Preface


Chapter 1

1. Page 10, Line 3: Change “Coulombs plus” to “Coulomb plus”
2. Page 24, Second line of Exercise 1.4: Change “++” to “+”
3. Page 27, Exercise 1.13(c): Change “Section 1.3” to “Section 1.2.3”
4. Page 27, Exercise 1.14: Change “v the” to “v is the”

Chapter 2

1. Page 52, Last line: change “3” to “4”
2. Page 61, Last line: insert “and \( V(x) < c \) inside the curve” after “differentiable”
3. Page 67, Second line of footnote: Change “is a also” to “is also”
4. Page 81, Exercise 2.14: Change “\( \ddot{y} \)” to “\( m\ddot{y} \)”
5. Page 82, Exercise 2.18: Change “\( zg(z) > 0 \)” to “\( zg(z) > 0 \) for \( z \neq 0 \)”

Chapter 3

1. Page 105, Exercise 3.2(5): Change “Section 1.2.5” to “Section 1.2.6”
2. Page 108, Hint of Exercise 3.19: change “\( \| x - y \| \geq min_i r_i \)” to “\( \| x - y \| \geq c \) for some \( c > 0 \)”
3. Page 109, Exercise 3.27: Change “\( f((t,x_i(t))) \)” to “\( f(t,x_i(t)) \)”

Chapter 4

1. Page 113, Line 17: Change “for any \( \varepsilon \)” to “for any sufficiently small \( \varepsilon \)”
2. Page 123: Remove the six-line segment from “For \( \Omega_c \)” to ”... only for \( c < 1 \),”, which start at Line 9 from the bottom. The discussion is not valid.
3. Page 125, Figure 4.5: At the bottom right corner change “\( x_2 = x_1 \)” to “\( x_2 = -x_1 \)”
4. Page 128, Line 21: At the end of the sentence “When \( V(x) \) is positive definite, \( \Omega_c \) is bounded for sufficiently small \( c \)” insert the footnote “\( \Omega_c \) may have more than one component. This sentence refers to the bounded component that contains the origin.”
6. Page 145, Lemma 4.3: Replace the last two sentences “If \( D = R^n \) ... class \( \mathcal{K}_\infty \)” by “If \( D = R^n \) and \( V(x) \) is radially unbounded, then there exist class \( \mathcal{K}_\infty \) functions \( \alpha_1 \) and \( \alpha_2 \) such that the foregoing inequality holds for all \( x \in R^n \).”
7. Page 156, Equation (4.29): Change \( A(t)x \) to \( A(t)x(t) \)
8. Page 163, Line 4: Change “a function \( V \)” to “a continuously differentiable function \( V \)”
10. Page 170, Line after (4.37): Insert “for some $\mu > 0.$”

11. Page 175, Second line of Definition 4.7: Change “for any initial state” to “for any initial time $t_0$, any initial state”

12. Page 176, Line 17: Change “consequences” to “consequence”

13. Page 176, Line 3 of the proof of Lemma 4.6: Change “satisfies (4.10) through (4.12)” to “satisfies the inequalities of the theorem”

14. Page 182, Exercise 4.6: change “for all $z \in \mathbb{R}$” to “for all $z \neq 0$”


16. Page 185, Exercise 4.21, part (b): Take $D = \mathbb{R}^n$

17. Page 186, Line 4: Change “nonsingular” to “positive definite”

18. Page 186, Line 4 from the bottom: Change “point asymptotically” to “point is asymptotically”

19. Page 188, Exercise 4.35, change “$\forall r_1, r_2 \in [0, a)$” to “$\forall r_1, r_2 \in [0, a/2)$”

20. Page 190, Exercise 4.49, change “exponentially” to “asymptotically” and “$Y_2^1$” to “$y_2^1$”

Chapter 5

1. Page 198, Line 6: Change “$u_\tau$” to “$u$”

2. Page 201, Definition 5.2: Change “with sup $0 \leq t \leq \tau \|u(t)\| \leq r$” to “and $\tau \in [0, \infty)$ with sup $t \geq 0 \|u(t)\| \leq r$”

3. Page 206, Line 16: Change “$x_0 \in \mathbb{R}$” to “$x_0 \in \mathbb{R}^n$”

4. Page 209, four lines before Section 5.3: Change “$W_3(x) = -(1-\theta)\|x\|^4_2$” to “$W_3(x) = (1-\theta)\|x\|^4_2$”

5. Page 211, Line 4: Change “$f(x)$ is locally Lipschitz, and $G(x), h(x)$ are” to “$f(x), G(x)$ are locally Lipschitz and $h(x)$ is”

6. Page 218, Line 2 from the bottom: Change “competed” to “completed”

7. Page 219, Example 5.13: Change “$e_2 = \psi(t, y_2)$” to “$y_2 = \psi(t, e_2)$”

8. Page 221, Line 10 from the bottom: Change “is $\mathcal{L}$ stable.” to “is $\mathcal{L}$ stable if $\varepsilon \gamma_1 \gamma_f < 1$.”

