Medical Imaging Signals and Systems

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This errata applies to the first printing of the book. The first printing can identified by looking on the copyright page (on the back of the title page) and finding the following text:

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The last number of the sequence 10 9, …, 1 is the printing — in this case, 1, the first.

In the bulleted items below, entries starting with an asterisk are errors that should be corrected. Entries without an asterisk are either typographical corrections or corrections related to clarity.

Preface

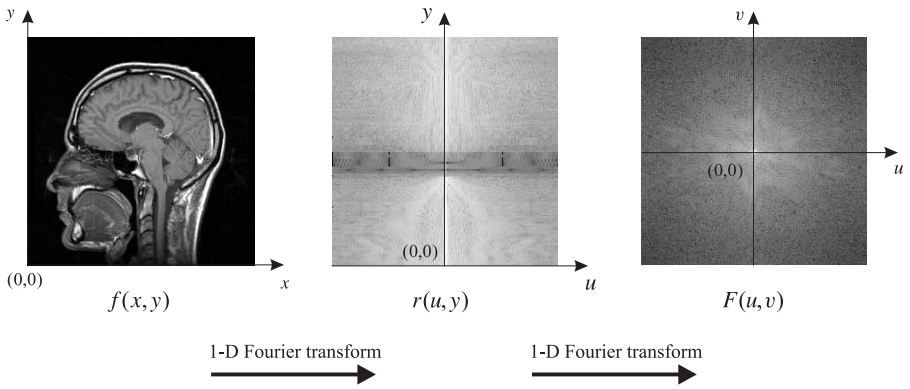
- **Page xv:** The first words of the last paragraph should read "Part III presents the physics ..."

Part I: Basic Imaging Principles

- **Page 4:** The figure references in the parenthetical sentence on lines 5 and 6 should be I.1(d) and I.1(c).

Chapter 2: Signals and Systems

* **Page 43:** Figure 2.11 should look like this:



- **Page 52:** In the second line in Section 2.8.2, the word "rect" should be "rectangle."

Chapter 3: Image Quality

* **Page 84:** In the Answer to Example 3.8, the first line has an incorrect interval. It should read $t < T < t + \Delta t$.

* **Page 84:** In the Answer to Example 3.8, the fifth displayed equation (not numbered) ends with the symbol Δ. There should be a t after the symbol, yielding $\lambda \Delta t$ on the right hand side of that particular equation.

- **Page 96:** The second displayed impulse response function in Problem 3.3 should be $h_2(x)$.

- **Page 99:** Problem 3.22 should read: Suppose the probability law of a test result for patients with and without a disease are modeled as Gaussian with different ..." Part (a) should read: "Write down the expression for the probability density function of the test value ..."

Chapter 4: Physics of Radiography

- **Page 114:** Table 4.3 should be modified as shown.

Table 4.3 Radiation Concepts

	Imaging	Dose
Particulate	Bremsstrahlung Characteristic radiation *Positron annihilation** *Range*	Linear energy transfer Specific ionization
Electromagnetic	Attenuation Photoelectric effect Compton scatter Characteristic radiation Polyenergetic	Air kerma Dose Dose equivalent Effective dose f-factor

*Italicized entries are discussed in Chapter 7.

- **Page 133:** On the fourth line from the top, Kg should be kg (not capitalized).

- **Page 133:** In Problem 4.7, Kg should be kg (not capitalized) in three places.

Chapter 5: Projection Radiography

- **Page 138:** In Figure 5.5, Bremsstrahlung is misspelled

* **Page 160:** Equation (5.26) should read

$$k \propto \frac{1}{m^2(z)} \,. \tag{5.26}$$

* **Page 160:** Equation (5.27) should read

$$\frac{s(x/m, y/m)}{m^2} \to S(0,0)\delta(x, y) \,. \tag{5.27}$$

- **Page 164:** Figure 5.22 should be modified as shown.

- **Page 164:** In the first line of text (below Fig 5.22), there is an extra word "it" after the comma.

