Holton DSP Errata

7/15 up “…and \( n = 364 \) is December 31…”

14/1 “… Chapters 6 and 13 …”

31/4

\[
\text{Im}(x[n]) = \frac{1}{\sqrt{2}} (x[n] - x^*[n]) = \frac{1}{2j} \left( - (2 + j) \delta[n - 1] + \delta[n] - 3j \delta[n - 1] \right)
\]

= \left( 2j \delta[n + 1] - 6j \delta[n - 1] \right) / 2j = \delta[n + 1] - 3\delta[n - 1]

47/19 In Section 1.9.3 “The output of the system is \( y[n] = T\{x[n]\} = x^2[n] \)”

85/2 Equation should be

\[
\sum_{k=-\infty}^{\infty} |h[k]| < \infty
\]

91/2 up

\[ 
\begin{align*}
\mathbf{x}^T &= [x[n-1] \ x[n-2] \ \cdots \ x[n-N]] \\
\mathbf{y}^T &= [y[n-1] \ y[n-2] \ \cdots \ y[n-N]]
\end{align*}
\]

115/8 Example 3.1(b): “Find the output of this system, \( y[n] \), when the input is \( x[n] = e^{j\pi n / 3} \)”

115/13 Example 3.1(b) Solution: “When \( x[n] = e^{j\pi n / 3} \)”

115/6 up Example 3.2(b): “Find the output of this system, \( y[n] \), when the input is \( x[n] = e^{j\pi n / 3} \)”

115/5 up Example 3.2(c): “Find the output of this system, \( y[n] \), when the input is \( x[n] = e^{j\pi n / 2} \)”

