Chapter 7

Corrections and additional comments

Page 5: Eq. 1.2 should read

$$f(\mathbf{r}) = \frac{1}{(2\pi)^{3/2}} \int F(\mathbf{b}) e^{+i\mathbf{b}\cdot\mathbf{r}} d^3\mathbf{b}$$

Page 14: Replace the following text after Eq. 2.46 "Writing $\mathbf{C} = \nabla^2 \mathbf{G}(\mathbf{r})$ and defining $\mathbf{\Pi}' = \mathbf{\Pi} - \nabla \times \mathbf{G}$ we see that both $\mathbf{\Pi}$ and $\mathbf{\Pi}'$ satisfy the same equations. Consequently, it is possible to choose $\mathbf{C} = 0$." by "Writing $\mathbf{C} = \nabla^2 \mathbf{G}(\mathbf{r})$ and defining $\mathbf{\Pi}' = \mathbf{\Pi} - \nabla \times \mathbf{G}$ we see that it is possible to choose $\mathbf{C} = 0$."

Page 14: The current density $\mathbf{J}$ in Eq. 2.48 refers to other than Ohmic currents. The reader may verify that $\nabla \cdot \mathbf{J}_{tot} + \partial\rho/\partial t = 0$. For a conducting material, the Hertz vector has the following relationship to the scalar and vector potentials:

$$\begin{aligned} \varphi &= -\nabla \cdot \mathbf{\Pi} \\ \mathbf{A} &= \mu\epsilon \frac{\partial \mathbf{\Pi}}{\partial t} + \mu\sigma\mathbf{\Pi} \end{aligned}$$

Page 15: Replace φ and $\mathbf{A}$ in Eq. 2.50 by φ^* and $\mathbf{A}^*$.

Page 19: Eq. 3.12 should read

$$\frac{dP_{rad}}{d\Omega} = ... = \frac{\mu_0 c^3 k^4}{32\pi^2} |(\mathbf{n} \times \mathbf{p}) \times \mathbf{n}|^2$$

Note also that $\mathbf{p}$ is generally a complex-valued vector.

Page 20: In Eq. 3.14, $(1/r - ik)$ in front of the integral: $1/r$ is from Eq. 3.6 ensuring that the vector potential is exact outside of the source. The leading term $-ik$ is from the power series 3.4 (see *Jackson* for mathematical details).

Page 21: Sect. 3.2.1: It is also possible to calculate **E** without the scalar potential as explained in Sect. 3.1. Some care is needed when using the formula $\mathbf{E} = ic^2\nabla\times\mathbf{B}/\omega$, since it requires the complex representation of the time-harmonic terms.

Page 22: Eq. 3.31 should read

$$\frac{dP}{d\Omega} = ... = \frac{1}{\epsilon_0 c}(\frac{I_0 L\omega}{4\pi c})^2 \sin^2\theta\cos^2\omega(t - R/c)$$

Page 25: Eq. 3.47 should read

$$\mathbf{J}(\mathbf{r}) = I\sin(kd/2 - k|z|)\theta(d/2 - |z|)\delta(x)\delta(y)\mathbf{e}_z$$

Page 31: Addition after Eq. 3.86: the Cartesian components of the operator **L** are

$$\begin{aligned}
L_x &= -i(y\frac{\partial}{\partial z} - z\frac{\partial}{\partial x}) = i(\sin\phi\frac{\partial}{\partial\theta} + \cot\theta\cos\phi\frac{\partial}{\partial\phi}) \\
L_y &= -i(z\frac{\partial}{\partial x} - x\frac{\partial}{\partial z}) = i(-\cos\phi\frac{\partial}{\partial\theta} + \cot\theta\sin\phi\frac{\partial}{\partial\phi}) \\
L_z &= -i(x\frac{\partial}{\partial y} - y\frac{\partial}{\partial x}) = -i\frac{\partial}{\partial\phi}
\end{aligned}$$