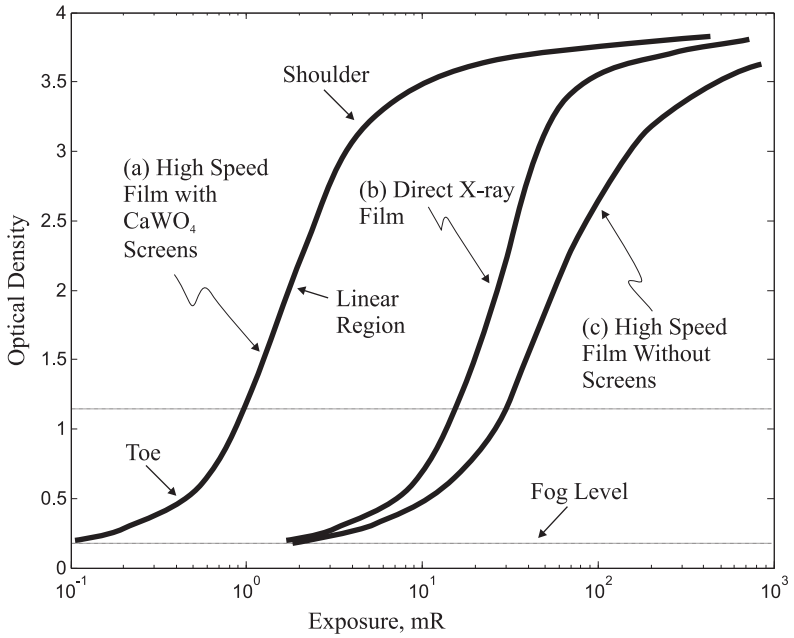


Figure 5.22 An H&D curve.

Chapter 6: Computed Tomography

- **Page 186:** In the second paragraph under **Answer**, in the second line, the first few words should read "increment is $180°/360 = 0.5°$ …"
- **Page 203:** On the second line, the word "it" should be "its."
- **Page 210:** There is an extra closed parenthesis in equation (6.49), which should read:

$$\mathcal{R}\{f * h\} = \mathcal{R}\{f\} * \mathcal{R}\{h\} \tag{6.49}$$

* **Page 210:** The sentence immediately after equation (6.49) should read: Notice that the convolution on the left in (6.49) is two-dimensional, while that on the right is one-dimensional.

- **Page 220:** The word "simply" in Problem 6.5 should be "simplify."
- **Page 212:** The first equation has a typo; it should read:

$$\mathcal{H}\{f(ar)\} = \frac{1}{a^2} F(q/a)$$

* **Page 216:** On the line before equation (6.77), the substitution should be $d = L/D$, not $w = L/D$.

- **Page 216:** In the 4th line of EXAMPLE 6.6, the word "contract" should be "contrast."

* **Page 216:** The second to the last equation should read:

$$\sigma_\mu^2 = 5.625 \times 10^{-9}\ \text{cm}^{-2} = \frac{2\pi^2}{3} \frac{\varrho_0^3 T}{M\overline{N}}$$

* **Page 217:** The answer to EXAMPLE 6.6 should be

$$1.87 \times 10^{10} \text{ minimum}$$

- **Page 220:** There is an extra closed parenthesis in the displayed equation in problem 6.9. It should read

$$\mathcal{R}\{f * h\} = \mathcal{R}\{f\} * \mathcal{R}\{h\}$$

- **Page 223:** In problem 6.16(d), there should only be one * for the convolution (to stay with convention in the book).

Chapter 7: The Physics of Nuclear Medicine

- **Page 249:** The second line of the Early reference should be indented.

* **Page 251:** In Problem 7.8(a), the DF equation should read

$$\text{DF} = e^{-0.693t/T_{1/2}}$$

Chapter 8: Planar Scintigraphy

- **Page 259:** There should be a question mark at the end of the question in Example 8.2.

- **Page 261:** On the very first line, the word "tomography" should have a period after it instead of a comma.

* **Page 269:** On the second line below equation (8.12), the variable r should be replaced by $|z|$.

* **Page 270:** The first equation on the page should read:

$$R_C = \frac{d}{l}(l + b + r) = d + \frac{b + r}{l} d \, .$$

The second equation should read:

$$R'_C = \frac{d}{2l}(2l + b + r) = d + \frac{b + r}{2l} d < R_C \, .$$

* **Page 280:** The fourth line of Problem 8.4 should read: A is at a distance of r from the camera, directly below the hole.

* **Page 283:** The fourth line of the page (within problem Problem 8.10) should read: ratio in the last image?

