Errata for the <u>5th Printing</u> of
"Understanding Digital Signal Processing, 2/E",
by Richard Lyons

I beg your pardon for the typographical errors in the book.
It will not take long to make these corrections. I promise.
- Rick Lyons

Page 7: In the third line below Eq. (1-7), the text:

   "... indicate that $X_{sum}(n)$ has a frequency ..."

The uppercase "X" should be lowercase "x" as:

   "... indicate that $x_{sum}(n)$ has a frequency ..."

[Found by Angela Livingstone, 3/30/08; [Production Error]

Page 23: On the right side of Eq. (2-3), the text is printed as:

$$\ldots = \sin(2\pi(f_o + \frac{1}{32})nt_s) \qquad\qquad (2\text{-}3)$$

The fraction $\frac{1}{32}$ should be $\frac{m}{nt_S}$, making the text print as:

$$\ldots = \sin(2\pi(f_o + \frac{m}{nt_s})nt_s) \qquad\qquad (2\text{-}3)$$

[Found by Jim Murphy [9/14/05].][Author Error]

Page 34: In the 5th line down, the text:

   "... where spectral replications do not butt up against each
     other except at zero Hz."

is confusing. Please edit it as follows:

   "... where spectral replications ~~do not~~ butt up against each
     other ~~except~~ at zero Hz."

Page 37: The "f_s" labels, within the arrows, at the very
bottom of Figure 2-13 should be "$f_s/2$".

[Found by Author [6/20/06].][Author Error]

Page 38: In the fifth line up from the bottom of the page,
the text:

   "... where m_{odd} is an odd integer[14]."

should be changed to:

   "... where m_{odd} is an odd integer greater than one[14]."

[Found by Jim Murphy [9/14/05] & Justin Reeves [6/20/06].][Author Error]

Page 40: In the 2nd line below Eq. (2-14), the text:

"m = 2 provide an optimum ..."

should be changed to:

   "m_{even} = 2 provide an optimum ..."

[Found by Justin Reeves, 6/20/06.][Author Error]

Page 42: In the middle of Table 2-2, on the right side,
the text:

   "m_{odd} is any positive odd integer ..."

should be changed to:

   "m_{odd} is an odd integer greater than one ..."

[Found by Justin Reeves, 6/20/06.][Author Error]

Page 48: The incorrect letter "v" in the third line of Eq. (3-4d)
       should be replaced with a "$\cdot$" multiplication symbol.

[Found by Uday Padmanabhan, 11/19/08.][Author Error]

Page 49: In Equation (3-8), the ϕ subscript for the X at the
left-hand side is missing, and superscript after the "tan" characters
should be "-1".   Equation (3-8) should look like:

$$X_\phi(m) = \tan^{-1}\left(\frac{X_{\text{imag}}(m)}{X_{\text{real}}(m)}\right) \qquad (3-8)$$

[Found by Justin Reeves [6/19/06].][Production Error]

Page 62: The second part of equation (3-18') printed as:

$$x(n) = \frac{1}{\sqrt{N}} \sum_{n=0}^{N-1} X''(m)e^{j2\pi nm/N} \qquad (3\text{-}18')$$

should have the lower limit of the summation changed to "m"
instead of "n", as :

$$x(n) = \frac{1}{\sqrt{N}} \sum_{\boldsymbol{m}=0}^{N-1} X''(m)e^{j2\pi nm/N} \qquad (3\text{-}18')$$

[Found by Larry Ong, 2/19/08.][Author Error]

Page 63: on line 9, the text:

    "..., that $X(N/2+1)$, when m = $N/2+1$"

should be

    "..., that $X(N/2)$, when m = $N/2$"

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 77: For <u>**both**</u> Eq. (3-29) and Eq. (3-30), the "-1" characters
should be deleted from the denominator of the cosine arguments.
The cosine argument, in both equations, should be:

     "...$\cos(2\pi n/N)$,"

[Found by Author, 10/26/07.][Author Error]

Page 93: The last term in Equ. 3-37 has a missing minus sign in
its exponent. The last term should be:

$$\ldots + e^{-jq(K-1)}].$$

[Found by Stan Moore, 3/19/12.][Production Error]

Page 105: In Table 3-1, on the second row the 1st column text:

     "Frequency in radians"

should be replaced with:

     "Frequency in radians/second"

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 110: In both lines of Equation (3-58) there is a missing
minus sign in front of the "j" in the exponent of "e".
For both lines of Eq. (3-58) the printed expression should be:

$$= e^{-j(2\pi n/N)\ldots}$$

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 114: The label text above the arrow in Figure 3-41 states:

      " ... transform of $x(n)$ ..."

