

Essentials of Digital
Signal Processing

Errata for the First Edition

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Errata

What follows is a sequential list of known errors (as of January 31, 2017) in the first edition of Essentials of Digital Signal Processing (Cambridge University Press, 2014). If you find additional errors in the book, please email Roger Green at Roger.Green@ndsu.edu.

p. 45, MATLAB line 01 should read

```
01 omega0 = 2; K = 5; t = linspace(-1.5*pi,1.5*pi,10001);
```

p. 45, MATLAB line 04 should read

```
04 xK = xK+Xk(k)*exp(1j*k*omega0*t);
```

p. 80, Prob. 1.5-8, “ $h(t) = e^{(j-t)t}u(t)$ ” should read “ $h(t) = e^{(j-1)t}u(t)$.”

p. 81, Prob. 1.7-11, last four parts should be labeled (b), (c), (d), and (e) rather than (a), (b), (c), and (d).

p. 83, Prob. 1.10-4(e), ROC should be $-2 < \text{Re}\{s\} < 3$.

p. 99, second line, “the the” should read “the”.

p. 151, Prob. 2.2-3, all occurrences of a should read $|a|$.

p. 151, Prob. 2.3-2, “transfer functions” should read “frequency responses.”

p. 153, Prob. 2.6-6, “the dc point” should read “the $\omega = 0$ or $\omega = \infty$ point.”

p. 153, Prob. 2.7-4, “the the” should read “the”.

p. 154, Prob. 2.7-9 should read “Repeat Prob. 2.7-1 for a Chebyshev filter with 1 dB of passband ripple.”

p. 154, Prob. 2.7-14 should read “Repeat Prob. 2.7-1 for an inverse-Chebyshev filter with 20 dB of stopband ripple.”

p. 188, Drill 3.12, “the the” should read “the”.

p. 196, line just before Drill 3.15, “3.5 to 4 bits” should read “2.5 to 4 bits.”

p. 154, Prob. 2.7-17 should read “Using functions from MATLAB’s Signal Processing Toolbox, repeat Prob. 2.7-1 for an elliptic filter with 1 dB of passband ripple and 20 dB of stopband ripple. Plot the magnitude response to verify specifications are met.”

p. 205, Prob. 3.1-11 is more appropriately located with the problems for Sec. 3.2.

pp. 206–211, most problem numbers do not correctly reflect their corresponding sections in the text.

- The following problems labeled as from Sec. 3.2 should instead be labeled as from Sec. 3.3: 3.2-8, 3.2-9, 3.2-10, 3.2-11, 3.2-12, 3.2-13, 3.2-14, 3.2-17, 3.2-18, and 3.2-19.
- All problems labeled as from Sec. 3.3 should instead be labeled as from Sec. 3.4.
- All problems labeled as from Sec. 3.4 should instead be labeled as from Sec. 3.5.
- All problems labeled as from Sec. 3.5 should instead be labeled as from Sec. 3.6.
- All problems labeled as from Sec. 3.6 should instead be labeled as from Sec. 3.7.

p. 206, Prob. 3.2-4b should instead read “Determine the frequency response of the FOH filter. Analytically and graphically compare this response with the frequency responses of ideal and ZOH reconstruction filters.”

p. 207, Prob. 3.2-8, “ f_s ” should read “ F_s .”

p. 207, Prob. 3.2-12(e) and 3.2-12(f), “ $2/N$ ” should read “ $F_s = 4/N$ Hz.”

p. 208, Prob. 3.2-15, “ $x(t) = \frac{\text{sinc}(2Bt)}{1-2\pi Bt}$ ” should read “ $x(t) = \frac{\text{sinc}(2Bt)}{1-2Bt}$,” and “This pulse, known as” should read “This pulse, known as.”

p. 209, Prob. 3.4-1, “The Fourier transform of a signal $x(t)$ ” should read “The Fourier transform of a real signal $x(t)$.”