9. Page 224, Exercise 5.16, part (a): remove “finite-gain”

Chapter 6

1. Page 228, Line 10 of Section 6.1: Change “$uy = Gy^2$” to “$uy = Gu^2$”

2. Page 232, Line 10 from the bottom: Change “$Ly$” to “$Lu$”

3. Page 238, Line 8: Change “of of” to “of”

4. Page 238, Lemma 6.1: Change the third bullet to: either $G(\infty) + G^T(\infty)$ is positive definite or it is positive semidefinite and $\lim_{\omega \to \infty} \omega^{2(p-q)} \det[G(j\omega) + G^T(-j\omega)] > 0$, where $q = \text{rank}[G(\infty) + G^T(\infty)]$. The proof of the corrected lemma is given in the paper: Corless, M. and Shorten, R., “On the Characterization of Strict Positive Realness for General Matrix Transfer Functions”, IEEE Transactions on Automatic Control, Vol. 55, No. 8, pp. 1899–1904, 2010.

5. Page 239, Line 7 from the bottom: Change the (1,1) element of the matrix\(^1\) from “$s$” to “$s + 1$”

\(^1\)This $G(s)$ and the one given at the end of the page need to be corrected because $G(0) + G^T(0)$ is singular.
6. Page 239, Line 3 from the bottom: Change the (1,1) element of the matrix from “ω²” to “ω² + 1”

7. Page 239, Last line: Change the (1,1) element of the matrix from “s/(s+1)” to “(s + 2)/(s + 1)”

8. Page 240, Line 4: Change the (1,1) element of the matrix from “2ω²/(1 + ω²)” to “2(2ω²)/(1 + ω²)”

9. Page 241: First line of proof of Lemma 6.4: Change “V(s)” to “V(x)”

10. Page 244, Example 6.5: Change “f is locally Lipschitz, G and h are continuous” to “f and G are locally Lipschitz, h is continuous”

11. Page 244, Line 6 from the bottom: Change “−kyy” to “kyT y”

12. Page 245, Section 6.5: In describing the feedback connection of Figure 6.11 it should be noted that u₁, y₁, u₂, and y₂ could be vectors of the same dimension.

13. Page 257, Line 4 to 6 from the bottom: Change “the condition

\[ \Re \left[ \frac{1 + j\omega a}{1 - \omega^2 + j\omega} \right] = \frac{1 + (a-1)\omega^2}{(1-\omega^2)^2 + \omega^2} > 0, \quad \forall \omega \in R \]

if \( a \geq 1 \). Thus, choosing \( a \geq 1 \), we can apply Lemmas 6.3 and 6.4 to conclude that” to “the conditions

\[ \Re \left[ \frac{1 + j\omega a}{1 - \omega^2 + j\omega} \right] = \frac{1 + (a-1)\omega^2}{(1-\omega^2)^2 + \omega^2} > 0, \quad \forall \omega \in R \]

and

\[ \lim_{\omega \to \infty} \omega^2 \Re \left[ \frac{1 + j\omega a}{1 - \omega^2 + j\omega} \right] = a - 1 > 0 \]

if \( a > 1 \). Thus, choosing \( a > 1 \), we can apply Lemmas 6.1 and 6.4 to conclude that”

14. Page 260, Exercise 6.9, Line 4: Change V to \( \dot{V} \)

Chapter 7

1. Page 285, Line 5 from the bottom should read as “Equation (7.29) can be written as” while Line 3 from the bottom should start with “Since the describing function \( \Psi(a) \) is real, this equation . . . ”