Page 31: The last formula in Eq. 3.89 should read

$$\mathbf{L}\cdot(\nabla\times\mathbf{F}) = i\nabla^2(\mathbf{r}\cdot\mathbf{F}) - \frac{i}{r}\frac{\partial}{\partial r}(r^2\nabla\cdot\mathbf{F})$$

Page 34: Eq. 3.105 should read

$$\begin{aligned}
a_M(l,m)g_l(kr) &= \frac{kc}{\sqrt{l(l+1)}}\int Y_{lm}^*\ \mathbf{r}\cdot\mathbf{B}\ d\Omega \\
a_E(l,m)f_l(kr) &= -\frac{k}{c\sqrt{l(l+1)}}\int Y_{lm}^*\ \mathbf{r}\cdot\mathbf{E}\ d\Omega
\end{aligned}$$

Note that the definitions of the multipole fields vary in literature.

Page 37: Eq. 3.127 should read

$$\begin{aligned}
a_M(l,m)g_l(kr) &= \frac{kc}{\sqrt{l(l+1)}}\int Y_{lm}^*\ \mathbf{r}\cdot\mathbf{B}\ d\Omega \\
a_E(l,m)f_l(kr) &= -\frac{k}{c\sqrt{l(l+1)}}\int Y_{lm}^*\ \mathbf{r}\cdot\mathbf{E}'\ d\Omega
\end{aligned}$$

Page 37: Eq. 3.129 should read

$$\int d\Omega\ Y_{lm}^*(\theta,\phi)\ \frac{e^{ik|\mathbf{r}-\mathbf{r}'|}}{|\mathbf{r}-\mathbf{r}'|} = 4\pi ikh_l^{(1)}(kr)j_l(kr')Y_{lm}^*(\theta',\phi')$$

Page 38: Eq. 3.130 should read

$$
\begin{aligned}
a_M(l,m) &= -\frac{\mu_0 k^2 c}{\sqrt{l(l+1)}} \int j_l(kr) Y_{lm}^*(\theta,\phi)\ \mathbf{L}\cdot\mathbf{J}(\mathbf{r})\ d^3\mathbf{r} \\
a_E(l,m) &= \frac{i\mu_0 k}{\sqrt{l(l+1)}} \int j_l(kr) Y_{lm}^*(\theta,\phi)\ \mathbf{L}\cdot\nabla\times\mathbf{J}(\mathbf{r})\ d^3\mathbf{r}
\end{aligned}
$$

Page 39: The magnetic field in Eq. 4.1 should be $\mathbf{B}_{inc} = \mathbf{n}_0 \times \mathbf{E}_{inc}/c$

Page 47: Addition concerning Eq. 5.10: the secondary Hertz vector in the air could be simply written as

$$\int_0^\infty db\ C(b) J_0(b\rho) e^{-K_0 z}$$

The reason for expressing $C(b)$ in an apparently much more complicated way is that then boundary conditions have a convenient form. Frankly speaking, we have also used knowledge of the solution beforehand.

Page 51: Eq. 5.27 should read

$$
\begin{aligned}
D_n e^{K_n z_n} + G_n e^{-K_n z_n} &= D_{n+1} e^{K_{n+1} z_n} + G_{n+1} e^{-K_{n+1} z_n} \\
\frac{K_n}{\mu_n}(D_n e^{K_n z_n} - G_n e^{-K_n z_n}) &= \frac{K_{n+1}}{\mu_{n+1}}(D_{n+1} e^{K_{n+1} z_n} - G_{n+1} e^{-K_{n+1} z_n})
\end{aligned}
$$

Page 52, first row: Replace $e^{-b'x}$ by $e^{-ib'x}$.

Page 52: Addition after Eq. 5.37: The recursion formula shows that the surface impedance is an even function of b: $Z(-b) = Z(b)$.

