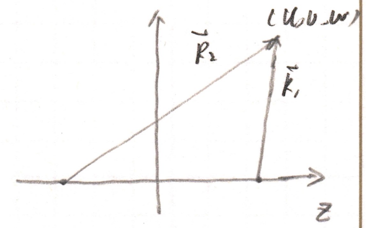
5.17 With image current, the magnetic field for $z>0$ is



$$\vec{B}_> = \frac{\mu_0}{4\pi}\int\left[\frac{\vec{J}(x,y,z)\times\vec{R}_1}{R_1^3} + \frac{\vec{J}'(x,y,-z)\times\vec{R}_2}{R_2^3}\right]d^3x$$

and for $z<0$,

$$\vec{B}_< = \frac{\mu}{4\pi}\int\frac{\vec{J}''(x,y,z)\times\vec{R}_1}{R_1^3}\,d^3x,$$

where $\vec{R}_1 = (u-x, v-y, w-z)$ and $\vec{R}_2 = (u-x, v-y, w+z)$. At the boundary, $w=0$, we must have

$$B_{>,z}(x,y,0) = B_{<,z}(x,y,0), \quad H_{>,x(y)}(x,y,0) = H_{<,x(y)}(x,y,0)$$

Since
$$\vec{J}(x,y,z)\times\vec{R}_1\Big|_{w=0} = \hat{i}\left(-j_y z - j_z(v-y)\right) + \hat{j}\left(j_z(u-x) + j_x z\right) + \hat{k}\left(j_x(v-y) - j_y(u-x)\right)$$

$$\vec{J}'(x,y,-z)\times\vec{R}_2\Big|_{w=0} = \hat{i}\left(j_y' z - j_z'(v-y)\right) + \hat{j}\left(j_z'(u-x) - j_x' z\right) + \hat{k}\left(j_x'(v-y) - j_y'(u-x)\right)$$

$$\vec{J}''(x,y,z)\times\vec{R}_1\Big|_{w=0} = \hat{i}\left(-j_y'' z - j_z''(v-y)\right) + \hat{j}\left(j_z''(u-x) + j_x'' z\right) + \hat{k}\left(j_x''(v-y) - j_y''(u-x)\right)$$

we have the conditions, which leads to,

$$\begin{cases} j_x - j_x' = j_x'' \\ j_y - j_y' = j_y'' \\ j_z + j_z' = j_z'' \\ j_x + j_x' = \frac{\mu}{\mu_0} j_x'' \\ j_y + j_y' = \frac{\mu}{\mu_0} j_y'' \end{cases}
\qquad
\begin{aligned} j_x' &= \frac{\mu_r - 1}{\mu_r + 1} j_x \\ j_y' &= \frac{\mu_r - 1}{\mu_r + 1} j_y \\ j_x'' &= \frac{2}{\mu_r + 1} j_x \\ j_y'' &= \frac{2}{\mu_r + 1} j_y \end{aligned}$$

with $\mu_r = \mu/\mu_0$.

To determine the z components of the image currents, we can invoke the continuity condition. $\nabla\cdot\vec{J} = 0$.

Notice that for $\vec{J}'$, $z<0$. We then have

$$j_z' = -\frac{\mu_r - 1}{\mu_r + 1} j_z, \qquad j_z'' = \frac{2}{\mu_r + 1} j_z$$