2. Page 299, Line 2: Change “with G(s)” to “with output e, zero input, and G(s)”

Chapter 8

1. Page 311, Last line: Change “−∥y∥²” to “−\( \frac{1}{2} ∥y∥^2 \)”

2. Page 312, Line 2: Change to “\( \dot{V} \leq -\frac{1}{2} ∥y∥^4 \), for ∥y∥ < \( \frac{1}{3ε} \)”

3. Page 313, Line 2: Change “\( x_{pr} \) in Suppose” to “\( x_{pr} \) in Figure 8.1. Suppose”

4. Page 313, Line 8 from the bottom: Change “find \( t_c \) by Figure 8.1. integrating” to “find \( t_c \) by integrating”

Chapter 9

1. Page 342, Line 11 from the bottom: Change “\( \dot{V}(x) \)” to “\( \dot{V}(t, x) \)”

Chapter 11

1. Page 434, Equation (11.21) and Page 439, Equation (11.24): Change “\( \dot{y}(t/ε) \)” to “\( \dot{y}((t - t_0)/ε) \)”

Chapter 12

1. Page 474, Line 12 from the bottom: Change “contain” to “contains”
2. Page 482, Line 5: Change “\( K = \begin{bmatrix} K_1 & K_2 \end{bmatrix} \)” to “\( K = \begin{bmatrix} K_1 + K_3C & K_2 \end{bmatrix} \)”

3. Page 482, Line 15: Change “We note . . . \( K_3 = 0 \)” to “We note that in the stabilization of \((x_{ss}, u_{ss})\) we can take \( K_3 = 0 \)”

4. Page 483, Line before Equation (12.24): Change “\( \rho_3 \)” to “\( \rho_2 \)”

5. Page 484, First line after the figure: Change “feedback” to “feedback”

6. Page 490, Line 10: Change “\( v = \alpha \)” to “\( \rho = \alpha \)”

7. Page 492, Line 22: Change “from \( \psi \) to \( u \)” to “from \( \psi \) to \( u - M_3(\alpha)e \)”

8. Page 495, second line after (12.57): Change “initated” to “initiated”

Chapter 13

1. Page 517, Line 5 from the bottom: Change “reduces” to “reduces to”

2. Page 527, Line 8 from the bottom: Change “\( \text{span}(g, ad_f g, ad_f^2 g) \)” to “\( \text{span}(g, ad_f g, ad_f^2 g) \)”

3. Page 533, five lines before Example 13.17: Change “\( \dot{\xi} = f_0(\eta, \xi) \)” to “\( \dot{\eta} = f_0(\eta, \xi) \)”

4. Page 535, Line 13: Change “Chapter 10” to “Chapter 9”

Chapter 14

1. Page 553, Line 5: It should be noted that \( u = -\beta(x)\text{sgn}(s) \) is used only for \( s \neq 0 \) since in ideal sliding mode control \( u \) is not defined on the sliding surface \( s = 0 \). Alternatively, we can write \( u = -\beta(x)\text{sgn}(s) \) for all \( s \) if \( \text{sgn}(s) \) is not defined at \( s = 0 \). The same remark applies throughout the chapter to ideal sliding mode control.

2. Page 553, Line 10: Change “\( W = \sqrt{V} \)” to “\( W = \sqrt{2V} \)”

3. Page 553, Line 15: Change “\( \dot{V} \leq -2g_0\beta_0|s| \)” to “\( \dot{V} \leq -g_0\beta_0|s| \)”

4. Page 562, Line 2 from the bottom: Change “\( A_0P_0^T \)” to “\( A_0^T P_0 \)”


7. Page 573, last line and Page 574, Lines 4, 7, and 9 from the bottom: Change “\( \gamma(\rho) \)” to “\( \gamma(\rho) \)”

8. Page 575, Line 7: Change “exists” to “exists”

9. Page 577, Line 10: Change “\( L_f^0(x) \)” to “\( L_f^0 h(x) \)”

10. Page 578: To show the inequality satisfied by \( \dot{V}_0 \), we need the additional condition:
    \[
    \left| \frac{\Delta(x_{ss}, v_1, w, r) - \Delta(x_{ss}, v_2, w, r)}{L_g L_f^{-1} h(x_{ss}, w)} \right| \leq \ell|v_1 - v_2|, \quad 0 \leq \ell < 1
    \]
    for all \((v_1, v_2, w, r) \in R \times R \times D_w \times D_r\).

