Typos and Corrections (updated June 2008)

Fundamentals of Digital Communication, by U. Madhow. Cambridge University Press, 2008.

Chapter 2

p. 19, sentence after equation (2.26): insert ”baseband” after ”real-valued”

p.27: line 7 from bottom. FCC refers to the United States Federal Communications Commission, one of whose responsibilities is to regulate the use of frequency spectrum. In general, replace the term “FCC” by “regulatory agency.”

p. 29, Example 2.2.5, replace “We see” by “We shall see”

p. 31, section 2.3: in first sentence, replace “infinite” by “unbounded”

p. 36-38: For notational consistency, $E[\cdot]$ should be replaced by $\mathbb{E}[\cdot]$ in equations (2.60)-(2.65)

Equation (2.30): The right-hand side is missing a factor $\sqrt{2}$

Problem 2.13: In the displayed equation on p. 65 for the PSD, replace $S_n(f)$ by $S_{n_p}(f)$.

Problem 2.14(b): replace u by v. That is, the task is to show that v is WSS.

Problem 2.21: Reword so that the answer is unique:
(a) It should read “What is the *smallest* value of T as a function of W for which $r_n = b_n$?”
(c) The second sentence should read “For ideal sampling as in (a), what are the two *smallest* values of T such that $r_n = b_n$?”

Chapter 3

Equation (3.11): Covariance should be $\mathbf{ACA}^T$, and the equation should read

$$\mathbf{AX} + \mathbf{b} \sim N(\mathbf{Am} + \mathbf{b}, \mathbf{ACA}^T)$$

Problem 3.28, p.149: In the remark after (e), the asymptotic efficiency should be defined as a^2/b^2.

Chapter 4

p. 177, line before equation (4.44): replace $\mathbf{m_X} = E[\mathbf{X}]$ by $\mathbf{m_X} = \mathbb{E}[\mathbf{X}]$ for notational consistency.

Chapter 5

p. 208, line 4: ”Figure 5.4” should be replaced by ”Figure 5.5”

p. 208, second displayed equation towards the end of the boxed example: The expression for $m_n(s[n] \rightarrow s[n+1])$ is incorrect. The correct expression is given by equation (5.16) on p. 207.

p. 208: Accumulated metric computations in the first four sentences after the boxed example are wrong. However, the branch metrics in Figure 5.5 are correct.
Replace first four sentences after boxed example as follows:
“Consider now a bit sequence $b[0] = +1, b[1] = +1, b[2] = +1$. From Figure 5.5, this has an accumulated metric of $2.5 - 1.5 = 1$. Compare it with the sequence $b[0] = +1, b[1] = -1, b[2] = +1$. This has an accumulated metric of $-2.5 - 2.5 = -5$.”

Chapter 6

Problem 6.7: In Figure 6.9, the transition probabilities corresponding to correct reception (i.e. for $0 \to 0$ and $1 \to 1$) should be $1 - p - q$.

Chapter 7

p. 349-351: The description of Gallager Algorithm A on p. 349 starts with *Initialization (variable node)*, where variable nodes send the channel messages to the check nodes. Then comes *Iteration 1 (check node),* where the check nodes generate messages. Then comes *Iteration 1 (variable node),* where the variable nodes generate messages. **The preceding description and notation in p. 349 is inconsistent with the notation in the performance analysis on p. 351,** where an iteration is defined as the variable nodes generating messages, and then the check nodes generating messages. In the notation of the analysis on p. 351, iteration 0 corresponds to the initialization, where the variable nodes send the channel messages to the check node. **We will stick with the notation and terminology of p. 351** regarding how to number iterations.

p. 351, equation (7.94) and the line before it: replace $q(l)$ by $q(l-1)$.

p. 355, equation (7.108): Delete the term $\phi(m)$ from the extreme right-hand side.

Chapter 8

p. 391: In the displayed equation at the bottom of the page, on left-hand side, replace $x[n]$ by $x[N]$ and $y[n]$ by $y[N]$

p. 444: The dimensions of $\mathbf{D}$ in (8.125) are wrongly specified in the line below (8.125). The matrix $\mathbf{D}$ is $N_R \times N_T$. This is needed for the product $\mathbf{H} = \mathbf{UDV}^H$ to make sense: $\mathbf{U}$ is $N_R \times N_R$ and $\mathbf{V}^H$ is $N_T \times N_T$. For $N_R \geq N_T$ as assumed, $\mathbf{D}$ can be constructed by appending $N_R - N_T$ rows of zeros to the $N_T \times N_T$ diagonal matrix diag $\left(\lambda_1^{\frac{1}{2}}, ..., \lambda_{N_T}^{\frac{1}{2}}\right)$.

p. 445-446: replace entropy notation H by differential entropy notation h throughout, since we are computing differential entropy and conditional differential entropy for the channel output, which is a continuous random vector.

p. 447, equation (8.130): replace $\mathbf{W}$ by $\mathbf{w}$

Problem 8.1: In third sentence, replace "95%" by "5%"

Problem 8.4: In part (b), the equation for $p(G)$ should be $p(G) = \frac{1}{2}e^{-G\bar{E}_b/N_0}$ (i.e., replace E_b by $\bar{E}_b$ in the equation).

Problem 8.6: Parts (c)-(e) should be corrected and reworded as follows:
(c) Show that the event $Y \in (y, y+\delta)$ is equivalent to the event $\{N(y) \leq N-1\}$ **and** $\{N(y+\delta) \geq N\}$.
(d) For small δ, argue that the event in (c) is dominated by the event $\{N(y) = N-1\}$ **and** $\{N(y+\delta) = N\}$.
Hint: Show that the ratio of the probability that the increment over an interval of length δ equals 2 or more to the probability that it equals one tends to zero as $\delta \to 0$.
(e) Using (c) and (d), find the density $p(y)$ of Y using the following relations for small δ:

$$P[Y \in [y, y+\delta)] \approx p(y)\delta$$

and

$$P[Y \in [y, y+\delta)] \approx P[N(y) = N-1, N(y+\delta) = N] = P[N[y] = N-1, N(y+\delta) - N(y) = 1]$$

Use the independent increments property and simplify to obtain (8.139).

Problem 8.11(a): In the hint, define β by $-\beta = \min_{s<0}\{M(s) - st\}$. We then get $\beta > 0$ in a Chernoff bound of the form $e^{-\beta N}$ that decays exponentially with N.

Problem 8.12: The third displayed equation should read

$$P_e \leq e^{NM^*(0)}$$

Problem 8.12(b): The minimizing value should be

$$s_0 = \frac{\mu_v - \mu_u}{2}$$

Problem 8.12(d) : Set $E = \overline{e_b}$ instead of $E = E_b$ for binary FSK.

Problem 8.16: The rms delay spread for the indoor channel should be 100 nanoseconds, not 100 milliseconds.

Problem 8.22(c): Should be $\sigma^2 \to 0$, not $\sigma^2 \to \infty$.