First-edition Book Errata, Version 1.3

Preface

Page xxv

The statement

Video_Clips\TWS\Documents\Readme.PDF

should read as follows:

Part_2\Video_Clips_TWS\Documents\Readme.PDF

Page xxv

The statement

Video_Clips\TWS\Flights

should read as follows:

Video_Clips_TWS\Flights

Chapter 1

Page 2

The URL

http://goo.gl/DD82m

should read as follows:

http://tinyurl.com/ndw59la

Page 3

At the bottom of the page the statement

Video_Clips\TWS\Documents\Readme.PDF

should read as follows:

Part_2\Video_Clips_TWS\Documents\Readme.PDF

Page 3

At the bottom of the page the statement

Video_Clips\TWS\Flights

should read as follows:

Video_Clips_TWS\Flights

Page 9

The statement

the throughput of the next wave of computers similar to dwarf

should read as follows:

the throughput of the next wave of computers similarly to dwarf

Page 18

The item

$$\boldsymbol{X}^*_{t_n+1,\, t_n}$$

should read as follows:

$$\boldsymbol{X}^*_{t_{n+1},\, t_n}$$

Page 39

Footnote 13 should read as follows:

See References 106 – 110 and 157.

Page 40

The statement

with a (*1-Hz*) data rate

should read as follows:

with a *1-Hz* data rate

Page 40

The statement

In the down-loadable material there is a folder called ***Video_Clips***, in which you will find two sub-folders:

should read as follows:

In the down-loadable material there are two folders called ***Part_2*** and ***Part 3*** in which you will find sub-folders relating to ***Doppler*** and ***TWS***:

Page 41

The statement

Please include the words 'Tracking Filter' in the title of your email.

should read as follows:

Please include the words *Tracking Filter Engineering* in the title of your email.

Chapter 2

Page 60

In equation (2.2.1) each occurrence of the constant *c* should be replaced by *-c*

In the notes below equation (2.2.1) the statement $c = -\rho_0\alpha/2m$ should be replaced by $c = \rho_0\alpha/2m$

Page 71

The final three lines currently reads as follows:

However,

$$exp(t\boldsymbol{A})exp(t\boldsymbol{B}) = exp\big(t(\boldsymbol{A}+\boldsymbol{B})\big) \tag{2.4.5}$$

if and only if ***A*** and ***B*** commute. ■■

Those lines should read as follows:

Moreover if ***A*** and ***B*** commute then

$$exp(t\boldsymbol{A})exp(t\boldsymbol{B}) = exp\big(t(\boldsymbol{A}+\boldsymbol{B})\big) = exp(t\boldsymbol{B})exp(t\boldsymbol{A}) \tag{2.4.5}$$

■■

Page 83

Equation (2.6.16) currently reads as follows:

$$D\begin{pmatrix} \boldsymbol{\delta} x(t) \\ \boldsymbol{\delta} \dot{x}(t) \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ 0 & 2k\dot{x}(t) \end{pmatrix}_{\boldsymbol{X}(t)} \begin{pmatrix} \boldsymbol{\delta} x(t) \\ \boldsymbol{\delta} \dot{x}(t) \end{pmatrix} \tag{2.6.16}$$

The four *δ's* should not be bold, and so the equation should read as follows:

$$D\begin{pmatrix} \delta x(t) \\ \delta \dot{x}(t) \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ 0 & 2k\dot{x}(t) \end{pmatrix}_{\boldsymbol{X}(t)} \begin{pmatrix} \delta x(t) \\ \delta \dot{x}(t) \end{pmatrix} \tag{2.6.16}$$

Page 87

The statement

> This DE is nonlinear. Deriving its sensitivity matrix $\boldsymbol{A}(\bar{\boldsymbol{X}}(t_n))$ using (2.6.13) we obtain

should read as follows:

> This DE is nonlinear. Deriving its sensitivity matrix $\boldsymbol{A}(\bar{\boldsymbol{X}}(t_n))$ using (2.6.13) we obtain (see Problem 3.10)

Page 87

Equation (2.6.37) currently reads as follows:

$$D\begin{pmatrix} \boldsymbol{\delta} x(t) \\ \boldsymbol{\delta} \dot{x}(t) \\ \boldsymbol{\delta} \omega \end{pmatrix} = \boldsymbol{A}(\bar{\boldsymbol{X}}(t))\begin{pmatrix} \boldsymbol{\delta} x(t) \\ \boldsymbol{\delta} \dot{x}(t) \\ \boldsymbol{\delta} \omega \end{pmatrix} \qquad (2.6.37)$$