120 The equation/figure in the middle of the page (after “…of different frequencies”) is wrong! Here is the replacement:

```
integral of scaled exponential sequences
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\[ 
\begin{align*}
x[n] &= \frac{1}{2\pi} \int_{-\pi}^{\pi} X(\omega) e^{j\omega n} d\omega
\end{align*}
\]

141 Equation 3.29 should be numbered 3.30.

151 Two display equations have errant periods in them:
\[
y_{\text{FD}}[n] = \cos(0.15\pi n - 3\pi) + \cos(0.30\pi n - 6\pi) + \cos(0.45\pi n - 9\pi) \\
= \cos(0.15\pi(n-20)) + \cos(0.30\pi(n-20)) + \cos(0.45\pi(n-20)) \\
= x[n-20]
\]
\[
y_{\text{ID}}[n] = \cos(0.15\pi n - 1.33\pi) + \cos(0.30\pi n - 2.88\pi) + \cos(0.45\pi n - 5.23\pi) \\
= \cos(0.15\pi(n-8.87)) + \cos(0.30\pi(n-9.60)) + \cos(0.45\pi(n-11.62))
\]

154 Second display equation in Example 3.19: the last term in the first line should be \(e^{-j4\omega}\)
\[
X(\omega) = e^{j\omega} + 2e^{j2\omega} + 2e^{-j2\omega} + e^{-j4\omega} \\
x[n] = \delta[n+4] + 2\delta[n+2] + 2\delta[n-2] + \delta[n-4]
\]

157/15 Code should be ‘\(x = X\)’ rather than ‘out = X’

161/2 up \(\cos 3\pi/4 = \cos(3\pi/4 - 2\pi) = \cos(-5\pi/4)\)

179 Figure 13.38. The plots for \(w[n]\) and \(y[n] = x[n]w[n]\) should each only have 11 points, \(-5 \leq n \leq 5\).

185 Figure 3.44. The red trace in part a) is \(N_{b_{2N-1}}[n]\), not \(h_{2N-1}[n]\).

189/3 Purely cosmetic, but last terms don’t need parentheses:
\[
H(\omega) = \frac{2}{1 - \frac{1}{4} e^{-j\omega}} + \frac{2}{1 - \frac{1}{4} e^{-j2\omega}} = \frac{4}{1 - \frac{1}{2} e^{-j\omega}} - \frac{2}{1 - \frac{1}{4} e^{-j\omega}}
\]

192 Figure 3.48 is incorrect. Here is the replacement:
209/4 Equation should be

\[ H(\omega) = \frac{B(\omega)}{A(\omega)} = \sum_{m=0}^{M} b_m e^{j\omega m} \over \sum_{n=0}^{N} a_n e^{j\omega n} \]

229/3 Since \(\alpha = 0.75\), the display equation and the following line of text should be

\[ H(z) = \frac{z(z - \frac{3}{4})}{(z - \frac{1}{4})^2} = \frac{z}{z - \frac{1}{4}} \]

A zero at \(z = 3/4\) has cancelled one of the poles at \(z = 3/4\), leaving a single real pole and a single zero.

230/1 The display equation should be

\[ H(z) = \frac{z(z + \frac{3}{4})}{(z + \frac{1}{4})^2} = \frac{z}{z + \frac{1}{4}} \]

232/6 Equation 4.10

\[ H(z) = z^{-n} (b_0 + b_1 z^{-1} + \cdots + b_{N-1} z^{-(N-1)}) = z^{-n} (b_0 z^{-N-1} + b_1 z^{-N-2} + \cdots + b_{N-1}) \]

\[ = \left( \frac{b_0 z^{-N-1} + b_1 z^{-N-2} + \cdots + b_{N-1}}{z^{b_0+N-N}} \right) \]

250 Cosmetic: denominator terms in second and third \(H(z)\) don’t need parentheses

258 The display equation after Equation (4.25) should have \(H(z)\), not \(H(z^{-1})\):

\[ H(z) = C \prod_{k=0}^{M-1} (z - z_k) \over \prod_{k=0}^{N-1} (z - p_k) \]

261/12 Cosmetic

\[ H(z) = 1 - \frac{1}{4} z^{-1} \over 1 - \frac{1}{4} z^{-1} = 1 - \frac{1}{4} z^{-1}, \quad |z| > \frac{1}{4} \]

272 Figure 4.30a) The equation above the figure should read \(h_1[n] = -5\delta[n] - 15(-1.5)^n u[-n-1]\)
Problem 4-12. It should be “…and that $F(0) = 8$”

Figure 5.23 The legend for the red trace should say, “Pole at $z = 0.9$”

Example 5.17 “Assume we have a cosine signal with a DC level added, $x[n] = 1 + \cos n\pi/4$ …”

Figure 5.24 should have two zeros. The first line of text under the figure should read, “The zeros at $z = 0$ have…”.

