Errata

Chapter 1

p. 23, (1.2.17) initial value of the Z-transform:

$$\lim_{k\to 0} f(kT_s) = \lim_{z\to\infty} \frac{z-1}{z} F(z)$$

$\rightarrow$

$$\lim_{k\to 0} f(kT_s) = \lim_{z\to\infty} F(z)$$

p. 27_3 added material:

$$f(kT_{s)} = \frac{5}{3}\left(1 - e^{-0.916k}\right), \qquad k = 0, 1, 2, \ldots$$

change for

$$f(kT_{s)} = \frac{5}{3}\left(1 - e^{-0.916k}\right) = \frac{5}{3}\left(1 - \left(\frac{2}{5}\right)^k\right), \qquad k = 0, 1, 2, \ldots$$

p. 30, (1.4.6) delete $q^{-d}()$:

$$B(q^{-1}) = q^{-d}(b_1 q^{-1} + b_2 q^{-2} + \cdots + b_m q^{-m})$$

change for

$$B(q^{-1}) = b_1 q^{-1} + b_2 q^{-2} + \cdots + b_m q^{-m}$$

p. 29-30 errors is discretisation $T_s + 2$ change for $T_s + 1$

$$G(s) = \frac{Z_2}{(T_1 s + 1)(T_2 s + 2)}, \qquad T_1 \neq T_2$$

change for

$$G(s) = \frac{Z_2}{(T_1 s + 1)(T_2 s + 1)}, \qquad T_1 \neq T_2$$

4 changes in b_1, b_2, a_1, a_2:

$$\begin{aligned}
b_1 &= Z_2 T_1 T_2 \left[-\left(e^{-\frac{T_s}{T_1}} + e^{-\frac{T_s}{T_2}}\right) - \frac{T_1(1 + e^{-\frac{T_s}{T_2}})}{T_2 - T_1} + \frac{T_2(1 + e^{-\frac{T_s}{T_1}})}{T_2 - T_1} \right] \\
b_2 &= Z_2 T_1 T_2 \left[e^{-\frac{T_s}{T_1}} e^{-\frac{T_s}{T_2}} + \frac{T_1 e^{-\frac{T_s}{T_2}}}{T_2 - T_1} - \frac{T_2 e^{-\frac{T_s}{T_1}}}{T_2 - T_1} \right] \\
a_1 &= -\left(e^{-\frac{T_s}{T_1}} + e^{-\frac{T_s}{T_1}}\right) \\
a_2 &= e^{-\frac{T_s}{T_1}} e^{-\frac{T_s}{T_1}}
\end{aligned}$$

change for

$$\begin{aligned}
b_1 &= Z_2\left[-\left(e^{-\frac{T_s}{T_1}}+e^{-\frac{T_s}{T_2}}\right)-\frac{T_1(1+e^{-\frac{T_s}{T_2}})}{T_2-T_1}+\frac{T_2(1+e^{-\frac{T_s}{T_1}})}{T_2-T_1}\right]\\
b_2 &= Z_2\left[e^{-\frac{T_s}{T_1}}e^{-\frac{T_s}{T_2}}+\frac{T_1e^{-\frac{T_s}{T_2}}}{T_2-T_1}-\frac{T_2e^{-\frac{T_s}{T_1}}}{T_2-T_1}\right]\\
a_1 &= -\left(e^{-\frac{T_s}{T_1}}+e^{-\frac{T_s}{T_2}}\right)\\
a_2 &= e^{-\frac{T_s}{T_1}}e^{-\frac{T_s}{T_2}}
\end{aligned}$$

p. 35, (1.5.39) typo: change $\boldsymbol{B}$ to $\boldsymbol{\Gamma}$

$$= \boldsymbol{\Phi}^2\boldsymbol{x}(0)+\boldsymbol{\Phi\Gamma u}(0)+\boldsymbol{Bu}(1)$$

$\rightarrow$

$$= \boldsymbol{\Phi}^2\boldsymbol{x}(0)+\boldsymbol{\Phi\Gamma u}(0)+\boldsymbol{\Gamma u}(1)$$

