frac{1}{\eta_2}\hat{a}_z \times (\hat{a}_x E_{t0} e^{-j\beta_2 z}) = \hat{a}_y \frac{E_{t0}}{\eta_2} e^{-j\beta_2 z}$$
$$\overline{H}_r(z) = \frac{1}{\eta_1}(-\hat{a}_z) \times \overline{E}_r(z) = -\frac{1}{\eta_1}\hat{a}_z \times (\hat{a}_x E_{r0} e^{+j\beta_1 z}) = -\hat{a}_y \frac{E_{r0}}{\eta_1} e^{+j\beta_1 z}$$

$$\overline{\mathscr{E}}_i(z;t) = \hat{a}_x E_{i0} \cos(\omega t - \beta_1 z)$$
$$\overline{\mathscr{E}}_t(z;t) = \hat{a}_x E_{t0} \cos(\omega t - \beta_2 z)$$
$$\overline{\mathscr{E}}_r(z;t) = \hat{a}_x E_{r0} \cos(\omega t + \beta_1 z)$$

$$\overline{\mathscr{H}}_i(z;t) = \hat{a}_y \frac{E_{i0}}{\eta_1} \cos(\omega t - \beta_1 z)$$
$$\overline{\mathscr{H}}_t(z;t) = \hat{a}_y \frac{E_{t0}}{\eta_2} \cos(\omega t - \beta_2 z)$$
$$\overline{\mathscr{H}}_r(z;t) = -\hat{a}_y \frac{E_{r0}}{\eta_1} \cos(\omega t + \beta_1 z)$$

$$\eta_1 = \sqrt{\frac{\mu_1}{\varepsilon_1}} \qquad \beta_1 = \omega\sqrt{\mu_1\varepsilon_1}$$

$$\eta_2 = \sqrt{\frac{\mu_2}{\varepsilon_2}} \qquad \beta_2 = \omega\sqrt{\mu_2\varepsilon_2}$$

Ortam 1'deki toplam elektrik alan:

$$\bar{\mathscr{E}}_1(z;t) = \bar{\mathscr{E}}_i(z;t) + \bar{\mathscr{E}}_r(z;t) = \hat{a}_x E_{i0}\cos(\omega t - \beta_1 z) + \hat{a}_x E_{r0}\cos(\omega t + \beta_1 z)$$

Ortam 2'deki toplam elektrik alan:

$$\bar{\mathscr{E}}_2(z;t) = \bar{\mathscr{E}}_t(z;t) = \hat{a}_x E_{t0}\cos(\omega t - \beta_2 z)$$

Ortam 1'deki toplam manyetik alan:

$$\bar{\mathscr{H}}_1(z;t) = \bar{\mathscr{H}}_i(z;t) + \bar{\mathscr{H}}_r(z;t) = \hat{a}_y \frac{E_{i0}}{\eta_1}\cos(\omega t - \beta_1 z) - \hat{a}_y \frac{E_{r0}}{\eta_1}\cos(\omega t + \beta_1 z)$$

Ortam 2'deki toplam manyetik alan:

$$\bar{\mathscr{H}}_2(z;t) = \bar{\mathscr{H}}_t(z;t) = \hat{a}_y \frac{E_{t0}}{\eta_2}\cos(\omega t - \beta_2 z)$$

Sınır Koşulları:

z=0'da elektrik alanın teğet bileşeni sürekli olmak zorundadır:

$$\bar{\mathscr{E}}_1(z;t)\Big|_{z=0} = \bar{\mathscr{E}}_2(z;t)\Big|_{z=0}$$

$$\Rightarrow \bar{\mathscr{E}}_i(0;t) + \bar{\mathscr{E}}_r(0;t) = \hat{a}_x E_{i0}\cos(\omega t) + \hat{a}_x E_{r0}\cos(\omega t) = \bar{\mathscr{E}}_t(0;t) = \hat{a}_x E_{t0}\cos(\omega t)$$

$$\Rightarrow \hat{a}_x (E_{i0} + E_{r0})\cos(\omega t) = \hat{a}_x E_{t0}\cos(\omega t)$$

$$\Rightarrow E_{i0} + E_{r0} = E_{t0}$$

Benzer şekilde, z=0'da manyetik alanın teğet bileşeni de sürekli olmak zorundadır:

$$\bar{\mathscr{H}}_1(z;t)\Big|_{z=0} = \bar{\mathscr{H}}_2(z;t)\Big|_{z=0}$$

$$\Rightarrow \bar{\mathscr{H}}_i(0;t) + \bar{\mathscr{H}}_r(0;t) = \hat{a}_y \frac{E_{i0}}{\eta_1}\cos(\omega t) - \hat{a}_y \frac{E_{r0}}{\eta_1}\cos(\omega t) = \bar{\mathscr{H}}_t(0;t) = \hat{a}_y \frac{E_{t0}}{\eta_2}\cos(\omega t)$$

$$\Rightarrow \hat{a}_y \left(\frac{E_{i0} - E_{r0}}{\eta_1}\right)\cos(\omega t) = \hat{a}_y \frac{E_{t0}}{\eta_2}\cos(\omega t)$$

$$\Rightarrow \frac{E_{i0} - E_{r0}}{\eta_1} = \frac{E_{t0}}{\eta_2}$$

Yansıma katsayısı (elektrik alanın ortam 1'e ne oranda yansıdığına dair bir ölçüt):

$$\Gamma = \frac{E_{r0}}{E_{i0}} = \frac{\eta_2 - \eta_1}{\eta_2 + \eta_1}$$

İletim katsayısı (elektrik alanın ortam 2'ye ne oranda iletildiğine dair bir ölçüt):

$$\tau = \frac{E_{t0}}{E_{i0}} = \frac{2\eta_2}{\eta_2 + \eta_1}$$

$$1 + \Gamma = \tau$$

$$S = \frac{|E|_{\max}}{|E|_{\min}} = \frac{1 + |\Gamma|}{1 - |\Gamma|}$$

$$|\Gamma| = \frac{S - 1}{S + 1}$$

Not: Yukarıdaki katsayılar ve eşitlikler, sadece dik etkime için geçerlidir!...

Ortam 1'deki toplam elektrik alan:

$$\bar{\mathscr{E}}_1(z;t) = \bar{\mathscr{E}}_i(z;t) + \bar{\mathscr{E}}_r(z;t) = \hat{a}_x E_{i0} \cos(\omega t - \beta_1 z) + \hat{a}_x E_{r0} \cos(\omega t + \beta_1 z)$$

$$\bar{E}_1(z) = \bar{E}_i(z) + \bar{E}_r(z) = \hat{a}_x E_{i0} e^{-j\beta_1 z} + \hat{a}_x E_{r0} e^{+j\beta_1 z}$$

$$= \hat{a}_x E_{i0} e^{-j\beta_1 z} + \hat{a}_x \Gamma E_{i0} e^{+j\beta_1 z}$$

$$= \hat{a}_x E_{i0} e^{-j\beta_1 z} (1 + \Gamma e^{+j2\beta_1 z})$$

Bu şekilde ifade edilebilen dalgalara, “Duran Dalga” adı verilir.