Process Modelling, Identification, and Control – Errata

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Errata

Chapter 2

p. 18, **(2.22)** typo $F_1 \to F_2$:

$$\begin{aligned}\frac{\mathrm{d}h_1}{\mathrm{d}t} &= \frac{q_0}{F_1} - \frac{k_{11}}{F_1}\sqrt{h_1 - h_2}\\ \frac{\mathrm{d}h_2}{\mathrm{d}t} &= \frac{k_{11}}{F_1}\sqrt{h_1 - h_2} - \frac{k_{22}}{F_2}\sqrt{h_2}\end{aligned}$$

$\to$

$$\begin{aligned}\frac{\mathrm{d}h_1}{\mathrm{d}t} &= \frac{q_0}{F_1} - \frac{k_{11}}{F_1}\sqrt{h_1 - h_2}\\ \frac{\mathrm{d}h_2}{\mathrm{d}t} &= \frac{k_{11}}{F_2}\sqrt{h_1 - h_2} - \frac{k_{22}}{F_2}\sqrt{h_2}\end{aligned}$$

Chapter 3

p. 55_5 wrong sign $- \to +$:

$$= \frac{1}{2j}\left[\frac{\mathrm{e}^{-(s-j\omega)t}}{-(s-j\omega)}\right]_0^\infty + \frac{1}{2j}\left[\frac{\mathrm{e}^{-(s+j\omega)t}}{-(s+j\omega)}\right]_0^\infty$$

$\to$

$$= \frac{1}{2j}\left[\frac{\mathrm{e}^{-(s-j\omega)t}}{-(s-j\omega)}\right]_0^\infty - \frac{1}{2j}\left[\frac{\mathrm{e}^{-(s+j\omega)t}}{-(s+j\omega)}\right]_0^\infty$$

Chapter 4

p. 135$_{13}$ incorrect reference to equation: Substracting (4.58) from $\to$ Substracting (4.59) from

p. 153, (4.3.11) missing j in denominator

$$y(t) = Z_1 A_1\left[\frac{-\omega T_1}{(\omega^2 T_1^2 + 1)}\frac{\mathrm{e}^{-\mathrm{j}\omega t} + \mathrm{e}^{\mathrm{j}\omega t}}{2} + \frac{1}{(\omega^2 T_1^2 + 1)}\frac{\mathrm{e}^{\mathrm{j}\omega t} - \mathrm{e}^{-\mathrm{j}\omega t}}{2}\right]$$

$\to$

$$y(t) = Z_1 A_1\left[\frac{-\omega T_1}{(\omega^2 T_1^2 + 1)}\frac{\mathrm{e}^{-\mathrm{j}\omega t} + \mathrm{e}^{\mathrm{j}\omega t}}{2} + \frac{1}{(\omega^2 T_1^2 + 1)}\frac{\mathrm{e}^{\mathrm{j}\omega t} - \mathrm{e}^{-\mathrm{j}\omega t}}{2j}\right]$$

Chapter 5

p. 197, (5.36) initial value of the Z-transform:

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

→

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

p. 210, (5.120) typo: change $\boldsymbol{B}$ to $\boldsymbol{\Gamma}$

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

→

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

Chapter 7

p. 265, (7.29) log → ln:

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

p. 265, (7.30) missing division in expression for maximum overshoot:

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

→

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

p. 272, Fig. 7.12 Remove setpoint w from legend untranslated string: Regulator → Contro

p. 289, Table 7.2, Table 7.3 untranslated string: Regulator → Controller

p. 2904_7 typo, tume → time

Chapter 8

p. 327^6 typo, sufficent → sufficient

p. 338, (8.236) 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. 338, (8.243), (8.244), (8.246) missing transpose

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

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

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

$\rightarrow$

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

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

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

p. 342, (8.264) 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. 349, Fig. 8.17 typo: change: $p(s)/o(s) \rightarrow q(s)/o(s)$

p. 350, (8.334) typo: delete minus sign

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

$\rightarrow$

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

Chapter 9

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

p. 417, eq. (9.74) 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. 427, eq. (9.109a) corrected 1/2 in cost function:

$$I^*(\boldsymbol{x}_0) = \boldsymbol{x}_0^T \boldsymbol{Y} \boldsymbol{x}_0 + \min_{\boldsymbol{U}_N} \frac{1}{2} \left\{ \boldsymbol{U}_N^T \boldsymbol{H} \boldsymbol{U}_N + \boldsymbol{x}_0^T \boldsymbol{F} \boldsymbol{U}_N \right\}$$
$$\text{subj. to } \boldsymbol{G}\boldsymbol{U}_N \leq \boldsymbol{W} + \boldsymbol{E}\boldsymbol{x}_0$$

→

$$I^*(\boldsymbol{x}_0) = \frac{1}{2} \boldsymbol{x}_0^T \boldsymbol{Y} \boldsymbol{x}_0 + \min_{\boldsymbol{U}_N} \left\{ \frac{1}{2} \boldsymbol{U}_N^T \boldsymbol{H} \boldsymbol{U}_N + \boldsymbol{x}_0^T \boldsymbol{F} \boldsymbol{U}_N \right\}$$
$$\text{subj. to } \boldsymbol{G}\boldsymbol{U}_N \leq \boldsymbol{W} + \boldsymbol{E}\boldsymbol{x}_0$$

p. 428, eq. (9.111) corrected cost function:

$$I^*(\boldsymbol{x}_0) = \min_{\boldsymbol{z}} \frac{1}{2} \left\{ \boldsymbol{z}^T \boldsymbol{H} \boldsymbol{z} \right\}$$
$$\text{subj. to } \boldsymbol{G}\boldsymbol{z} \leq \boldsymbol{W} + \boldsymbol{S}\boldsymbol{x}_0$$

where $\boldsymbol{S} = \boldsymbol{E} + \boldsymbol{G}\boldsymbol{H}^{-1}\boldsymbol{F}^T$.

→

$$I_z^*(\boldsymbol{x}_0) = \min_{\boldsymbol{z}} \frac{1}{2} \left\{ \boldsymbol{z}^T \boldsymbol{H} \boldsymbol{z} \right\}$$
$$\text{subj. to } \boldsymbol{G}\boldsymbol{z} \leq \boldsymbol{W} + \boldsymbol{S}\boldsymbol{x}_0$$

where $\boldsymbol{S} = \boldsymbol{E} + \boldsymbol{G}\boldsymbol{H}^{-1}\boldsymbol{F}^T$ and $I_z^*(\boldsymbol{x}_0) = I^*(\boldsymbol{x}_0) - \boldsymbol{x}_0^T(\boldsymbol{Y} - 1/2\boldsymbol{F}\boldsymbol{H}^{-1}\boldsymbol{F}^T)\boldsymbol{x}_0$.

p. 429[14] typo, repeated word: the the

Chapter 10

p. 448, (10.1) typo in numerator of transfer function

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

→

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