Equation (6.12) Cosmetic:

$$X_e(\omega) = \mathcal{F}\{x_e[n]\} = \mathcal{F}\{x[n]s[n]\} = \frac{1}{2\pi} X(\omega) \ast S(\omega) = \frac{1}{2\pi} \left\{ X(\omega) \ast \frac{2\pi}{D} \sum_{k=0}^{D-1} \delta(\omega - 2\pi k/D) \right\}$$

$$= \frac{1}{2\pi} \frac{2\pi}{D} \sum_{k=0}^{D-1} X(\omega) \ast \delta(\omega - 2\pi k/D) = \frac{1}{D} \sum_{k=0}^{D-1} X(\omega - 2\pi k/D)$$

The display equation at the bottom of the page is wrong

$$H(\omega) = \sum_{n=0}^{N-1} h[n]e^{-j\omega n} = e^{-j\omega(N-1)/2} \sum_{n=0}^{N-1} h[n]e^{-j\omega(n-(N-1)/2)} = e^{j\omega M} \sum_{n=0}^{2M} h[n]e^{-j\omega(n-M)}$$

The upper limit of the summation in the first line of the display equation should be $2M$. The rest is the same.
\[
H(\omega) = e^{-jM} \sum_{n=0}^{M} h[n]e^{j\omega n}
\]

\[
= e^{-jM} \left( h[0]e^{j\omega M} + h[1]e^{j\omega (M-1)} + \ldots + h[M-1]e^{j\omega 1} + h[M] + h[1]e^{-j\omega M} + h[2]e^{-j\omega (M-1)} + \ldots \right)
\]

\[
= e^{-jM} \left( h[0]e^{j\omega M} + h[1]e^{j\omega (M-1)} + \ldots + h[M-1]e^{j\omega 1} + h[M] + h[1]e^{-j\omega M} + h[2]e^{-j\omega (M-1)} + \ldots \right)
\]

\[
= e^{-jM} \left( h[0] \left( e^{j\omega M} + e^{-j\omega M} \right) + h[1] \left( e^{j\omega (M-1)} + e^{-j\omega (M-1)} \right) + \ldots \right)
\]

\[
= e^{-jM} \left( h[M] + 2h[M-1] \cos \omega + \ldots + 2h[1] \cos \omega (M-1) + 2h[0] \cos \omega M \right)
\]

\[
= e^{-jM} \sum_{n=0}^{M} a[m] \cos m\omega
\]

\[
= e^{-jM} A(\omega)
\]

414 Table 7.2

<table>
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<tr>
<th>Type</th>
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<th>Must A(\pi) = 0?</th>
<th>Lowpass?</th>
<th>Highpass?</th>
<th>Bandpass?</th>
<th>Bandstop?</th>
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</table>

421 Equation 7.9

\[
W(\omega) = \mathcal{F} \left\{ \text{rect}_N(n) \right\} = \sum_{n=-(N-1)/2}^{(N-1)/2} e^{-j\omega n} = \sum_{n=0}^{N-1} e^{-j\omega n - (N-1)/2} = e^{j\omega (N-3)/2} \sum_{n=0}^{N-1} e^{-j\omega n}
\]

\[
= e^{j\omega (N-3)/2} \frac{1 - e^{-j\omega N}}{1 - e^{-j\omega}} = e^{j\omega (N-3)/2} \frac{e^{j\omega N/2} - e^{-j\omega N/2}}{e^{j\omega/2} - e^{-j\omega/2}}
\]

\[
= \frac{\sin \omega N/2}{\sin \omega/2} = N \frac{\sin \omega N/2}{\sin \omega/2}
\]

442/17-23 Cosmetic: all instance of \( h_{lp}[n] \) should be \( h_{lp}[n] \), \( h_{hp}[n] \) should be \( h_{hp}[n] \), \( H_{lp}(\omega) \) should be \( H_{lp}(\omega) \) and \( H_{hp}(\omega) \) should be \( H_{hp}(\omega) \),

452 Equation 7.17 is wrong.
\[ H(\omega) = \frac{1}{2\pi} H_s(\omega) * R(\omega) = \begin{cases} 
1, & |\omega| < \omega_c - \Delta\omega/2 \\
\frac{1}{2} - \frac{1}{2} \sin \frac{\pi(\omega - \omega_c)}{\Delta\omega}, & \omega_c - \Delta\omega/2 < |\omega| < \omega_c + \Delta\omega/2 \\
0, & |\omega| > \omega_c + \Delta\omega/2 
\end{cases} \]

458/3 up Last line of equation is wrong.

\[
H(\omega) = \sum_{n=0}^{N-1} h[n] e^{-j\omega n} = \sum_{n=0}^{N-1} \left( \frac{1}{N} \sum_{k=0}^{N-1} H[k] e^{j2\pi k n/N} \right) e^{-j\omega n} = \frac{1}{N} \sum_{k=0}^{N-1} H[k] e^{-j(\omega-2\pi k/N)n} = \frac{1}{N} \sum_{k=0}^{N-1} H[k] e^{j(\omega-2\pi k/N)(N-1)\pi} \frac{\sin(\omega - \frac{2\pi k}{N})}{\sin(\omega - \frac{2\pi k}{N})} 