Page 53, Eq. 5.40: The coefficient in front of the integral must be

$$\frac{i\mu_0 I(\omega)}{4\pi}$$

Page 55: For better notations, write Eq. 5.47 as

$$R(K) = \int_0^{\infty e^{i\alpha}} ds\ f(s) e^{-sK}$$

and replace b by s in the text following this equation. Also, write Eq. 5.48 as

$$
\begin{aligned}
\Pi = \frac{IL}{4\pi(\sigma - i\omega\epsilon)}(\int_0^\infty db\ \frac{b}{K}(e^{-K|z-h|} J_0(b\rho) + \\
\int_0^{\infty e^{i\alpha}} ds\ f(s) \int_0^\infty db\ \frac{b}{K} e^{-K(z+h+s)} J_0(b\rho))
\end{aligned}
$$

Replace in the following text on page 56 b by s in the corresponding places.

Page 58, first row: We neglect the displacement current everywhere and assume a non-conducting air, approximating $K_0 \approx b$.

Page 58, Eq. 5.63: There must be a minus sign between the two exponential terms in the integrand.

Page 66, Eq. 5.89: Replace in the latter term $ig(\omega)$ by $-ig(\omega)$.

Updated: February 24, 2005.

Pages 67-68: Remove the following partly badly formulated text: "We can also see this as a consequence of a general mathematical fact: assume that functions $a(t)$ and $b(t)$ are related in the frequency domain by $a(\omega) = c(\omega)b(\omega)$. Assume that $c(\omega)$ has no poles in the half plane $Im(\omega) \geq 0$ and that $|c(\omega)| \to 0$ when $|\omega| \to 0$ in that half plane. Then $a(t)$ depends only on previous values of $b(t)$. The reader may verify that these assumptions hold in our example."

Page 85: Note that the z coordinate used in Sect. 6.1 is not along the axis of a waveguide as elsewhere in Chapter 6. For clarity, replace z in Sect. 6.1 by s, for example.

Page 86, Eq. 6.23: We write $F_z(\rho) = J_0(\gamma\rho)$ for $\rho \leq a$ without any coefficient, since we are only looking for possible wave numbers. We could as well write $F_z(\rho) = CJ_0(\gamma\rho)$, but it would not affect Eq. 6.28.

Page 88: Corrected Fig. 6.1 below.

Page 89: TM mode means in the spherical geometry that there is no radial magnetic field.

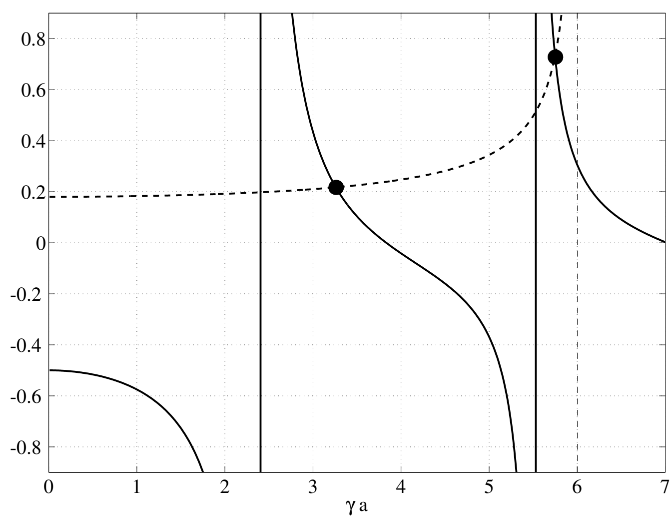

Figure 7.1: Corrected Fig. 6.1

Page 89, Eq. 6.31: Note that the Laplacian operates on a vector given by spherical components. It is safer to consider the equivalent equation

$$\nabla \times (\nabla \times \mathbf{B}) - \frac{\omega^2}{c^2}\mathbf{B} = 0$$

since $\nabla \times (\nabla \times \mathbf{B}) = \nabla\nabla \cdot \mathbf{B} - \nabla^2\mathbf{B} = -\nabla^2\mathbf{B}$. Calculate first $\nabla \times \mathbf{B}$ and then its curl in spherical coordinates.

Updated: February 28, 2005.