Errata to (2000 printing)
Adaptive filtering and change detection
010821

This is a list of the essential errors in the *first* printing, 2000. These are corrected in the 2001 printing.

Page 9 Equation (1.2) should be $\hat{\theta}_t = \hat{\theta}_{t-1} + (1-\lambda_t)\varepsilon_t$ to be consistent with *e.g.* (3.12).

Pages 60-61 Sections 3.3.1-3.3.2 use incorrect scalings of variances P_t. These should be

$$P_t = \frac{1}{t^2}\sum_{i=1}^{t} R = R/t,$$
$$P_t = \frac{1-\lambda}{1-\lambda^t}\frac{1+\lambda^t}{1+\lambda}R,$$
$$\hat{P}_t = \left(\frac{1-\lambda}{1-\lambda^t}\right)^2 \frac{1+\lambda^t}{1+\lambda}V_t(\hat{\theta}),$$
$$P_t = \frac{1}{L^2}\sum_{i=1}^{t} R = R/L,$$

respectively.

Page 62 Equations (3.14)–(3.15) have time shifted parameter estimate. Should be

$$\hat{\theta}_t = \hat{\theta}_{t-1} - \mu\frac{1}{2}\left.\frac{dV_t(\theta)}{d\theta}\right|_{\theta=\hat{\theta}_{t-1}},$$
$$\hat{\theta}_t = \hat{\theta}_{t-1} + \mu\varepsilon_t$$

to be consistent with other forms.

Page 64 σ^2 should be P_t in (3.23).

Page 65 s_t instead of y_t in (3.24)a dn (3.27) is more consequent.

Page 75 In the example, 500 data are used, not 50.

Page 77 In (3.48), minus should be plus in the sum.

Page 85 and 86 On row 4 on page 85 and row 2 on page 86, σ should be V.

Page 85, 225 and 259 Stirling's formula in Equation (3.57) should be

$$\Gamma(n+1) \approx \sqrt{2\pi}n^{n+1/2}e^{-n}.$$

Page 87 Equation (3.62) should be

$$g_t^{GLR}(k) = \max_{\nu} 2 \log \frac{p(y^t|H_1(k,\nu))}{p(y^t|H_0)}$$

Page 90 The max should be min in the expression

$$\widehat{k^n} = \arg \min_{n \geq 1, 0 < k_1 < \cdots < k_n = N} V(k^n).$$

Page 104 On line 3, $U > h$ should be $g > h$.

Page 122 Equation (5.32) should be

$$V(\theta) = \sum_{k=1}^{t} \varepsilon_k^2(\theta).$$

Page 133 Reference to Figure 5.11 should be 5.9.

Page 138 $P_t \neq \operatorname{Cov} \hat{\theta}$ for RLS. This implies that two occurences of the word covariance matrix on page 138-139 should be replaced by just P_t and P_0 respectively.

Page 140 On the first row, reference to Equation (5.29) should be to (5.30).

Page 143 As a note to the NLMS interpretation: let $\alpha = 1/\mu$ in (5.39). Admittedly, this is a rather peculiar version of NLMS, which behaves as something in between LMS (step size μ^2) and NLMS (for large regressors).

Page 145 Equation (5.56) should be

$$M(t) = \frac{V_{ex}}{V_{min}} \to \bar{M}, \quad \text{as } t \to \infty.$$

Page 145 The first equation in Section 5.5.1 should be

$$\tilde{\theta}_t = (I - \mu \varphi_t \varphi_t^T)(\tilde{\theta}_{t-1} + v_{t-1}) - \mu \varphi_t e_t.$$

Page 145 On the second last line, ascending should be descending.

Page 147 The first equation in Section 5.5.2 should be

$$\tilde{\theta}_t = (I - (R_t^{\varphi})^{-1} \varphi_t \varphi_t^T)(\tilde{\theta}_{t-1} + v_{t-1}) - \mu \varphi_t e_t.$$

Page 149 Equation (5.63) should be

$$s_t = (\Delta\theta_t)^T \Delta\theta_{t-1} = \varepsilon_{t-1}^T K_{t-1}^T K_t \varepsilon_t$$

Page 160 In Figure 5.27, there should be a delay in one block: $q^{-D}D(q)$.

Page 175 On line 5, the measured slip should have a positive offset.

Page 199 On line 3, remove the factor $\frac{1}{2}$.

Page 190 Y_1 on the middle of the page should be Y_ε.