Chapter 3

p. 75, Fig. 3.1.1 Actuator should be a part of process

p. 84, (3.3.14) log $\rightarrow$ ln:

$$T_\epsilon \approx \frac{\ln\left(p\sqrt{1-\zeta^2}\right)}{\zeta\omega_0}$$

p. 84, (3.3.15) missing division in expression for maximum overshoot:

$$e_{\max} = e^{-\pi\zeta\sqrt{1-\zeta^2}} = \sqrt{\zeta_d}$$

$\rightarrow$

$$e_{\max} = e^{-\pi\zeta/\sqrt{1-\zeta^2}} = \sqrt{\zeta_d}$$

Chapter 4

p. 115_7 typo: change Hamiltonian function to Hamilton function

p. 126, Fig. 4.2.3 superfluous ... after second exchanger

p. 134, (4.3.20) superfluous (t_f):

$$\boldsymbol{\gamma}(t_f) = \boldsymbol{C}^T(t_f)\boldsymbol{Q}_{yt_f}\boldsymbol{w}(t_f)$$

change for

$$\boldsymbol{\gamma}(t_f) = \boldsymbol{C}^T\boldsymbol{Q}_{yt_f}\boldsymbol{w}(t_f)$$

p. 137 typo: sufficent → sufficient

p. 145, (4.5.11)–(4.5.13) change $\boldsymbol{\xi}_0(t)$ to $\boldsymbol{\xi}_x(t)$:

$$\dot{\boldsymbol{x}}(t) = \boldsymbol{A}\boldsymbol{x}(t) + \boldsymbol{\xi}_0(t)$$

where $\boldsymbol{\xi}_0(t)$ is n-dimensional stochastic process vector. We assume that the processes have properties of a Gaussian noise

$$\begin{aligned} E\{\boldsymbol{\xi}_0(t)\} &= \boldsymbol{0} \\ \operatorname{Cov}(\boldsymbol{\xi}_0(t), \boldsymbol{\xi}_0(\tau)) &= E\left\{\boldsymbol{\xi}_0(t)\boldsymbol{\xi}_0^T(\tau)\right\} = \boldsymbol{V}\delta(t-\tau) \end{aligned}$$

change for

$$\dot{\boldsymbol{x}}(t) = \boldsymbol{A}\boldsymbol{x}(t) + \boldsymbol{\xi}_x(t)$$

where $\boldsymbol{\xi}_x(t)$ is n-dimensional stochastic process vector. We assume that the processes have properties of a Gaussian noise

$$\begin{aligned} E\{\boldsymbol{\xi}_x(t)\} &= \boldsymbol{0} \\ \operatorname{Cov}(\boldsymbol{\xi}_x(t), \boldsymbol{\xi}_x(\tau)) &= E\left\{\boldsymbol{\xi}_x(t)\boldsymbol{\xi}_x^T(\tau)\right\} = \boldsymbol{V}\delta(t-\tau) \end{aligned}$$

p. 147, (4.5.27) wrong sign

$$\boldsymbol{x}(0) = \bar{\boldsymbol{x}}_0 + \boldsymbol{N}_0\boldsymbol{\lambda}(0)$$

→

$$\boldsymbol{x}(0) = \bar{\boldsymbol{x}}_0 - \boldsymbol{N}_0\boldsymbol{\lambda}(0)$$

p. 148, (4.5.34), (4.5.35), (4.5.38) missing transpose

$$\begin{aligned} &\dot{\boldsymbol{z}}(t) - \dot{\boldsymbol{N}}(t)\boldsymbol{\lambda}(t) \\ &\quad - \boldsymbol{N}(t)\left[\boldsymbol{C}^T\boldsymbol{S}^{-1}\boldsymbol{y}(t) - \boldsymbol{C}\boldsymbol{S}^{-1}\boldsymbol{C}\left(\boldsymbol{z}(t) - \boldsymbol{N}(t)\boldsymbol{\lambda}(t)\right) - \boldsymbol{A}^T\boldsymbol{\lambda}(t)\right] \\ &\qquad\qquad = \boldsymbol{A}\left[\boldsymbol{z}(t) - \boldsymbol{N}(t)\boldsymbol{\lambda}(t)\right] - \boldsymbol{V}\boldsymbol{\lambda}(t) \end{aligned}$$