11. Page 587, Line 9: Change “\( k_0 = \)” to “\( k_0 \geq \)” and “\( k = \)” to “\( k \geq \)”

12. Page 596, Lines 3 and 4: Change “\( \phi \)” to “\( \phi_0 \)”

13. Page 596, three lines above Example 14.10: Change “\( \phi_2 \)” to “\( \phi_1 \)”

14. Page 610, Last equation: Change “\( k\zeta \)” to “\( k\xi \)”
15. Page 611, Line 14: Change “designing $C$” to “designing $H$”
16. Page 622, Theorem 14.6: In the fourth bullet of the theorem add the requirement that $f(\mathcal{X})$ is continuously differentiable in some neighborhood of $\mathcal{X} = 0$.
17. Page 625, Line 18: Change “$e_p$” to “$\hat{e}_p$”
18. Page 644, Exercise 14.56(d): Change the units of $I$ from “Kg/m²” to “Kg m²”

**Appendix**

1. Page 662, Line 14: Change “If $D = \mathbb{R}^n$, ” to “If $D = \mathbb{R}^n$ and $V(x)$ is radially unbounded,”
2. Page 662, Line 18: Change “If $V(x)$” to “Because $V(x)$”
3. Page 665: Change the second and third lines to
   \[
   \|x(t)\| \leq \min\{\alpha(\|x(t_0)\|), U_r(t - t_0)\}, \quad \forall t \geq t_0, \quad \forall \|x(t_0)\| < r
   \]
   Thus, inequality (4.20) is satisfied with $\beta(r, s) = \min\{\alpha(r), U_r(s)\}$.
4. Page 693: Replace lines 18 to 24 (starting with “This expression . . . ” and ending with “. . . parameterized in $\eta$.”) by the following: This expression is valid for any $t \in R$. The limit of the integral term as $t \to -\infty$ is
   \[
   \int_{-\infty}^{0} \exp(-Bs)G(\pi(s; y(\tau), \eta), \eta(\pi(s; y(\tau), \eta))) \, ds
   \]
   which is well defined because $\eta$ is bounded, $G$ is globally bounded in $\pi$, and $B$ is Hurwitz. Let us rewrite the expression (C.60) with $y(\tau)$ replaced by $y$ and denote it by $(P\eta)(y)$.
   \[
   (P\eta)(y) = \int_{-\infty}^{0} \exp(-Bs)G(\pi(s; y, \eta), \eta(\pi(s; y, \eta))) \, ds
   \]
   With this definition, we can write
   \[
   \exp[B(t - \tau)][z(\tau) - (P\eta)(y(\tau))] = z(t) - \int_{-\infty}^{t} \exp[-B(s - t + \tau)]G(\pi(s; y(\tau), \eta), \eta(\pi(s; y(\tau), \eta))) \, ds
   \]
   Substituting $\xi = s - t + \tau$ in the integral and using $\pi(\xi + t - \tau; y(\tau), \eta) = \pi(\xi; y(t), \eta)$, we obtain
   \[
   \exp[B(t - \tau)][z(\tau) - (P\eta)(y(\tau))] = z(t) - (P\eta)(y(t))
   \]
   which shows that if $z(\tau) = (P\eta)(y(\tau))$, then $z(t) = (P\eta)(y(t))$ for all $t \in R$. Hence, $z = (P\eta)(y)$ defines an invariant manifold for (C.58)–(C.59) parameterized in $\eta$.
5. Page 695, Line 2: Change “, $\eta(\pi(t; y, \eta)))$” to “, $\eta(\pi(t; y, \eta)))$”
6. Page 698, Equation (C.66): Change “$A_1 \pm$” to “$A_1 y +$”
7. Page 716, Lines 17 and 18: Change “$U(x)$” to “$U(\mathcal{X})$”

**Bibliography**

1. Page 725, Ref.[9]: Change “Anstaklis” to “Antsaklis”

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2This change was suggested by Professor E. Sontag because $U_r(s)$ is infinite at $s = 0$.
3The need for this change in the proof was pointed out by Professor H. Shim. The original proof implicitly used $\lim_{t \to -\infty} \exp[-B(t - \tau)]z(t) = 0$, which cannot be guaranteed at this point in the proof because we cannot guarantee that $z(t)$ is bounded as $t \to -\infty$. 

5


4. Page 737, Ref.[185]: Change “tracking” to “torque”

Index

1. Page 744, Feedback Passivation: Change “607” to “606”

In the third print of the book, a new typo appeared on page 553, line 13: Change “dotV” to “\dot{V}”