The six δ*'s* should not be bold, and so the equation should read as follows:

$$D\begin{pmatrix} \delta x(t) \\ \delta \dot{x}(t) \\ \delta \omega \end{pmatrix} = \boldsymbol{A}(\bar{\boldsymbol{X}}(t))\begin{pmatrix} \delta x(t) \\ \delta \dot{x}(t) \\ \delta \omega \end{pmatrix} \qquad (2.6.37)$$

Page 88

The statement

in which $\bar{x}_n$, $\bar{\dot{x}}_n$ and $\bar{\omega}$ are the values contained in the nominal trajectory

should read as follows:

in which $\bar{x}_n$, $\bar{\dot{x}}_n$ and $\bar{\omega}$ are the values contained in the nominal trajectory's state vector at t_n, namely

Page 88

The statement

The parameters $\bar{x}_n$, $\bar{\dot{x}}_n$ and $\bar{\omega}$ in (2.6.41) are the same three *fixed* values that specify the nominal trajectory in (2.6.40).

should read as follows:

The parameters $\bar{x}_n$, $\bar{\dot{x}}_n$ and $\bar{\omega}$ in (2.6.42) are the same three *fixed* values that specify the nominal trajectory in (2.6.40).

Page 90

Equation (2.6.45) currently reads as follows:

$$\boldsymbol{\delta X}(t) \equiv \left(\boldsymbol{\delta} x_1(t),\ \boldsymbol{\delta} x_2(t),\ \boldsymbol{\delta} x_3(t),\ \boldsymbol{\delta} x_4(t),\ \boldsymbol{\delta} x_5(t),\ \boldsymbol{\delta} x_6(t)\right)^T \qquad (2.6.45)$$

The six δ*'s* on the right-hand side of the equation should not be bold, and so the equation should read as follows:

$$\boldsymbol{\delta X}(t) \equiv \left(\delta x_1(t),\ \delta x_2(t),\ \delta x_3(t),\ \delta x_4(t),\ \delta x_5(t),\ \delta x_6(t)\right)^T \qquad (2.6.45)$$

Page 96

Equation (A2.2.4) currently reads as follows:

$$[\boldsymbol{X}(t)]_j \equiv D^j x(t) \qquad 0 \le i \le m \qquad \text{(A2.2.4}$$

The i on the right should be a j and so the equation should read as `follows:

$$[\boldsymbol{X}(t)]_j \equiv D^j x(t) \qquad 0 \le j \le m \qquad \text{(A2.2.4)}$$

Page 97

Equation (A2.2.9) currently reads as follows:

$$\tau^i/i!\, D^i x\big((n+h)\tau\big) = \sum_{j-i}^{m} \binom{j}{i} h^{j-i} \tau^j/j!\, D^j x(n\tau, \quad 0 \le i \le m \qquad \text{(A2.2.9)}$$

The summation commences from $j = i$, and so the equation should read as follows:

$$\tau^i/i!\, D^i x\big((n+h)\tau\big) = \sum_{j=i}^{m} \binom{j}{i} h^{j-i} \tau^j/j!\, D^j x(n\tau) \quad 0 \le i \le m \qquad \text{(A2.2.9)}$$

Page 97

Equation (A2.2.10) currently reads as follows:

$$\boldsymbol{Z}_n \equiv (\mathrm{x}, \ \tau\dot{x}, \ \tau^2/\boldsymbol{2}!\ \ddot{x}, \ldots \ \tau^m/m!\ D^m x)_n^{\boldsymbol{T}} \qquad \text{(A2.2.10)}$$

The *2* should not be bold, and so the equation should read as follows:

$$\boldsymbol{Z}_n \equiv (x, \ \tau\dot{x}, \ \tau^2/2!\ \ddot{x}, \ldots \ \tau^m/m!\ D^m x)_n^{\boldsymbol{T}} \qquad \text{(A2.2.10)}$$

Page 101

Equation (A2.4.4) currently reads as follows:

$$D\begin{bmatrix} \boldsymbol{\delta} x_1 \\ \boldsymbol{\delta} x_2 \end{bmatrix} = \begin{pmatrix} f_1(x_1+\boldsymbol{\delta} x_1, x_2+\boldsymbol{\delta} x_2) \\ f_2(x_1+\boldsymbol{\delta} x_1, x_2+\boldsymbol{\delta} x_2) \end{pmatrix} - \begin{pmatrix} f_1(x_1, x_2) \\ f_2(x_1, x_2) \end{pmatrix} \qquad \text{(A2.4.4)}$$