$$\dot{\boldsymbol{z}}(t) - \boldsymbol{N}(t)\boldsymbol{C}^T\boldsymbol{S}^{-1}\left(\boldsymbol{y}(t) - \boldsymbol{C}\boldsymbol{z}(t)\right) - \boldsymbol{A}\boldsymbol{z}(t)$$
$$= \left[\dot{\boldsymbol{N}}(t) - \boldsymbol{N}(t)\boldsymbol{A}^T - \boldsymbol{A}\boldsymbol{N}(t) + \boldsymbol{N}(t)\boldsymbol{C}\boldsymbol{S}^{-1}\boldsymbol{C}\boldsymbol{N}(t) - \boldsymbol{V}\right]\boldsymbol{\lambda}(t)$$

$$\boldsymbol{V} = \dot{\boldsymbol{N}}(t) - \boldsymbol{N}(t)\boldsymbol{A}^T - \boldsymbol{A}\boldsymbol{N}(t) + \boldsymbol{N}(t)\boldsymbol{C}\boldsymbol{S}^{-1}\boldsymbol{C}\boldsymbol{N}(t)$$

$\rightarrow$

$$\dot{\boldsymbol{z}}(t) - \dot{\boldsymbol{N}}(t)\boldsymbol{\lambda}(t)$$
$$- \boldsymbol{N}(t)\left[\boldsymbol{C}^T\boldsymbol{S}^{-1}\boldsymbol{y}(t) - \boldsymbol{C}^T\boldsymbol{S}^{-1}\boldsymbol{C}\left(\boldsymbol{z}(t) - \boldsymbol{N}(t)\boldsymbol{\lambda}(t)\right) - \boldsymbol{A}^T\boldsymbol{\lambda}(t)\right]$$
$$= \boldsymbol{A}\left[\boldsymbol{z}(t) - \boldsymbol{N}(t)\boldsymbol{\lambda}(t)\right] - \boldsymbol{V}\boldsymbol{\lambda}(t)$$

$$\dot{\boldsymbol{z}}(t) - \boldsymbol{N}(t)\boldsymbol{C}^T\boldsymbol{S}^{-1}\left(\boldsymbol{y}(t) - \boldsymbol{C}\boldsymbol{z}(t)\right) - \boldsymbol{A}\boldsymbol{z}(t)$$
$$= \left[\dot{\boldsymbol{N}}(t) - \boldsymbol{N}(t)\boldsymbol{A}^T - \boldsymbol{A}\boldsymbol{N}(t) + \boldsymbol{N}(t)\boldsymbol{C}^T\boldsymbol{S}^{-1}\boldsymbol{C}\boldsymbol{N}(t) - \boldsymbol{V}\right]\boldsymbol{\lambda}(t)$$

$$\boldsymbol{V} = \dot{\boldsymbol{N}}(t) - \boldsymbol{N}(t)\boldsymbol{A}^T - \boldsymbol{A}\boldsymbol{N}(t) + \boldsymbol{N}(t)\boldsymbol{C}^T\boldsymbol{S}^{-1}\boldsymbol{C}\boldsymbol{N}(t)$$

p. 150, (4.6.5) typo CL $\rightarrow$ LC

$$\begin{pmatrix}\dot{\boldsymbol{x}}(t)\\ \dot{\boldsymbol{e}}(t)\end{pmatrix} = \begin{pmatrix}\boldsymbol{A}-\boldsymbol{B}\boldsymbol{K} & \boldsymbol{B}\boldsymbol{K}\\ \boldsymbol{0} & \boldsymbol{A}-\boldsymbol{C}\boldsymbol{L}\end{pmatrix}\begin{pmatrix}\boldsymbol{x}(t)\\ \boldsymbol{e}(t)\end{pmatrix} + \begin{pmatrix}\boldsymbol{B}\\ \boldsymbol{0}\end{pmatrix}\tilde{\boldsymbol{w}}(t),$$