There is a missing "c" subscript, the arrow's label text should state:

      " ... transform of $x_c(n)$ ..."

[Found by Jimmy Ceilidh [12/26/04].][Author Error]

Page 122: The caption to Figure 3-47 was printed as:

      "DTFT magnitude $|X_O(w)|$"

    The "w" should be the Greek "ω" character, making the caption:

      "DTFT magnitude $|X_O(\omega)|$"

[Found by Author, 4/16/05.][Production Error]

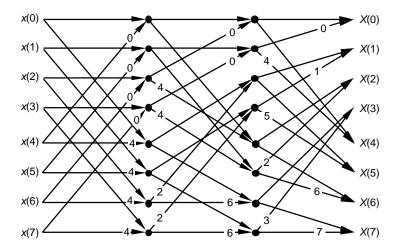**Page 135:** On the 3rd line from the bottom, the "1" in:

     "$e^{-j\pi} = 1$"

should be a minus 1 as

"$e^{-j\pi} = -1$"

Page 143: In Figure 4-10, in the middle stage there is
the number 4 on the 1st and 2nd (counting down from the top)
southeast-pointing arrows. Those 4s should not be there.
The 4s should be on the 3rd and 4th southeast-pointing arrows
of the middle stage as shown below.

Page 163: The text on the bottom line, printed as:

"Figures 5-8(a) and 5-8(b)."

should be changed to

"Figures 5-8(b) and 5-8(c)."

Page 178: In the 3rd & 4th lines of the 1st paragraph the text
printed as:

"... defined by 32 discrete samples, to which 480 zeros were ..."

should be

"... defined by 16 discrete samples, to which 496 zeros were ..."

Page 179: In the 5th line of the next to the last paragraph the text
printed as:

"... by 32 discrete samples, with 480 zeros appended, ..."

should be

"... by 16 discrete samples, with 496 zeros appended, ..."

Page 198: On line 8, the text:

    "... in Figure-34(b), ..."

Should be:

    "... in Figure 5-40(b), ..."

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 222: In Figure 6-7(a), the label above the arrow should be

   "$\sigma = -a_0/a_1$"

just as it is in Figure 6-8(a)

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 244: The normalized-frequency labeling (radians/sample) on the frequency axis of Figures 6-24(b) and 6-24(c) should be changed as:

      -2π changed to -4π
     $-\pi$ changed to -2π
      π changed to 2π
    2π changed to 4π

[Found by Author, 10/17/08.][Author Error]

Page 245: On the second line the text:

    "... if Figure 6-4(a) ..."

should be changed to

    "... if Figure 6-24(a) ..."

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 247: On the last line of the footnote, the text:

    "... in Step 5."

should be changed to:

    "... in Step 6."

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 257: In the eleventh line below Eq. (6-87)

    "... Figure 6-21(b). Knowing that ..."

should be changed to:

    "... Figure 6-**22**(b). Knowing that ..."

 [Found by Yancen Li (7/14/14)]; [Author Error]

Page 264: In the 6th line of the first full paragraph, the text:

    "...squeezed in toward zero Hz."

should be:

"...squeezed in toward $\mathbf{f_s/2}$ Hz."

[Found by VV (vanamali), 3/12/09.] [Author Error]

Page 264: In the next to the last line of the first full paragraph
there's a missing "|" vertical bar character indicating
"magnitude". The text:

   "...in $|H_d(f_d)-$..."

should be:

   "...in $|H_d(f_d)|-$..."

[Found by Author, 7/14/05.] [Author Error]

Page 265: In the first and third lines of the caption to Figure 6-32,
the subscripted "c" in "f_c" should be an "a", as "f_a".

In the third line of the caption, the subscripted "c" in "H_c" should
be an "a", as "H_a".

[Found by Author, 7/14/05.] [Author Error]

Page 267: There is a missing "x(n)" factor in Equation (6-114), the
first part of that equation should be:

   $y(n)$ = $0.20482712 \cdot \mathbf{x(n)}$ + $0.40965424 \cdot x(n-1)$ + ...