The six *δ's* should not be bold, and so the equation should read as follows:

$$D\begin{bmatrix} \delta x_1 \\ \delta x_2 \end{bmatrix} = \begin{pmatrix} f_1(x_1+\delta x_1, x_2+\delta x_2) \\ f_2(x_1+\delta x_1, x_2+\delta x_2) \end{pmatrix} - \begin{pmatrix} f_1(x_1, x_2) \\ f_2(x_1, x_2) \end{pmatrix} \qquad \text{(A2.4.4)}$$

Page 101

Equation (A2.4.5) currently reads as follows:

$$D\begin{pmatrix} \boldsymbol{\delta} x_1(t) \\ \boldsymbol{\delta} x_2(t) \end{pmatrix} = \begin{pmatrix} D_{x_1} f_1\big(x_1(t)\,,\,x_2(t)\big) & D_{x_2} f_1\big(x_1(t)\,,\,x_2(t)\big) \\ D_{x_1} f_2\big(x_1(t)\,,\,x_2(t)\big) & D_{x_2} f_2\big(x_1(t)\,,\,x_2(t)\big) \end{pmatrix}_{\mathbf{X}(t)} \begin{pmatrix} \boldsymbol{\delta} x_1(t) \\ \boldsymbol{\delta} x_2(t) \end{pmatrix} \tag{A2.4.5}$$

The four δ*'s* should not be bold, and so the equation should read as follows:

$$D\begin{pmatrix} \delta x_1(t) \\ \delta x_2(t) \end{pmatrix} = \begin{pmatrix} D_{x_1} f_1\big(x_1(t)\,,\,x_2(t)\big) & D_{x_2} f_1\big(x_1(t)\,,\,x_2(t)\big) \\ D_{x_1} f_2\big(x_1(t)\,,\,x_2(t)\big) & D_{x_2} f_2\big(x_1(t)\,,\,x_2(t)\big) \end{pmatrix}_{\mathbf{X}(t)} \begin{pmatrix} \delta x_1(t) \\ \delta x_2(t) \end{pmatrix} \tag{A2.4.5}$$

Page 102

The statement

> We refer you to Problems 2.24 and 2.25 where we ask you to apply the above.

should read as follows:

> We refer you to Problems 2.18, 2.19, 2.20, 2.23, 2.24 where we ask you to apply the above.

Chapter 3

Page 116

The first line currently reads as follows:

We now factor out $\boldsymbol{X}_n$ from the matrix on the right

The line should read as follows:

We now factor out $\boldsymbol{X}_n$ from the first vector on the right

Page 123

The top line currently reads as follows:

All the equation that have

The top line should read as follows:

All the equations that have

Page 123

Equation (3.3.22) currently reads as follows:

$$\left[A(\boldsymbol{X}(t))\right]_{i,j} = \partial f_i(x_1, \ldots\ x_m)/\partial x_j \Big|_{\bar{\boldsymbol{X}}(t)} \qquad 1 \le i, j \le m \qquad (3.3.22)$$

There should be a bar over the $\boldsymbol{X}$ on the far left, and so it should read as follows:

$$\left[A(\bar{\boldsymbol{X}}(t))\right]_{i,j} = \partial f_i(x_1, \ldots\ x_m)/\partial x_j \Big|_{\bar{\boldsymbol{X}}(t)} \qquad 1 \le i, j \le m \qquad (3.3.22)$$

Page 124

Equation (3.3.33) currently reads as follows:

$$\begin{pmatrix} \delta Y_n \\ \text{------} \\ \delta Y_{n-1} \\ \text{------} \\ \vdots \\ \text{------} \\ \delta Y_{n-L} \end{pmatrix} = \begin{pmatrix} M(\bar{X}_n)\delta X_n \\ \text{---------------} \\ M(\bar{X}_{n-1})\,\Phi\,(t_{n-1}, t_n; \bar{X})\,\delta \bar{X}_n \\ \text{---------------} \\ \vdots \\ \text{---------------} \\ M(\bar{X}_{n-L})\,\Phi\,(t_{n-L}, t_n; \bar{X})\,\delta \bar{X}_n \end{pmatrix} + \begin{pmatrix} N_n \\ \text{------} \\ N_{n-1} \\ \text{------} \\ \vdots \\ \text{------} \\ N_{n-L} \end{pmatrix} \qquad (3.3.33)$$