$\rightarrow$

$$\begin{pmatrix}\dot{\boldsymbol{x}}(t)\\ \dot{\boldsymbol{e}}(t)\end{pmatrix} = \begin{pmatrix}\boldsymbol{A}-\boldsymbol{B}\boldsymbol{K} & \boldsymbol{B}\boldsymbol{K}\\ \boldsymbol{0} & \boldsymbol{A}-\boldsymbol{L}\boldsymbol{C}\end{pmatrix}\begin{pmatrix}\boldsymbol{x}(t)\\ \boldsymbol{e}(t)\end{pmatrix} + \begin{pmatrix}\boldsymbol{B}\\ \boldsymbol{0}\end{pmatrix}\tilde{\boldsymbol{w}}(t),$$

p. 156, Fig. 4.6.5 typo: change: $p(s)/o(s) \rightarrow q(s)/o(s)$

p. 358, (4.6.75) typo: delete minus sign

$$u = -\frac{q(s)}{p(s)}(w - y)$$

$\rightarrow$

$$u = \frac{q(s)}{p(s)}(w - y)$$

p. 181, (4.7.51) typo: sign change $- \rightarrow +$

$$\boldsymbol{R}(s) = (\tilde{\boldsymbol{X}}_L(s) - \tilde{\boldsymbol{T}}(s)\tilde{\boldsymbol{B}}_L(s))^{-1}(\tilde{\boldsymbol{Y}}_L(s) - \tilde{\boldsymbol{T}}(s)\tilde{\boldsymbol{A}}_L(s))$$

change for

$$\boldsymbol{R}(s) = (\tilde{\boldsymbol{X}}_L(s) - \tilde{\boldsymbol{T}}(s)\tilde{\boldsymbol{B}}_L(s))^{-1}(\tilde{\boldsymbol{Y}}_L(s) + \tilde{\boldsymbol{T}}(s)\tilde{\boldsymbol{A}}_L(s))$$

p. 185_{16} typo: same situation is for he → same situation is for the

p. 185^{11} typo: delete exclamation mark

p. 191_{16} typo below (4.8.41): matrix → equation: To find such a matrix, we will transform the Riccati matrix as follows → To find such a matrix, we will transform the Riccati equation as follows

p. 198, (4.10.13) : missing transposition: $\boldsymbol{D}_{12}\boldsymbol{C}_1 \to \boldsymbol{D}_{12}^T\boldsymbol{C}_1$

p. 198_4 : forgotten right parenthesis: (4.10.14 → (4.10.14)

Chapter 5

replaced all occurences of $t+$ to $k+$, for example $y(t+1) \to y(k+1)$

p. 209, (5.3.20) missing formula with this number – deleted number.

p. 212, (5.3.40) missing term:

$$= \quad C\frac{A\Delta + \sum_{j=N_1}^{N_2} k_j z^{j-1}(B - G_j)}{\sum_{j=N_1}^{N_2} k_j}$$

change for

$$= \quad C\frac{A\Delta + \sum_{j=N_1}^{N_2} k_j z^{j-1}(B - A\Delta G_j)}{\sum_{j=N_1}^{N_2} k_j}$$

p. 213, (5.3.53), (5.3.54) matrix $\bar{C}$ must be inside:

$$\boldsymbol{G} = \bar{\boldsymbol{C}} \begin{pmatrix} \bar{\boldsymbol{B}} & \boldsymbol{0} & \dots & \dots & \boldsymbol{0} \\ \bar{\boldsymbol{A}}\bar{\boldsymbol{B}} & \bar{\boldsymbol{B}} & \boldsymbol{0} & \dots & \boldsymbol{0} \\ \vdots & & \ddots & \ddots & \vdots \\ \vdots & & & \bar{\boldsymbol{B}} & \boldsymbol{0} \\ \bar{\boldsymbol{A}}^{N_2-1}\bar{\boldsymbol{B}} & \dots & & \dots & \bar{\boldsymbol{B}} \end{pmatrix}$$