Page 191 The underbrace in Equation (5.88) should be

$$\begin{aligned}\hat{\theta}_t &= \underbrace{\left(\sum_{k=1}^{t} \varphi_k R_k^{-1} \varphi_k^T\right)}_{R_t^\varphi}^{-1} \underbrace{\sum_{k=1}^{t} \varphi_k R_k^{-1} y_k}_{f_t} \\ &= (R_t^\varphi)^{-1} f_t.\end{aligned}$$

Page 196 Equation (5.103) should be

$$\begin{aligned}p(y^N) = \textstyle\int_{-\infty}^{\infty} p(y^N|\theta)p(\theta)d\theta = (2\pi)^{-\frac{Np+d}{2}} (\det\Lambda)^{-\frac{1}{2}} (\det R_0^\varphi)^{+\frac{1}{2}} \\ \times \textstyle\int_{-\infty}^{\infty} \exp\left(-\frac{1}{2}\left((Y-\Phi^T\theta)^T\Lambda^{-1}(Y-\Phi^T\theta) + (\theta-\theta_0)^T R_0^\varphi(\theta-\theta_0)\right)\right) d\theta\end{aligned}$$

Page 197 The equation starting at the middle of the page should be (three errors in the exponents)

$$\begin{aligned}p(y^N) &= (2\pi)^{-\frac{Np}{2}} (\det\Lambda)^{-\frac{1}{2}} \left(\frac{\det R_0^\varphi}{\det R_0^\varphi + R_N^\varphi}\right)^{+\frac{1}{2}} \\ &\times \exp\left(-\frac{1}{2}\left((Y-\Phi^T\hat{\theta}_N)^T\Lambda^{-1}(Y-\Phi^T\hat{\theta}_N) + (\hat{\theta}_N-\theta_0)^T R_0^\varphi(\hat{\theta}_N-\theta_0)\right)\right) \\ &\times \int (2\pi)^{-\frac{d}{2}} (\det R_0^\varphi + R_N^\varphi)^{+\frac{1}{2}} \exp\left(-\frac{1}{2}\left(\theta-\hat{\theta}_N\right)^T (R_0^\varphi + R_N^\varphi)\left(\theta-\hat{\theta}_N\right)\right) d\theta \\ &= p(y^N|\hat{\theta}_N)\left(\frac{\det R_0^\varphi}{\det R_0^\varphi + R_N^\varphi}\right)^{1/2} \exp\left(-\frac{1}{2}(\hat{\theta}_N-\theta_0)^T R_0^\varphi(\hat{\theta}_N-\theta_0)\right) \\ &= p(y^N|\hat{\theta}_N)p_\theta(\hat{\theta}_N)\,(\det P_N)^{1/2}\,(2\pi)^{\frac{d}{2}}.\end{aligned}$$

p. 199 r3+: remove the factor 1/2

Page 216 The signal model on top of the page should be

$$y_k = \varphi_k^T(\theta - \theta_0) + e_k$$

Further, the distribution in the end of the example should be scaled with λ as

$$\eta_L(\theta_0) \in \text{AsN}\left(\frac{\lambda}{\sqrt{L}} P_L^{-1}(\hat{\theta}_L - \theta_0), \frac{\lambda^2}{L} P_L^{-1}\right).$$

Page 219 On line 5, $Y_0 = \Phi^T \theta_0$.

Page 219 The term $-\Phi^a \Delta\theta^a$ should be omitted, since it is already, implicitly, in Y.

Page 219

$$Q^a = \text{diag}(1, 0, 1, 0, \ldots, 1, 0) \Rightarrow V^a = Y^T Q^a Y = \sum_{i=t-L+1}^{t} (y_i^{(1)})^2$$

$$Q^b = \text{diag}(0, 1, 0, 1, \ldots, 0, 1) \Rightarrow V^b = Y^T Q^b Y = \sum_{i=t-L+1}^{t} (y_i^{(2)})^2.$$

should be

$$\Phi^a = (1, 0, 1, 0, \ldots, 1, 0) \Rightarrow V^a = Y^T Q^a Y = \frac{1}{L}\left(\sum_{i=t-L+1}^{t} y_i^{(1)}\right)^2$$

$$\Phi^b = (0, 1, 0, 1, \ldots, 0, 1) \Rightarrow V^b = Y^T Q^b Y = \frac{1}{L}\left(\sum_{i=t-L+1}^{t} y_i^{(2)}\right)^2.$$