There should not be bars over the δX_n in two places just to the left of the *plus* sign. The equation should therefore read as follows:

$$\begin{pmatrix} \delta Y_n \\ \text{------} \\ \delta Y_{n-1} \\ \text{------} \\ \vdots \\ \text{------} \\ \delta Y_{n-L} \end{pmatrix} = \begin{pmatrix} M(\bar{X}_n)\delta X_n \\ \text{---------------} \\ M(\bar{X}_{n-1})\,\Phi\,(t_{n-1}, t_n; \bar{X})\,\delta X_n \\ \text{---------------} \\ \vdots \\ \text{---------------} \\ M(\bar{X}_{n-L})\,\Phi\,(t_{n-L}, t_n; \bar{X})\,\delta X_n \end{pmatrix} + \begin{pmatrix} N_n \\ \text{------} \\ N_{n-1} \\ \text{------} \\ \vdots \\ \text{------} \\ N_{n-L} \end{pmatrix} \qquad (3.3.33)$$

Page 125

Equation (3.3.36) currently reads as follows:

$$\delta \mathbf{Y}_n = \mathbf{T}(\bar{X}_n)\,\delta X_n + N_n \qquad (3.3.36)$$

The final $\mathbf{N}$ should be sans-serif. Equation (3.3.36) should therefore read as follows:

$$\delta \mathbf{Y}_n = \mathbf{T}(\bar{X}_n)\,\delta X_n + \mathbf{N}_n \qquad (3.3.36)$$

Page 137

In Figure *A3.1.1: ENU coordinates*

The vector from the origin to ***P*** should be labelled ρ.

Chapter 4

Page 152

The second last line on p. 152 currently reads as follows:

Let ***X*** and ***Y*** be two random vectors that have been partitioned as follows:

The line should read

Let ***X*** and ***Y*** be two random vectors of the same dimension that have been partitioned as follows:

Page 156

Just below equation (4.3.4) the text currently reads as follows:

and the only way in which the equality can be achieved for any of the *a's* is if, for some nonzero vector ***c***,

The text should read as follows

and the only way in which equality to *0* can be achieved for any of the *a's* is if, for some nonzero vector ***c***,

Page 156

Equation (4.3.7) currently reads as follows:

$$c_1v_1 + c_2v_2 + c_3v_3 = 0 \tag{4.3.1}$$

The equation should read as follows

$$c_1v_1 + c_2v_2 + c_3v_3 = 0 \quad \text{with probability } 1 \tag{4.3.2}$$

Page 157

The words "(see Appendix 2.1)" should read "(see Appendix 2.1 and Reference 203)"

Page 161

Equation (4.4.1) currently reads as follows:

$$\boldsymbol{R} = \boldsymbol{A}^T\boldsymbol{S}\boldsymbol{A} \tag{4.4.1}$$

The equation should read as follows:

$$\boldsymbol{R} = \boldsymbol{A}\boldsymbol{S}\boldsymbol{A}^T \tag{4.4.1}$$

Page 165

Theorem 4.5 currently reads as follows:

Theorem 4.5: Let $\boldsymbol{W}$ be an $m \times k$ matrix where $k > m$ (i.e. $\boldsymbol{W}$ is wide) and let $\boldsymbol{R}_{\mathsf{Y}}$ be a positive-definite $k \times k$ matrix. Then $\boldsymbol{W}\boldsymbol{R}_{Y}\boldsymbol{W}^T$ is positive-definite if and only if $\boldsymbol{W}$ has full row rank. ■■

The subscript $\boldsymbol{Y}$ in $\boldsymbol{W}\boldsymbol{R}_{Y}\boldsymbol{W}^T$ should be sans-serif. The theorem should read as follows:

Theorem 4.5: Let $\boldsymbol{W}$ be an $m \times k$ matrix where $k > m$ (i.e. $\boldsymbol{W}$ is wide) and let $\boldsymbol{R}_{\mathsf{Y}}$ be a positive-definite $k \times k$ matrix. Then $\boldsymbol{W}\boldsymbol{R}_{\mathsf{Y}}\boldsymbol{W}^T$ is positive-definite if and only if $\boldsymbol{W}$ has full row rank. ■■

Page 170

Equation (A4.1.5) and the line that follows it currently read as follows:

$$z = r_{1,1}x^2 + 2r_{1,2}\,x(mx) + r_{2,2}(mx)^2$$
$$= (r_{1,1} + 2mr_{1,2} + m^2r_{2,2})x^2 = kx^2 \tag{A4.1.5}$$

in which k is positive (because $z > 0$).