and

$$\boldsymbol{y}_0 = \bar{\boldsymbol{C}} \begin{pmatrix} \bar{\boldsymbol{A}} \\ \bar{\boldsymbol{A}}^2 \\ \vdots \\ \bar{\boldsymbol{A}}^{N_2} \end{pmatrix} \bar{\boldsymbol{x}}(k)$$

change for

$$
\boldsymbol{G} = \begin{pmatrix}
\bar{\boldsymbol{C}}\bar{\boldsymbol{B}} & \mathbf{0} & \dots & \dots & \mathbf{0} \\
\bar{\boldsymbol{C}}\bar{\boldsymbol{A}}\bar{\boldsymbol{B}} & \bar{\boldsymbol{C}}\bar{\boldsymbol{B}} & \mathbf{0} & \dots & \mathbf{0} \\
\vdots & & \ddots & \ddots & \vdots \\
\vdots & & & \bar{\boldsymbol{C}}\bar{\boldsymbol{B}} & \mathbf{0} \\
\bar{\boldsymbol{C}}\bar{\boldsymbol{A}}^{N_2-1}\bar{\boldsymbol{B}} & \dots & & \dots & \bar{\boldsymbol{C}}\bar{\boldsymbol{B}}
\end{pmatrix}
$$

and

$$
\boldsymbol{y}_0 = \begin{pmatrix}
\bar{\boldsymbol{C}}\bar{\boldsymbol{A}} \\
\bar{\boldsymbol{C}}\bar{\boldsymbol{A}}^2 \\
\vdots \\
\bar{\boldsymbol{C}}\bar{\boldsymbol{A}}^{N_2}
\end{pmatrix} \bar{\boldsymbol{x}}(k)
$$

p. 216, (5.3.61) untranslated word from Slovak: inak → otherwise

$$
\bar{u}(k-i+j) = \begin{cases} u_f(k-1) & j \geq i \\ u_f(k-i+j) & \text{inak} \end{cases}
$$

→

$$
\bar{u}(k-i+j) = \begin{cases} u_f(k-1) & j \geq i \\ u_f(k-i+j) & \text{otherwise} \end{cases}
$$

p. 221, (5.5.8) added reference to the matrix inversion lemma, incorrect sign in the element (2,2) of the inverse matrix, matrices are not bold:

The block matrix inversion formula states

$$
\begin{pmatrix} A^{-1} & D \\ C & B \end{pmatrix}^{-1} = \begin{pmatrix} A + AD\Delta CA & -AD\Delta \\ -\Delta CA & -\Delta \end{pmatrix}, \quad \Delta^{-1} = B - CAD
$$

change for

The block matrix inversion formula states (see its proof of Lemma 2.3.1 on page 58)

$$
\begin{pmatrix} \boldsymbol{A}^{-1} & \boldsymbol{D} \\ \boldsymbol{C} & \boldsymbol{B} \end{pmatrix}^{-1} = \begin{pmatrix} \boldsymbol{A} + \boldsymbol{A}\boldsymbol{D}\boldsymbol{\Delta}\boldsymbol{C}\boldsymbol{A} & -\boldsymbol{A}\boldsymbol{D}\boldsymbol{\Delta} \\ -\boldsymbol{\Delta}\boldsymbol{C}\boldsymbol{A} & \boldsymbol{\Delta} \end{pmatrix}, \quad \boldsymbol{\Delta}^{-1} = \boldsymbol{B} - \boldsymbol{C}\boldsymbol{A}\boldsymbol{D}
$$

p. 224[13] typo: matrix $\boldsymbol{W}$ is not bold.

p. 229, Fig. 5.7.1 typo: N_1 change for N_2.

Chapter 6

p. 237, (6.3.1) typo in numerator of transfer function

$$G(s) = \frac{b_{s1}s + a_{s0}}{a_{s2}s^2 + a_{s1}s + 1}$$

$\rightarrow$

$$G(s) = \frac{b_{s1}s + b_{s0}}{a_{s2}s^2 + a_{s1}s + 1}$$