Page 222 Equation (6.14) should be

$$V_j(\theta) = \sum_{k \in T_j} \left(y_k - \varphi_k^T \theta\right)^T (\lambda_j R_k)^{-1} \left(y_k - \varphi_k^T \theta\right),$$

p. 225 Stirlings formula is $\ldots n^{n+1/2} \ldots$

Page 232 Second equation should be

$$\widehat{k^n} = \arg \min_{n \geq 1, 0 < k_1 < \cdots < k_n = N} V(k^n).$$

p. 234 (7.4)-(7.6): $\lambda(i)$ is missing

Page 234 Equation (7.8) should be

$$N(i) = k_i - k_{i-1}.$$

Page 235 Equation on line 2 should be

$$p(e^N) = \prod_{i=1}^{n} \prod_{t=k_{i-1}+1}^{k_i} (2\pi\lambda(i))^{-p/2} (\det R_t)^{-1/2} \exp(-e_t^T R_t^{-1} e_t/(2\lambda(i))).$$

p. 235 (7.9): A + is missing after $\log\det R_t$.

p. 259 Stirlings formula is $\ldots n^{n+1/2} \ldots$

Page 272-273 The A matrix in Section 8.2.3 and Example 8.4 should be transposed to get the observer canonical form.

p.279 Equation (8.41) should be $\ldots + K_t y_t + (I - K_t C_t) \ldots$ instead of $\ldots + K_t y_t (I - K_t C_t) \ldots$

p.288 r11-: D^k instead of D^{k-1}

p. 304 (8.96): Include $+B_{u,t} u_t$.

Page 310 Line 15, reference to Section 8.9 instead of 5.5.

Page 344 Equation (9.3) should be

$$\bar{x}_{t+1} = \begin{pmatrix} x_{t+1} \\ \theta_{t+1} \end{pmatrix} = \begin{pmatrix} A_t & B_{\theta,t} \\ 0 & I \end{pmatrix} \bar{x}_t + \begin{pmatrix} B_{u,t} \\ 0 \end{pmatrix} u_t + \begin{pmatrix} B_{v,t} & \mathbf{B}_{\theta,\mathbf{k}} \\ 0 & I \end{pmatrix} \begin{pmatrix} v_t \\ \delta_{t-k}\nu \end{pmatrix}$$

Page 353 Lemma 9.1 should be clarified as follows: If (9.1) is time invariant and ν is unknown, then the GLR test in Algorithm 9.1 gives the same estimated change time as the MLR test in Theorem 9.8 as $N - k \to \infty$ and $k \to \infty$ if the threshold is chosen as

$$h = -p\log(2\pi) + \log\det \bar{R}_N(k) - 2\log p_\nu(\hat{\nu})$$

when the prior of the jump is $\nu \in \mathrm{N}(\nu_0, P_\nu)$, and

$$h = \log\det \bar{R}_N(k)$$

for a flat prior. Here $\bar{R}_N(k) = \lim_{N-k\to\infty, k\to\infty} R_N(k)$, and $R_N(k)$ is defined in Algorithm 9.1.

Page 353 Note that (3.48) follows with $p = 1$ and $R(k) = \sum_{t=k+1}^{N} 1^T R^{-1} 1 = (t-k)/R$.

Page 354 On line 3, it should be $l_N(k) = l_N(k, \nu(k)) + 2\log p_\nu(\hat{\nu}) - \log\det R_N(k) + p\log(2\pi)$.

Page 354 On line 9, it should be $h_{MLR} = h_{GLR} + 2\log p_\nu(\hat{\nu}) + p\log(2\pi) - \log\det \bar{R}_N(k)$.

Page 373 Note that (9.39) can be rewritten as

$$\begin{aligned} C_{prior}(k) &= -\log\det P_\nu - (\hat{\nu}_N(k) - \nu_0)^T P_\nu^{-1} (\hat{\nu}_N(k) - \nu_0) \\ &= 2\log p_\nu(\hat{\nu}) + p\log 2\pi \end{aligned}$$

∗**p. 374** r16+ etc.: All F means A and all H means C.

∗**p. 399** r5+,1-: $M(\delta)$ is S^N.

∗**p. 404** (11.5): f_t should be F_t

∗**p. 405** (11.8): $Tr_t = Tw^T H_f$...

∗**p. 409** Alg 11.1: r1 in the matlab code `Hv` should be `Hd`

∗**p. 410** r14+,14-: f_t should be F_t.

∗**p. 438** (12.10): $f(X|Y)$ is missing

∗**p. 444** r1+: increasing instead of decreasing

Page 453 The derivation of the Kalman filter using algebraic projections holds only for the scalar y case. In the general case, the scalar product needs to be redefined, and a new projection theorem derived.