The k should be b, and so (A4.1.5) and the line that follows should read as follows:

$$z = r_{1,1}x^2 + 2r_{1,2}\,x(mx) + r_{2,2}(mx)^2$$
$$= (r_{1,1} + 2mr_{1,2} + m^2r_{2,2})x^2 = bx^2 \tag{A4.1.5}$$

in which b is positive (because $z > 0$).

Page 171

The statements

> Using this in (A4.1.5) gives
>
> $$z = Ax^2 = \big(k/(1+m^2)\big)||\boldsymbol{c}||^2 = k(m)||\boldsymbol{c}||^2 \qquad \text{(A4.1.8)}$$
>
> This means that there exists a positive constant $k(m) \equiv A/(1+m^2)$ that is independent of $||\boldsymbol{c}||$

should read as follows:

> Using this in (A4.1.5) gives
>
> $$z = bx^2 = \big(b/(1+m^2)\big)||\boldsymbol{c}||^2 = k(m)||\boldsymbol{c}||^2 \qquad \text{(A4.1.8)}$$
>
> This means that there exists a positive constant $k(m) \equiv b/(1+m^2)$ that is independent of $||\boldsymbol{c}|$

Chapter 6

Page 216

The statement

> This is a contradiction, and so the only way in which (A6.2.3) can be trues is if

The word *trues* should be *true,* and so the statement should read as follows:

> This is a contradiction, and so the only way in which (A6.2.3) can be true is if

----

Chapter 7

Page 223

The statement

> ***Note:*** The square-root ratio matrix is of value because its diagonals contain the *accuracy ratios.*

should read as follows:

> ***Note:*** If the matrices involved are covariance matrices then the square-root ratio matrix is of value because its diagonals contain the *accuracy ratios.*

Page 232

The statement

> (see Project 10.9)

should read as follows:

> (see Project 10.6)

Page 235

The statement

> Let the state vector of the observed trajectory be the *m*-vector ***X***.

should read as follows:

> Let the true state vector of the observed trajectory be the *m*-vector ***X***.

Chapter 8

Page 249

In the final line on the page, the statement

Problems 9.3 and 9.4

should read

Problems 9.6 and 9.7.

Page 253

Equation (8.2.7) currently reads as follows:

$$\mathbf{N^*}_n \mathbf{N^*}_n = SSR = \left(v_n{*}^2 + v_{n-1}{*}^2 + v_{n-2}{*}^2 + v_{n-3}{*}^2 + v_{n-4}{*}\right)_n \tag{8.2.1}$$

The star on the right are incorrectly placed. The equation should read

$$\mathbf{N^*}_n{}^T \mathbf{N^*}_n = SSR = \left(v{*}_n{}^2 + v{*}_{n-1}{}^2 + v{*}_{n-2}{}^2 + v{*}_{n-3}{}^2 + v{*}_{n-4}{}^2\right) \tag{8.2.2}$$

Page 257

The statement

and also that Version 2 avoids two of the seven matrix multiplications

should read as follows:

and also that Version 2 avoids two of the six matrix multiplications

Page 260

The statement

From a practical point, $\boldsymbol{S}_{actual}$ in (8.3.5) is estimated by

should read as follows:

From a practical point, $\boldsymbol{S}_{actual}$ in (8.4.5) is estimated by

Page 267

The statement

> We assume for simplicity that the observations $y_1, y_2, \ldots y_n$ are uncorrelated and that the variances of their errors are respectively $r_1, r_2, \ldots r_n$. Then the covariance matrix of the long-vector $\boldsymbol{Y}_n$ will be the diagonal matrix $\boldsymbol{R}_{\boldsymbol{Y}_n} = diag(r_1, \; r_2, \ldots r_n)$.

The *y's* and *r's* are incorrectly sequenced. The statement should read as follows:

> We assume for simplicity that the observations $y_n, y_{n-1}, \ldots y_1$ are uncorrelated and that the variances of their errors are respectively $r_n, r_{n-1}, \ldots r_1$. Then the covariance matrix of the long-vector $\boldsymbol{Y}_n$ will be the diagonal matrix $\boldsymbol{R}_{\boldsymbol{Y}_n} = diag(r_n, r_{n-1}, \ldots r_1)$.