\]

480 Figure 7.44b. The constellation diagram is wrong. Reading CCW, the order should be 11, 01, 00, 10.

480/7 et. seq The first display equation on the page should be

\[ x_f[n] = m[n] \sin \omega_0 n \]

The second equation should be

\[ |y[n]| = \sqrt{x_f^2[n] + x_i^2[n]} = \sqrt{(m[n] \cos \omega_0 n)^2 + (m[n] \sin \omega_0 n)^2} = \sqrt{m^2[n] \cos^2 \omega_0 n + \sin^2 \omega_0 n} \]

514/14 Line above Equation (8.26) should read, “Because \( \cos x = \cosh(jx) \) and \( \cos^{-1} x = j \cosh x \ …”

517/5 Sentence should read, “From the degree equation, Equation (8.28), we could also calculate the revised selectivity factor...”

518/4 up “The minor (real) axis of the ellipse is determined by \( \cosh \phi \) and the major (imaginary) axis by \( \sinh \phi \).”
519 Equations (8.32b) isn’t wrong; it just could be a bit clearer:

\[ K = |H(\omega = 0)| = \frac{1}{\sqrt{1 + e_p^2 T_N^2(0)}} = \begin{cases} \frac{1}{\sqrt{1 + e_p^2}}, & N \text{ even} \\ 1, & N \text{ odd} \end{cases} \]

525/1 up Equation (8.41) Parenthesis missing in numerator

\[ R_\nu(\xi, x) = \text{cd} \left( \left( N \frac{K(1/L(\xi))}{K(1/\xi)} \right) \text{cd}^{-1}(x, 1/\xi) \right) \]

529/7 “…selectivity factor \( \xi \) for a filter…”

544/1 up The first word on the last line on page should be “integrator” not “differentiator”

559/9 up Cosmetic

\[ H(z) = \frac{0.0156(1 + 5z^{-1} + 10z^{-2} + 10z^{-3} + 5z^{-4} + z^{-5})}{1 - 1.5097z^{-1} + 2.1610z^{-2} - 1.8229z^{-3} + 1.0800z^{-4} - 0.4083z^{-5}} \]

559/1 up It’s probably best to split the scale factors between the sections:

\[ H(z) = \frac{0.45755(1 + 2z^{-1} + z^{-2})}{1 - 0.62544z^{-1} + 0.89273z^{-2}} \cdot \frac{0.22653(1 + 2z^{-1} + z^{-2})}{1 - 0.74867z^{-1} + 0.6548z^{-2}} \cdot \frac{0.15076(1 + z^{-1})}{1 - 69847z^{-1}} \]

566/1 up Put scale factor at the beginning:

\[ H(z) = \frac{0.0102(1 + 4z^{-1} + 6z^{-2} + 4z^{-3} + z^{-4})}{1 - 1.9684z^{-1} + 1.7359z^{-2} - 0.7245z^{-3} + 0.1204z^{-4}} \]

570/4 Put scale factor at the beginning

\[ H(z) = \frac{0.0102(1 - 4z^{-1} + 6z^{-2} - 4z^{-3} + z^{-4})}{1 + 1.9684z^{-1} + 1.7359z^{-2} + 0.7245z^{-3} + 0.1204z^{-4}} \]

573/1 up In Equation (8.78a), it should be \( H_{by}(z) \), not \( H_{bp}(z) \)

574/9 up In the display equation, it should be \( H_{by}(z) \), not \( H_{bp}(z) \).

602/12 up In the second display equation from the bottom, \( W(z) \) in the numerator should have been crossed out:

\[ H(z) = \frac{Y(z)}{X(z)} = \frac{Y(z)}{X(z)} \cdot \frac{Y(z)}{W(z)} = \left( \sum_{k=0}^{N} b_k z^{-k} \right) \left( \frac{1}{1 + \sum_{k=1}^{N} a_k z^{-k}} \right) \]

604/6 up The last term of the in-line equation should be \( z^{-1}Q_2(z) \), not \( z^{-1}Q_2(z) : Q_2(z) \triangleq (h_1X(z) - a_1Y(z)) + z^{-1}Q_2(z) \)

607 Figure 9.10 The signs of the feedforward terms in parts a and b are wrong. They should be negative.
Equation (9.15) $G_i(z)$ instead of $G_k(z)$ on the second line

\[
F_i(z) = F_{i-1}(z) + k_i z^{-1}G_{i-1}(z)
\]
\[
G_i(z) = k_i F_{i-1}(z) + z^{-1}G_{i-1}(z)
\]

Should be $a_i$ in last term

\[
H(z) = \frac{Y(z)}{X(z)} = \frac{1}{A_i(z)} = \frac{1}{1 + k_i z^{-1}} = \frac{1}{1 + a_i z^{-1}}
\]

Several errors: 2\textsuperscript{nd} and 6\textsuperscript{th} lines

\[
V_2(z) = V_1(z) + k_2 z^{-1}W_1(z)