[Found by Kendall Castor-Perry, 5/3/09.] [Author Error]

Page 286: The feedback coefficient of the resonator in Figure
7-3, printed as:

   $e^{j\Box r}$

it should be changed to:

   $e^{j\omega r}$

[Found by Author, 7/14/09.] [Production Error]

Page 300: In Figure 7-18(b), the feedback coefficient label
on the right side of the figure printed as:

   $2r\cos(2{\neq}k/N)$,

the "$\neq$" should be replaced with "π" (pi), as:

   "$2r\cos(2\pi k/N)$"

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 339: In Figure 8-3, the last fraction on the right of the second
line down was printed as:

   $(jf)^6/6!$

The letter "f" should be changed to the Greek letter ϕ, as:

$$(j\phi)^6/6!$$

[Found by Prof. Kai-Kuang Ma, 2/28/05.] [Author Error]

Page 345: On the right side of Figure 8-8 the term $e^{j2\pi f_o t}$ should be divided by two, making it

$$e^{j2\pi f_o t}/2.$$

[Found by John Littig, 9/24/07.] [Author Error]

Page 353: In the sentence just before Eq. (8-17), the described notion of orthogonality of $i(n)$ and $q(n)$ is only conditionally true. Because this orthogonality topic was not described in sufficient detail, I suggest you strike out both the sentence just before Eq. (8-17) as well as Eq. (8-17).

[Found by Ken Walsh, 5/9/06.] [Author Error]

Page 354: In the third line from the bottom, the text:

    "... about zero Hz, not f_c Hz as in Figure 8-17(b)."

should have a comma inserted after "f_c Hz", as:

    "... about zero Hz, not f_c Hz, as in Figure 8-17(b)."

(Note: The missing comma is essential because it changes the meaning of the sentence.)

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 373: In Figure 9-11, in the middle and bottom figures, the two labels within the figures printed as:

    "... of $H_1(\square)$"

should be changed to

    "... of $H_1(\omega)$"

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 379: In Item# 6, in the 2nd sentence printed as:

   "In this case half the $h_{sin}(k)$ coefficients are zeros, and
      all but one of the $h_{cos}(k)$ coefficients are zeros!"

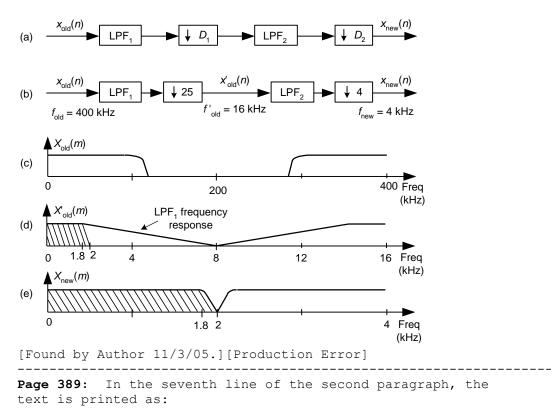the "cos" and "sin" subscripts should be swapped making that sentence become:

   "In this case half the $h_{cos}(k)$ coefficients are zeros, and
      all but one of the $h_{sin}(k)$ coefficients are zeros!"

[Found by Author 11/3/05.][Author Error]

Page 384: The "shading" in two places at
the bottom in Figure 10-3 doesn't show up in the figure.

The shading in Figure 10-3 should look like the following:

[Found by Author 11/3/05.][Production Error]

Page 389: In the seventh line of the second paragraph, the
text is printed as:

     "The lower the attenuation, the ...".

Please change the word "lower" to "greater" so that
the text reads:

     "The **greater** the attenuation, the ...".

[Found by Mark Kolber, 1/29/08.][Author Error]

Page 399:
Equation (10-8) was printed as:

$$Y(z) = \frac{1}{D}[X(n) + X(n)z^{-1} + X(n)z^{-2} + \ldots + X(n)z^{-D+1}] \qquad (10\text{-}8)$$

The X(n) terms should all be X(z), so Eq. (10-8) should be

$$Y(z) = \frac{1}{D}[X(z) + X(z)z^{-1} + X(z)z^{-2} + \ldots + X(z)z^{-D+1}] \qquad (10\text{-}8)$$
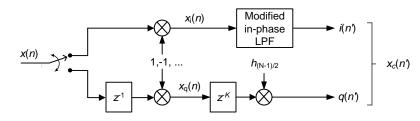
[Found by Gurpal Gill, 4/7/05.] [Author Error]

Page 353: In the sentence just before Eq. (8-17), the
described notion of orthogonality of $i(n)$ and $q(n)$ is only
conditionally true. Because this orthogonality topic was
not described in sufficient detail, I suggest you strike out
both the sentence just before Eq. (8-17) as well as Eq. (8-17).