Page 267

Equation (8.5.7) currently reads as follows:

$$\boldsymbol{R}_{\boldsymbol{Y}_n}^{-1} = diag\left(1/r_1, \; 1/r_2, \; 1/r_3, \; 1/r_4, \; 1/r_5\right)_n^T \qquad (8.5.7)$$

The *r's* are incorrectly sequenced. The equation should read as follows:

$$\boldsymbol{R}_{\boldsymbol{Y}_n}^{-1} = diag\left(1/r_n, \; 1/r_{n-1}, \; 1/r_{n-2}, \; 1/r_{n-3}, \; 1/r_{n-4}\right)^T \qquad (8.5.7)$$

Page 268

Equation (8.5.11) currently reads as follows:

$$\mathbf{T}_2^T \mathbf{R}_{\mathbf{Y}_2}^{-1} \mathbf{T}_2 = \begin{pmatrix} 1 & 1 \\ 0 & t_1 - t_2 \end{pmatrix} \begin{pmatrix} 1/r_1 & 0 \\ 0 & 1/r_2 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ 1 & t_1 - t_2 \end{pmatrix}$$

$$= \begin{pmatrix} 1/r_1 + 1/r_2 & (t_1 - t_2)/r_2 \\ (t_1 - t_2)/r_2 & (t_1 - t_2)^2/r_2 \end{pmatrix} \qquad (8.5.11)$$

The *r's* are incorrectly sequenced. The equation should read as follows:

$$\mathbf{T}_2^T \mathbf{R}_{\mathbf{Y}_2}^{-1} \mathbf{T}_2 = \begin{pmatrix} 1 & 1 \\ 0 & t_1 - t_2 \end{pmatrix} \begin{pmatrix} 1/r_2 & 0 \\ 0 & 1/r_1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ 1 & t_1 - t_2 \end{pmatrix}$$

$$= \begin{pmatrix} 1/r_2 + 1/r_1 & (t_1 - t_2)/r_1 \\ (t_1 - t_2)/r_1 & (t_1 - t_2)^2/r_1 \end{pmatrix} \qquad (8.5.11)$$

Page 268

The sentence

◊ At time t_2 the filter is cycled, using as the inputs $\mathbf{Y}_2 = (y_1, \ y_2)^T$ and the matrix $\mathbf{R}_{\mathbf{Y}_2} = diag(r_1, \ r_2)$. The outputs will be $\mathbf{X}^*_{2,2}$ and $\mathbf{S}^*_{2,2}$.

The *y's* and *r's* are incorrectly sequenced. The sentence should read as follows:

◊ At time t_2 the filter is cycled, using as the inputs $\mathbf{Y}_2 = (y_2, \ y_1)^T$ and the matrix $\mathbf{R}_{\mathbf{Y}_2} = diag(r_2, \ r_1)$. The outputs will be $\mathbf{X}^*_{2,2}$ and $\mathbf{S}^*_{2,2}$.

Page 268

The sentence

◊ At time t_3 the filter is cycled, using as the inputs $\boldsymbol{Y}_3 = (y_1, \ \ y_2, \ \ y_3)^T$ and the matrix $\boldsymbol{R}_{\boldsymbol{Y}_3} = diag(r_1, \ \ r_2, \ \ r_3)$. The outputs will be $\boldsymbol{X}^*_{3,3}$ and $\boldsymbol{S}^*_{3,3}$.

The *y's* and *r's* are incorrectly sequenced. The sentence should read as follows:

◊ At time t_3 the filter is cycled, using as the inputs $\boldsymbol{Y}_3 = (y_3, \ \ y_2, \ \ y_1)^T$ and the matrix $\boldsymbol{R}_{\boldsymbol{Y}_3} = diag(r_3, \ \ r_2, \ \ r_1)$. The outputs will be $\boldsymbol{X}^*_{3,3}$ and $\boldsymbol{S}^*_{3,3}$.

Page 268

The sentence

◊ At time t_4 the filter is cycled using $\boldsymbol{Y}_4 = (y_1, \ y_2, \ y_3, \ y_4)^T$ and $\boldsymbol{R}_{\boldsymbol{Y}_4} = diag(r_1, r_2, r_3, r_4)$. The outputs will be $\boldsymbol{X}^*_{4,4}$ and $\boldsymbol{S}^*_{4,4}$ and so on.