p. 209, Prob. 3.4-2, “A signal $x(t)$ is timelimited to τ seconds” should read “A signal $x(t)$ is time-limited to τ seconds and centered at $t = 0$.”

p. 210, Prob. 3.4-3, “For $\omega > 0$,” should read “For $\omega \geq 0$.”

p. 210, Prob. 3.4-4, “the Fourier series of $\tilde{x}(t)$ is a scaled and sampled version of the Fourier transform of $x(t)$ ” should read “the Fourier series coefficients of $\tilde{x}(t)$ are scaled samples of the Fourier transform of $x(t)$.”

p. 264, Prob. 4.1-1, the last four parts should be labeled as (e), (f), (g), and (h) rather than (d), (e), (f), and (g), and “Parts (f) and (g)” should read “Parts (g) and (h).”

p. 265, Prob. 4.2-9, part (e) should read “ $\text{sinc}(n/2)$ ” rather than “ $\text{sinc}(\pi n/2)$ ”, part (f) should read “ $\text{sinc}(3n/2)$ ” rather than “ $\text{sinc}(3\pi n/2)$ ”, and part (g) should read “ $\text{sinc}(2n)$ ” rather than “ $\text{sinc}(2\pi n)$ ”.

p. 265, Prob. 4.2-16, “in part (a)” should read “ $x(t)$ ”.

p. 266, Prob. 4.3-2, “a causal signal” should read “a causal energy signal,” and the part (b) text “Show that $E_{x_e} = E_{x_o} = 0.5E_x$ ” should instead read “Determine E_{x_e} and E_{x_o} and show that $E_{x_e} + E_{x_o} = E_x$.”

p. 266, Prob. 4.3-13, “ $\frac{1}{\sqrt{n}} u[n]$ ” should read “ $\frac{1}{\sqrt{n}} u[n-1]$.”

p. 267, Prob. 4.3-16, “ $\sum_{k=0}^{N_0-1} e^{j(k-m)\Omega_0 n}$ ” should read “ $\sum_{n=0}^{N_0-1} e^{j(k-m)\Omega_0 n}$.”

p. 268, Prob. 4.4-8(a) should read “Construct the model (equation) relating national income (output) to government expenditure (input).”

p. 268, Prob. 4.5-1(h), “ $y[n] = \sum_{n=-\infty}^n x[n]$ ” should read “ $y[n] = \sum_{k=-\infty}^n x[k]$.”

p. 269, Prob. 4.5-6(d), “ $y[n] = \sum_{k=-\infty}^{\infty} x[k]$ ” should read “ $y[n] = \sum_{k=-\infty}^n x[k]$.”

p. 287, first sentence after Ex. 5.10, “Although Eq. (5.20) can be used” should read “Although Eq. (5.19) can be used.”

p. 293, Table 5.2, third column of entry 9, “ $\frac{\gamma_1 \gamma_2}{(\gamma_1 - \gamma_2)^2} \left(\gamma_2^n + \frac{\gamma_2 - \gamma_1}{\gamma_1} n \gamma_2^n - \gamma_1^n \right) u[n]$ ” should read “ $\frac{\gamma_1 \gamma_2}{(\gamma_1 - \gamma_2)^2} \left(\gamma_1^n + \frac{\gamma_2 - \gamma_1}{\gamma_1} n \gamma_2^n - \gamma_2^n \right) u[n]$.”

p. 324, Prob. 5.3-1, the monthly interest rate should be expressed as “ $(1.12)^{1/12} - 1$ ” rather than “ $1 - (1.12)^{1/12}$.”

p. 324, Prob. 5.3-6, “ N th node” should read “ n th node” and “page 267” should read “page 268”.

p. 325, Prob. 5.4-6(d), “ $y[n] = \sum_{k=-\infty}^{\infty} x[k]$ ” should read “ $y[n] = \sum_{k=-\infty}^n x[k]$.”

