1.1 Equivalent model for region II

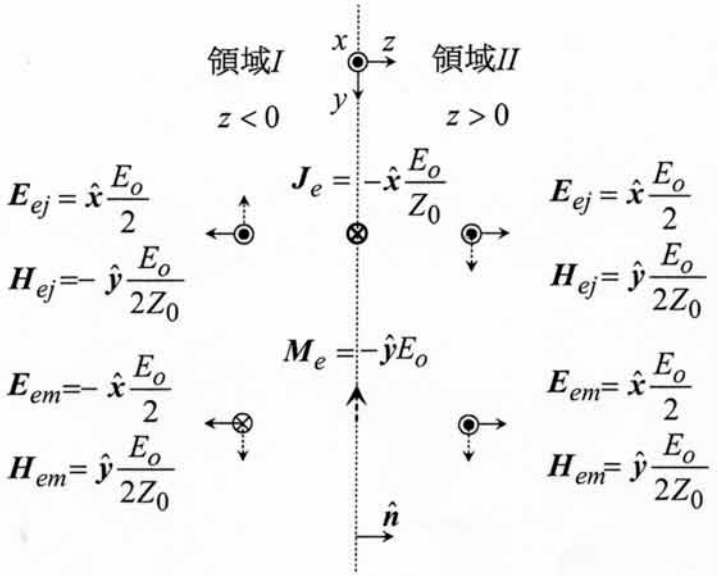

Figure 3: 領域 II の等価モデル (1)

In fig.3 the equivalent model for region II is shown. Because in region II plane wave does not exist, it is not taken into account (as real wave). We consider only the electromagnetic field produced by equivalent electromagnetic currents($\mathbf{J}_e$,$\mathbf{M}_e$) located on the boundary $S(z=0)$.

The equivalent electromagnetic currents($\mathbf{J}_e$,$\mathbf{M}_e$) on the boundary$S(z=0)$ are defined as:

$$\mathbf{J}_e = \hat{\mathbf{n}} \times \mathbf{H}_o = \hat{\mathbf{z}} \times \hat{\mathbf{y}}\frac{E_0}{Z_0} = -\hat{\mathbf{x}}\frac{E_0}{Z_0} \tag{3}$$

$$\mathbf{M}_e = \mathbf{E}_o \times \hat{\mathbf{n}} = \hat{\mathbf{x}} \times \hat{\mathbf{z}}E_0 = -\hat{\mathbf{y}}E_0 \tag{4}$$

where the vector $\hat{\mathbf{n}}$ is defined as unitary vector $\hat{\mathbf{z}}$ in the inner direction for region II.

The electromagnetic field ($\mathbf{E}_{ej}$,$\mathbf{H}_{ej}$) produced by equivalent electric current $\mathbf{J}_e$ is given as:

$$\mathbf{E}_{ej} = \begin{cases} \hat{\mathbf{x}}\frac{E_0}{2}\exp(jk_0z) & (z<0) \\ \hat{\mathbf{x}}\frac{E_0}{2}\exp(-jk_0z) & (z>0) \end{cases} \tag{5}$$

$$\mathbf{H}_{ej} = \begin{cases} -\hat{\mathbf{y}}\frac{E_0}{2Z_0}\exp(jk_0z) & (z<0) \\ \hat{\mathbf{y}}\frac{E_0}{2Z_0}\exp(-jk_0z) & (z>0) \end{cases} \tag{6}$$

where the magnetic field direction is given by clockwise rotation around the electric current. Because the propagation and magnetic field direction are known, the electric field direction is found by using right hand law. The plane wave produced by equivalent source propagates in $-z$ direction (region I) and $+z$ direction (region II).

The electromagnetic field ($\mathbf{E}_{em}$,$\mathbf{H}_{em}$) produced by equivalent electric current $\mathbf{M}_e$ is given as:

$$\mathbf{E}_{em} = \begin{cases} -\hat{\mathbf{x}}\frac{E_0}{2}\exp(jk_0z) & (z<0) \\ \hat{\mathbf{x}}\frac{E_0}{2}\exp(-jk_0z) & (z>0) \end{cases} \tag{7}$$