The *y's* and *r's* are incorrectly sequenced. The sentence should read as follows:

◊ At time t_4 the filter is cycled using $\boldsymbol{Y}_4 = (y_4, \ y_2, \ y_2, \ y_1)^T$ and $\boldsymbol{R}_{\boldsymbol{Y}_4} = diag(r_4, r_3, r_2, r_1)$. The outputs will be $\boldsymbol{X}^*_{4,4}$ and $\boldsymbol{S}^*_{4,4}$ and so on.

Page 271

The sentence

> As noted earlier, Version 2 of the MVA requires five matrix multiplications whereas Version 1 requires seven, and so, all else being equal, we would use Version 2.

should read as follows:

> As noted earlier, Version 2 of the MVA requires four matrix multiplications whereas Version 1 requires six, and so, all else being equal, we would use Version 2.

Page 274

The word ***Notes*** should read ***Note.***

Page 279

The fourth group in equation (8.9.31) currently reads as follows:

$$\boldsymbol{R}^{-1} = \left(\begin{array}{c|c} \boldsymbol{R}_1^{-1} & \\ \hline & \boldsymbol{R}_2^{-1} \end{array}\right)$$

The ***R*** on the left should be sans-serif. The equation should read as follows:

$$\boldsymbol{\mathsf{R}}^{-1} = \left(\begin{array}{c|c} \boldsymbol{R}_1^{-1} & \\ \hline & \boldsymbol{R}_2^{-1} \end{array}\right)$$

Page 282

Equation (8.9.39) currently reads as follows:

$$\boldsymbol{X}^*_k = \boldsymbol{S}^*_k{}^{-1}(\boldsymbol{S}^*_{k-1}\boldsymbol{X}^*_{k-1} + \boldsymbol{R}_k^{-1}\boldsymbol{Y}_k) \qquad (8.9.39)$$

The first inverse sign is in the wrong place. The equation should read as follows:

$$\boldsymbol{X}^*_k = \boldsymbol{S}^*_k(\boldsymbol{S}^*_{k-1}{}^{-1}\boldsymbol{X}^*_{k-1} + \boldsymbol{R}_k^{-1}\boldsymbol{Y}_k) \qquad (8.9.39)$$

Page 287

Equation (A8.1.2) and the line following it currently read as follows:

$$D_{X^*}((\boldsymbol{\mathsf{Y}}_n - \boldsymbol{\mathsf{T}}_n X^*_{n,n})^T \boldsymbol{\mathsf{R}}_{\boldsymbol{\mathsf{Y}}_n}{}^{-1}(\boldsymbol{\mathsf{Y}}_n - \boldsymbol{\mathsf{T}}_n X^*_{n,n}))$$

$$= -2\boldsymbol{\mathsf{T}}_n{}^T \boldsymbol{\mathsf{R}}_{\boldsymbol{\mathsf{Y}}_n}{}^{-1}(\boldsymbol{\mathsf{Y}}_n - \boldsymbol{\mathsf{T}}_n X^*_{n,n}) \qquad (A8.1.1)$$

Setting this result equal to **Ø** and dropping the *-2* we obtain

Equation (A8.1.2) and the line following it should read as follows:

$$D_{X^*}((\boldsymbol{\mathsf{Y}}_n - \boldsymbol{\mathsf{T}}_n X^*_{n,n})^T \boldsymbol{\mathsf{R}}_{\boldsymbol{\mathsf{Y}}_n}{}^{-1}(\boldsymbol{\mathsf{Y}}_n - \boldsymbol{\mathsf{T}}_n X^*_{n,n}))$$

$$= -2(\boldsymbol{\mathsf{Y}}_n - \boldsymbol{\mathsf{T}}_n X^*_{n,n})^T \boldsymbol{\mathsf{R}}_{\boldsymbol{\mathsf{Y}}_n}{}^{-1}\boldsymbol{\mathsf{T}}_n \qquad (A8.1.2)$$

Setting the transpose of this result equal to **Ø** and dropping the *-2* we obtain

Page 287

The second last sentence currently reads as follows:

... is properly constructed then $\boldsymbol{T}_n$ will read as follows:

The word *will* should be in italics. The sentence should read as follows:

... is properly constructed then $\boldsymbol{T}_n$ *will* read as follows:

Chapter 9

Page 314

The statement

Proof of the lemma is given in Problem 9.9.

should read as follows:

Proof of the lemma is given in Problem 9.14.