p. 326, Prob. 5.5-12, “ h_p ” should read “ $h_p[n]$ ” and “ h_c ” should read “ $h_c[n]$.”

p. 326, Prob. 5.5-16, “causal, time-variant system” should read “linear, time-variant system.”

p. 328, Prob. 5.5-28, “ $y[n] = \sum_{k=-\infty}^n x[n]$ ” should read “ $y[n] = \sum_{k=-\infty}^n x[k]$.”

p. 359, Eq. (6.37), “ $\angle H(\omega)$ ” should read “ $\angle H(\Omega)$.”

p. 369, Ex. 6.19, “ $\frac{1}{2\pi} \int_{-\infty}^{\infty} X(\Omega) e^{-jm\Omega} e^{jn\Omega} d\Omega$ ” should read “ $\frac{1}{2\pi} \int_{-\pi}^{\pi} X(\Omega) e^{-jm\Omega} e^{jn\Omega} d\Omega$.”

p. 398, last paragraph, “generalizing the frequency variable ω to” should instead read “generalizing

frequency from $j\Omega$ to.”

p. 400, Prob. 6.1-7, hint should instead read

Hint: Use the fact that for integer l ,

$$\frac{1}{2\pi} \int_{-\pi}^{\pi} e^{jl\Omega} d\Omega = \text{sinc}(l) = \delta[l].$$

p. 400, Prob. 6.1-13, “if $\Omega_0 \leq \pi/2$ ” should read “if $|\Omega_0| \leq \pi/2$.”

p. 401, Prob. 6.2-1(g), “ $x_g[n] = n^2\gamma^n u[n]$ ” should read “ $x_g[n] = n\gamma^{2n}u[n]$.”

p. 401, Prob. 6.2-3, “ x_a ” should read “ $x_a[n]$,” “ x_b ” should read “ $x_b[n]$,” “ x_c ” should read “ $x_c[n]$,” “ x_d ” should read “ $x_d[n]$,” and “ x_e ” should read “ $x_e[n]$.”

p. 401, Prob. 6.2-6, “Using time-shifting” should read “using the time-shifting” and “DTFT of th” should read “DTFT of the.”

p. 402, Fig. P6.2-6, to help avoid confusion the signal $x[n]$ should instead be labeled as $y[n]$.

p. 402, Prob. 6.2-10, “derive pairs 6, 7, 10, 12, 13, and 14” should instead read “derive pairs 2, 3, 4, 5, 6, and 7.”

p. 402, Prob. 6.2-13, “assume that $\Omega_0 < \pi/2$ ” should instead read “assume that $|\Omega_0| < \pi$.”

p. 402, Prob. 6.2-15, in part (b) “ $(-1)^n \text{sinc}(\Omega_1 n)$ ” should instead read “ $(-1)^n \text{sinc}(\Omega_1 n/\pi)$,” in part (d) “ $(-1)^n \text{sinc}^2(\Omega_2 n)$ ” should instead read “ $(-1)^n \text{sinc}^2(\Omega_2 n/\pi)$,” and in part (e) “ $|\text{sinc}(\Omega_2 n)|^4$ ” should instead read “ $|\text{sinc}(\Omega_2 n/\pi)|^4$.”

p. 402, Prob. 6.3-1, frequency response should be

$$H(\Omega) = \frac{e^{j\Omega} - 0.5}{(e^{j\Omega} + 0.5)(e^{j\Omega} - 0.1)}$$

p. 403, Prob. 6.3-11, “where $|r| < 1$ ” should instead read “where $0 < |r| < 1$.” In part (b), “Find the responses” should instead read “Using $r = 0.5$, find the responses.”

p. 404, Prob. 6.3-12, “ $x[n] = v[n] \cos(3\pi/4)$ ” should instead read “ $x[n] = v[n] \cos(3\pi n/4)$.”

p. 404, Prob. 6.3-13(b), “ $(-\gamma)^{[n]}$ ” should instead read “ $(-0.8)^n u[n]$.”