\]
\[
= \left( V_0(z) + k_1 z^{-1}W_0(z) \right) + k_2 z^{-1}W_0(z) \left( k_1 + z^{-1} \right)
\]
\[
= V_0(z) \left( 1 + k_1 (1 + k_2) z^{-1} + k_2 z^{-2} \right)
\]
\[
W_2(z) = k_2 V_1(z) + z^{-1}W_1(z)
\]
\[
= k_2 V_0(z) \left( 1 + k_1 z^{-1} \right) + z^{-1}W_0(z) \left( k_1 + z^{-1} \right)
\]
\[
= W_0(z) \left( k_2 + k_1 (1 + k_2) z^{-1} + z^{-2} \right)
\]

\[
H(z) = \frac{Y(z)}{X(z)} = \frac{1}{A_i(z)} = \frac{1}{1 + k_i (1 + k_2) z^{-1} + k_2 z^{-2}} = \frac{1}{1 + a_i z^{-1} + a_2 z^{-2}}
\]

Figure 9.23b: there should be more poles on real axis. Here is the revised figure:
“…where the discriminant is negative, $a_1^2 - 4a_2 < 0$.”

Figure 9.27 missing a black line in the legend for ‘Unquantized’

The sign of last term on second line of the big equation is wrong. The legends $x_1[n]$, $x_2[n]$, $x_3[n]$ and $x_4[n]$ are also in the wrong order.

\[
x[n] = \frac{1}{8} \left\{ X[0] + X[4](-1)^n + 2 \sum |X[k]| \cos \left( \frac{\pi k n}{4} + \angle X[k] \right) \right\} \\
= 0.375 + 0.125(-1)^n + 0.60 \cos \left( \frac{\pi n}{4} - \frac{\pi}{4} \right) + 0.25 \cos \left( \frac{\pi n}{2} - \frac{\pi}{2} \right) + 0.10 \cos \left( \frac{3\pi n}{4} + \frac{\pi}{4} \right) \\
= 0.375 + 0.125(-1)^n + 0.60 \cos \left( \frac{\pi (n-1)}{4} \right) + 0.25 \cos \left( \frac{\pi (n-1)}{2} \right) - 0.10 \cos \left( \frac{3\pi (n-1)}{4} \right)
\]
$y[n] = \mathcal{F}_N^{-1}\{Y[k]\} = 2\delta[n] + \delta[n-1] + \delta[n-3]$

730/9 Equation (11.13) et seq. Should use $\mathcal{F}_N$ instead of $\mathcal{F}$

$$x[n] = \mathcal{F}_N^{-1}\{X[k]\} = \frac{1}{N} \sum_{k=0}^{N-1} X[k] e^{j2\pi kn/N}$$

730/11 Same

$$X[k] = \mathcal{F}_N\{x[n]\} = \sum_{n=0}^{N-1} x[n] e^{-j2\pi nk/N}$$

732/18 Same: $X[k] = \mathcal{F}_N\{x[n]\}$

732/20 Same:

$$\mathcal{F}_N\{x'[n]\} = \mathcal{F}_N\left(\frac{1}{N} \sum_{n=0}^{N-1} x[n] e^{-j2\pi nk/N}\right)^* = \mathcal{F}_N\left(\frac{1}{N} \sum_{n=0}^{N-1} x[n] e^{-j2\pi nk/N}\right)^* = X^*[(-k)_N] = X^*[N-k]$$

732/23 “Hence, $\mathcal{F}_N\{x'[n]\} = \mathcal{F}_N\{x[n]\}$, so …”

734/5 Equation (11.15)

$$X_1[k] \triangleq \mathcal{F}_N\{x_1[n]\} = \mathcal{F}_N\left\{\frac{1}{2}(x[n] + x'[n])\right\} = \frac{1}{2}(X[k] + X^*[N-k])$$

$$X_2[k] \triangleq \mathcal{F}_N\{x_2[n]\} = \mathcal{F}_N\left\{\frac{1}{2}(x[n] - x'[n])\right\} = \frac{1}{2}(X[k] - X^*[N-k])$$

738/14 up Cosmetic replace IFFT with $\mathcal{F}_N^{-1}$

$$x_1[n] = \frac{1}{2} \left( \frac{1}{N/2} \sum_{k=0}^{N/2-1} X_1[k] W_{N/2}^{-kn} \right) = \frac{1}{2} \mathcal{F}_N^{-1}\{X_1[k]\}$$

$$x_2[n] = \frac{1}{2} \left( \frac{1}{N/2} \sum_{k=0}^{N/2-1} X_2[k] W_{N/2}^{-kn} \right) = \frac{1}{2} \mathcal{F}_N^{-1}\{X_2[k]\}$$

738/10 up Cosmetic replace IFFT with $\mathcal{F}_N^{-1}$

\[ \frac{1}{2} \mathcal{F}_N^{-1}\{X[k]\} = \frac{1}{2} \mathcal{F}_N^{-1}\{X_1[k]\} + j \frac{1}{2} \mathcal{F}_N^{-1}\{X_2[k]\} \]

739/14 disp('iiff(X[k]) x[n]'), disp([xx' x'])

740/11 up “frequencies $2\pi k/8$, …”

740/1 up Should be $(2k)$ in first summation
\[ Y[k] = X[2k] = \sum_{n=0}^{N-1} x[n]e^{-j2\pi(2k)n/N} = \sum_{n=0}^{2M/2-1} x[n]e^{-j2\pi nM/N} + \sum_{n=0}^{2M-1} x[n]e^{-j2\pi nM/M} \]

Figure 12.16a is missing the contrast sensitivity function (the red curve).

987/8 Code should be `isa(s, 'sequence')`