[Found by Ken Walsh, 5/9/06.] [Author Error]

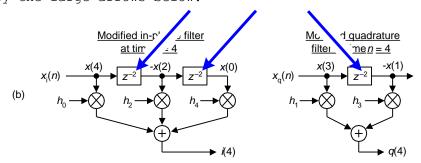**Page 478:** in the fifth line down, delete the text:

     "...followed by another K delay..."

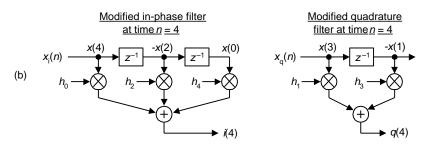In Figure 13-6(c) the final z^{-K} delay block should be deleted making that figure look as follows:

[Found by Brian Frantz, 8/8/17.][Author Error]

Page 479: In Figure 13-6(b) the superscripted "-2" characters shown by the large arrows below:

Should be changed from "-2" to "-1" making Figure 13-6(b) become:

[Found by Damon Bradley, 10/1/09.][Author Error]

Page 484: Equation (13-10) has suffered a series of "foul-ups" in different Printings of the book. Eq. (13-10) should be:

$$W(m)=\sum_{n=0}^{N-1}\alpha e^{-j2\pi nm/N}-\frac{\beta}{2}\cdot\sum_{n=0}^{N-1}e^{j2\pi n/N}e^{-j2\pi nm/N}-\frac{\beta}{2}\cdot\sum_{n=0}^{N-1}e^{-j2\pi n/N}e^{-j2\pi nm/N}$$

$$=\alpha\sum_{n=0}^{N-1}e^{-j2\pi nm/N}-\frac{\beta}{2}\cdot\sum_{n=0}^{N-1}e^{j2\pi n(m-1)/N}-\frac{\beta}{2}\cdot\sum_{n=0}^{N-1}e^{-j2\pi n(m+1)/N}. \qquad (13\text{–}10)$$

[Found by Author, 3/22/04.][Author Error]

Page 488: Equation (13-18) has minus signs where equal signs should be. Equation (13-18) should be:

x(0) **=** a(0) + jb(0)

x(1) **=** a(1) + jb(1)

x(2) **=** a(2) + jb(2)

```
        . . .
        . . .
    x(N–1) = a(N–1) + jb(N–1)            (13-18)
```

[Found by Author [1/11/07].][Production Error. Wierd. This
                          error was NOT in the 1st Edition!]

Page 489: In the 3rd line below Eq. (13-22) change
         the text from:

  "... in Eq. (13-40) , ...

to:

  "... in Eq. (13-**2**0) , ...

[Found by Antoine Trux, 1/11/07.][Author Error]

Page 496: In the 6th and 7th lines below Eq. (13-40)
         change the text from:

  "... real, X_a(N) through X_a(2N-1) are merely the
   complex conjugates of their X_a(0) through X_a(N-1)
   counterparts ..."

to:

  "... real, X_a(N**+1**) through X_a(2N-1) are merely the
   complex conjugates of their X_a(**N–1**) through X_a(**1**)
   counterparts ..."

[Found by Antoine Trux, 1/11/07.][Author Error]

I (the author) suggest you write the following in
the book's margin:

$$"X_{a,real}(N) = X_r(0) - X_i(0)"$$
$$"X_{a,imag}(N) = 0"$$

Page 518: For more accurate results, the "12/M" factor at the
beginning of Eq. (13-70) should be changed to sqrt(12/M).
Thus Eq. (13-70) should be:

$$y_{desired}(n) = \sqrt{\frac{12}{M}} \cdot \sigma ' \cdot \left[\left(\sum_{k=1}^{M} x_k(n) \right) - \frac{M}{2} \right] + \mu ' . \qquad (13-70)$$

[Found by Bharat Pathak, 7/13/07.][Author Error]