p. 405, Prob. 6.4-1, “Show that the power of a signal $x[n]$ and the power of its bandlimited interpolation $x_c(t)$ (defined in Eq. (6.45)) are identical” should instead read “Show that the energy of a signal $x[n]$ equals $\frac{1}{T}$ times the energy of its bandlimited interpolation $x_c(t)$ (defined in Eq. (6.45)).”

p. 405, Prob. 6.4-5, “Repeat Prob. 6.4-6” should instead read “Repeat Prob. 6.4-4.”

p. 405, Prob. 6.4-6, to help avoid confusion “ $x(t)$ ” should instead read “ $x_c(t)$ ” and “ $X(\omega)$ ” should instead read “ $X_c(\omega)$.”

p. 406, Prob. 6.5-8, to help avoid confusion all occurrences of “ $H(\omega)$ ” should be replaced with “ $\hat{H}(\omega)$.” Further, “ $\omega \leq \pi/T$ ” should read “ $|\omega| \leq \pi/T$.”

p. 408, Prob. 6.6-14(a), “bandlimited to $\Omega \leq \pi$ ” should instead read “bandlimited to $|\Omega| \leq \pi$.”

p. 408, Fig. P6.6-17a, “ $y[n]$ ” should instead read “ $y_a[n]$ ”, and “ $Y(\Omega)$ ” should instead read “ $Y_a(\Omega)$.”

p. 478, Prob. 7.1-2, “ $\delta(n - 2k + 1)$ ” should instead read “ $\delta[n - 2k + 1]$.”

p. 479, Prob. 7.3-3, the ROC “ R_x : all z ” should instead read “ R_x : $|z| > 0$.”

p. 480, Prob. 7.4-10, “A causal LTID system” should instead read “A causal, controllable, and observable LTID system.”

p. 481, Prob. 7.4-12, “ x_a ” should read “ $x_a[n]$,” “ x_b ” should read “ $x_b[n]$,” “ x_c ” should read “ $x_c[n]$,” and “ x_d ” should read “ $x_d[n]$.”

p. 483, Prob. 7.6-10(a), “the magnitude and the phase responses” should instead read “the magnitude and phase responses.”

p. 483, Prob. 7.6-13(b), “assuming $|a| < 1$ ” should instead read “assuming $|\gamma| < 1$.”

p. 484, Prob. 7.6-16, “two LTID system” should instead read “two LTID systems.”

p. 484, Prob. 7.6-16a, “ $H_2(z) = H_1(e^{j\pm\pi}z)$ ” should instead read “ $H_2(z) = H_1(e^{\pm j\pi}z)$.”

p. 488, inequality following Fig. 8.3, “ $|H(j\pi/T)| \leq 0.01H(j0)$ ” should instead read “ $|H_c(j\pi/T)| \leq 0.01H_c(j0)$.”

p. 491, Drill 8.1, “a Butterworth” should instead read “a first-order Butterworth.”

p. 504, first sentence in the solution of Ex. 8.7, “ $\omega_{2_s} = 4000$ ” should read “ $\omega_{s_2} = 4000$.”

p. 533, final sentence of Ex. 8.14, “(Fig. 8.13b)” should read “(Fig. 8.31b).”

p. 539, last sentence, “that Eq. (8.47) includes” should read “that Eq. (8.48) includes.”

p. 542, first paragraph of **Frequency Sampling Filters**, “an L_h -order comb filter in cascade with a parallel bank of $L_h - 1$ first-order filters” should read “an L_h th-order comb filter in cascade with a parallel bank of L_h first-order filters.”