Chapter 9: Emission Computed Tomography

- **Page 295:** In the 7th text line from the bottom, it should read: "to coincide with the x-axis when"

- **Page 297:** The arrow next to θ in Figure 9.7 should point in the other direction.

- **Page 299:** Third paragraph, 5th line. The sentence should begin: "This means that there will be N_0 gamma ray…"

- **Page 310:** The caption of Figure P9.1 should read: Problem 9.1.

- **Page 310:** Figure P9.1. The righthand crystal should be labelled C(4,6).

- **Page 310:** Problem 9.1(b) should read: "Find the numerical responses in each PMT to an event…"

Chapter 10: The Physics of Ultrasound

- **Page 321:** In example 10.2, second sentence: replace "At time" with "Starting at time".

- **Page 321:** In the paragraph after the start of section 10.2.3, the reference to Problem 10.2 should be: (see Problem 10.4).

- **Page 323:** Put immediately after (10.23) the following text: where c_1 and c_2 are the speeds of sound in Medium 1 and Medium 2, respectively.

* **Page 324:** The numbers in the answer to Example 10.3 (at the top of the page) are wrong. It should read as follows:

Answer: $\theta_r = \theta_i = 45°$. Since $c_1 = 1450$ m/s and $c_2 = 1570$ m/s,

$$\sin\theta_t = \frac{1570 \sin 45°}{1450} = 0.7656\,.$$

Solving this yields $\theta_t = 49.96°$. It makes intuitive sense that the transmission angle should be larger than the incidence or reflection angle, since $c_2 > c_1$.

* **Page 325, Example 10.4:** The computed value for R_I should be 0.0106, (the square of 0.103). Accordingly, the sentence after should read: "Only about 1 percent of the incident power is reflected back from the interface; about 99 percent is transmitted through."

* **Page 327, Example 10.5:** Because of the above error in Example 10.4, there is an error in this example as well. The last part of the example should read:

From the previous example, we know that the intensity reflectivity is 0.0106. The amplitude reflectivity is therefore $\sqrt{0.0106} = 0.103$. Putting these facts together yields

$$\text{dB loss} = 20\log_{10}\frac{A_z}{A_0} = 20\log_{10}(0.234 \times 0.103) = -32.4\text{ dB}\,.$$

* **Page 332:** Equation (10.48) should read:

$$f_D = \frac{2v\cos\theta}{c} f_S \tag{10.48}$$

- **Page 335:** In the first line of text, the word "is" should be "are."

* **Page 335:** The first "n" in equation (10.51) is set in the wrong font. The equation should read:

$$\mathrm{n}(t) = \tilde{n}(t)e^{-j2\pi f_0 t} \tag{10.51}$$

- **Page 344, 10.9(b):** plan should be plane

- **Page 352:** The last line of the Question in Example 11.2 should read: sound is $c = 1540$ m/s, what is the maximum rate of revolution of the transducer?

* **Page 352:** The last equation should read:

$$T = 2 \times \frac{15 \text{ cm}}{1540 \text{ m/s}} = 195 \ \mu\text{s}$$

- **Page 360:** Remove the expression "as shown in this figure" from the last line of Section 11.5.2.

Chapter 12: Physics of Magnetic Resonance

- **Page 385:** In the last line of text, the equation reference should be (12.8).
- **Page 405:** In the second line of text, the word vector should be plural: vectors.
- **Page 405:** In problem 12.4, the word envelope is mispelled (it is missing the last "e").

Chapter 13: Magnetic Resonance Imaging

* **Page 437:** In the first equation appearing in Example 13.7, there should be a 2π in the second exponential term, right before $\not\gamma$.

* **Page 442:** In equation (13.48), there should be a space between the square root symbol and symbol t, as follows:

$$\varrho = \not\gamma\sqrt{G_x^2 + G_y^2}\ t\ . \tag{13.48}$$

* **Page 443:** Equation (13.52) should read

$$G(\varrho, \theta) = s_0\left(\frac{\varrho}{\not\gamma\sqrt{G_x^2 + G_y^2}}, \theta\right)\ . \tag{13.52}$$

* **Page 459:** The duration of the gradient pulse in Figure P13.5 should be NT.

- **Page 459:** In problem 13.12, part (a), there should be a circle around the number 2 (as in Figure 13.20).