Page 544: In the exponent of Eq. (13-104), originally printed as:

$$X(k) = \sum_{n=0}^{M-1} x(n) e^{-j2\pi nk/N} . \qquad (13-104)$$

The "N" should be changed to an "M", making the equation print as:

$$X(k) = \sum_{n=0}^{M-1} x(n)e^{-j2\pi nk/M}. \qquad\qquad (13\text{-}104)$$
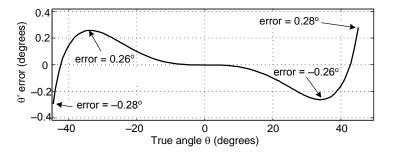
[Found by Author 3/13/06.][Author Error]

Page 548: 4th line below Eq. (13-107), change the text:

      "... 0.26^{o} using ..."

to

      "... $0.2\mathbf{8}^{\mathrm{o}}$ using ...".

For preciseness, you might note on Figure 13-59 that the error is -0.28^{o} at True $\theta = -45^{\mathrm{o}}$, and the error is $+0.28^{\mathrm{o}}$ at True $\theta = +45^{\mathrm{o}}$, as shown in the following figure.

[Found by Chris Zarowski, 4/27/06.][Author Error]

Page 549: 4th line below Eq. (13-109'), change the text:

      "... error is 0.26^{o} for ..."

to

      "...error is $0.2\mathbf{8}^{\mathrm{o}}$ for ...".

[Found by Chris Zarowski, 4/27/06.][Author Error]

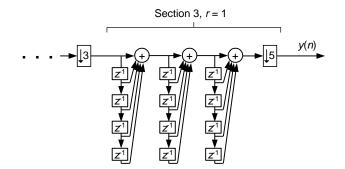**Page 551:** In Figure 13-61(a) there needs to be a Delay element inserted just after the "Inverse" operation as shown below. The length of that (missing) Delay element should be the same length as the Delays in the I and Q input paths.

[Found by "Jerry W." on comp.dsp, 8/25/05.][Author Error]

Page 560: In Figure 13-70(b), on the right side in the

"Section 3, r = 1" part of the figure, there should be three
stages of delay lines instead of only two stages as shown
in the figure. That "Section 3, r = 1" part of the figure should
look like the following:

[Found by Mike Totham, 8/31/07.][Author Error]

Page 561: Equation (13-123) has a missing 1/N scale factor in
front of the summation. That equation should be:

$$M(q) = \frac{1}{N} \sum_{k=qN}^{(q+1)N-1} x(n) \qquad\qquad (13\text{-}123)$$

[Found by Author, 8/24/08.][Production Error]

Page 569: In the right $X_{int}(m)$ column of Table 13-8, the *underline*
character associated with row $m = 9$ should be a zero "0" value
as follows:

m	$X_{int}(m)$
...	...
9	0
...	...

[Found by Author, 3/21/09.][Production Error]

Page 574: In Figure 13-77(a), the "log(R)" factor applied to the
adder should be two times the log of R, that is "2log(R)".

[Found by Mark Borgerding, 6/8/05.][Author Error]

Page 575: The two labels in Figure 13-78(c) were strangely messed up
during the typesetting process. The

        α = 0.7   and the   α = 0.09

labels above the graphs should be changed to

        α = 0.2   and the   α = 0.05

The bottom line in the figure caption is printed as:

        "... (c) $E(n)$ for α = 0.7 and α = 0.9."

That caption text should be changed to:

        "... (c) $E(n)$ for α = 0.2 and α = 0.05."

[Found by Author, 3/24/05.][Production Error]

Page 607: Two corrections: In the second line of Eq. (D-7), the term:

"... -cos(ωt)] ...

should be:

"... -cos(**2**ωt)] ...

In the third line of Eq. (D-7), the term:

"... $-\frac{1}{2}\big(\sin(\omega t)\big)$..."
should be:

"... $-\frac{1}{4}\big(\sin(\mathbf{2}\omega t)\big)$..."

[Found by Julian Vrbancich, 10/23/12; [Author Error]

Page 627: The minus sign before the "0.04" value in Eq. (F-5) should be deleted, making Eq. (F-5) end with:

"... $= \dfrac{0.25}{2\pi} = 0.04$ seconds.   (F-5)"

[Found by Author, 4/22/05.][Author Error]

Dear Reader, if you find any additional errors, no matter how trivial,
please notify me at: R.Lyons@ieee.org
I'd sure appreciate hearing from you and I promise I'll
reply to your E-mail.

Thanks,
[-Rick Lyons-]