p. 544, the first equation should instead read

$$\begin{aligned} H(z) &= \frac{1 - z^{-7}}{7} \left(\frac{1}{1 - z^{-1}} + \frac{2 \cos(6\pi/7) - 2 \cos(8\pi/7)z^{-1}}{1 - 2 \cos(2\pi/7)z^{-1} + z^{-2}} \right) \\ &= \underbrace{\frac{1 - z^{-7}}{7}}_{H_1(z)} \underbrace{\left(\frac{1}{1 - z^{-1}} - \frac{1.802(1 - z^{-1})}{1 - 1.247z^{-1} + z^{-2}} \right)}_{H_2(z)}. \end{aligned}$$

p. 549, Eq. (8.63), the term “ $H_d^*[L_h - k]$ ” should instead read “ $H_d^*[K - k]$.”

p. 550, first paragraph, “(Fig. 8.60a)” should read “(Fig. 8.37a).”

p. 550, first paragraph, “(Fig. 8.60b)” should read “(Fig. 8.37b).”

p. 554, Prob. 8.1-6a, the equation

$$H(z) = (1 - z^{-1}) \mathcal{Z} \left\{ \left(\mathcal{L}^{-1} \frac{H_c(s)}{s} \right) \Big|_{t=nT} \right\}$$

would be more clearly written as

$$H(z) = \left(\frac{z-1}{z} \right) \mathcal{Z} \left\{ \mathcal{L}^{-1} \left\{ \frac{H_c(s)}{s} \right\} \Big|_{t=nT} \right\}.$$

p. 554, Prob. 8.1-9, “ $H_{mc}(s)$ ” should instead read “ $H_c(s)$.”

p. 555, Prob. 8.1-25a, “ $j\omega$ -axis” should instead read “ ω -axis.”

p. 556, Prob. 8.2-10, “plot the resulting magnitude response $|H(e^{j\Omega})|$ ” should instead read “plot the resulting magnitude responses,” and “How does this filter compare” should instead read “How do these filters compare.”

p. 557, Prob. 8.2-17 should instead read “Using the window method with a Blackman window, design a length $L_h = 101$ digital bandpass filter with $\Omega_{c_1} = \pi/4$, $\Omega_{c_2} = 3\pi/8$, and $\alpha_s = 60$ dB. Plot the corresponding magnitude response, and determine the approximate widths of the two transition bands. Lastly, describe an efficient block diagram realization of the filter.”

p. 557, Prob. 8.2-23d should instead read “Transform the LP filter in part (c) into a bandpass filter with $\Omega_{ctr} = \frac{\pi}{2}$. Plot both $h_{bp}[n]$ and $|H_{bp}(e^{j\Omega})|$.”

p. 619, Prob. 9.1-8(c), “Using this windowed function” should instead read “Using this windowed data.”

p. 622, Prob. 9.6-2, to help avoid confusion the signals $x_1[n]$ and $x_2[n]$ should instead be labeled as $x_a[n]$ and $x_b[n]$, respectively.

p. 623, Prob. 9.7-8, “the FFT $X[k]$ of a $2N$ -point real signal $g[n]$ ” should instead read “the FFT $G[k]$ of a $2N$ -point real signal $g[n]$.”

p. 629, sentence following MATLAB line 16, “In line 15” should instead read “In line 16.”

p. 708, Drill 8.1, “the phase response is shown in Fig. 8.5a” should instead read “the phase response is shown in Fig. 8.5b.”

p. 708, Drill 8.2, sentence before MATLAB line 01, “uses” should instead read “uses.”

p. 709, MATLAB line 01 should read

```
01 alphap = 0.5; alphas = 40; K = 6; omegap = 1;
```

p. 709, Drill 8.3, sentence before MATLAB line 08, “using Eqs. (8.24) and (8.25)” should instead read ““using Eqs. (8.26) and (8.27).”

p. 710, MATLAB line 16 should read

```
16 plot(Omega,abs(H),'k-');
```

p. 720, part (b), “ $X[2]$ and $X[3]$ ” should read “ $X[1]$ and $X[2]$.”

p. 720, part (b), “ $k = 2$ and $k = 3$ ” should read “ $k = 1$ and $k = 2$.”