Page 320

In Appendix 9.3, equation (A9.3.2) currently reads as follows:

$$L = (2\pi)^{-k/2} | \boldsymbol{R} |^{-1/2} exp\left(-\tfrac{1}{2}(\boldsymbol{Y} - \boldsymbol{T}X^*)^T \boldsymbol{R}_{\boldsymbol{Y}}^{-1} (\boldsymbol{Y} - \boldsymbol{T}X^*)\right) \quad \text{(A9.3.2)}$$

The first $\boldsymbol{R}$ should have a subscript. The equation should read as follows:

$$L = (2\pi)^{-k/2} | \boldsymbol{R}_{\boldsymbol{Y}} |^{-1/2} exp\left(-\tfrac{1}{2}(\boldsymbol{Y} - \boldsymbol{T}X^*)^T \boldsymbol{R}_{\boldsymbol{Y}}^{-1} (\boldsymbol{Y} - \boldsymbol{T}X^*)\right) \quad \text{(A9.3.2)}$$

Chapter 10

Page 339

The statement

Video_Clips\TWS\Flights

should read as follows:

Part_2\Video_Clips_TWS\Flights

Page 339

The statement

Video_Clips\TWS\Documents\Readme

should read as follows:

Part_2\Video_Clips_TWS\Documents\Readme

Page 344

The statement

These are then transformed to Cartesian coordinates and fed to three filters – Kalman, Swerling and Gauss-Newton

should read as follows:

These are then transformed to Cartesian coordinates and, after prefiltering, are fed to three filters – Kalman, Swerling and Gauss-Newton

Page 349

The statement

the values $\boldsymbol{X}^*_{max}$, $\boldsymbol{S}^*_{max}$ and SSR^*_{max} have been placed in storage

The *SSR* should not have a star. The statement should read as follows:

the values $\boldsymbol{X}^*_{max}$, $\boldsymbol{S}^*_{max}$ and SSR_{max} have been placed in storage

Page 351

The statement

In (A10.1.5) we show the values for N_{X^*3}, N_{X^*4} and N_{X^*5}.

should read as follows:

In (A10.1.4) we show the values for N_{X^*3}, N_{X^*4} and N_{X^*5}.

Chapter 11

Page 387

The first paragraph currently reads as follows:

As an example, we see from Figure A11.16.3 that when $N = 1600$, on average the Gauss–Newton $\dot{x}$, $\dot{y}$ and $\dot{z}$ estimates are *100* times more accurate than those of Kalman.

The figure number is incorrect. The paragraph should read as follows:

As an example, we see from Figure A11.4.3 that when $N = 1600$, on average the Gauss–Newton $\dot{x}$, $\dot{y}$ and $\dot{z}$ estimates are *100* times more accurate than those of Kalman.

Chapter 12

Page 417

In Example 12.7 the three variables on the left of the equations currently read

$$\sigma(x_0{}^*{}_{101\,,\,100}),\quad \sigma(x_1{}^*{}_{101\,,\,100}),\quad \sigma(x_2{}^*{}_{101\,,\,100})$$

They should read

$$\sigma(x_0{}^*{}_{1001\,,\,1000}),\ \sigma(x_1{}^*{}_{1001\,,\,1000}),\ \sigma(x_2{}^*{}_{1001\,,\,1000})$$

Page 420

In Figure 12.21(b) the expression

$$20(1 - \theta)^7/\tau^2(1 + \theta)^7$$

The item τ^2 is incorrect. The expression should read as follows:

$$20(1 - \theta)^7/\tau^6(1 + \theta)^7$$

Page 420

In Figure 12.21(b) the expression

$$\begin{array}{c} 5(449\theta^6+29888\theta^5+100130\theta^4+212160\theta^3+289230\theta^2+255880\theta+12199)(1 - \theta)^3 \\ 72\tau^2(1 + \theta)^9 \end{array}$$

There is a division line missing. The expression should be as follows:

$$\frac{5(449\theta^6+29888\theta^5+100130\theta^4+212160\theta^3+289230\theta^2+255880\theta+12199)(1 - \theta)^3}{72\tau^2(1 + \theta)^9}$$

Page 423

Equation (12.2.56) now reads

$$\boldsymbol{VRF}(\boldsymbol{X^*}_{n+1,n}) = \begin{pmatrix} 1.25(1-\theta) & 6(1-\theta)^2/\tau \\ 6(1-\theta)^2/\tau & 12(1-\theta)^3/\tau^2 \end{pmatrix} \qquad (12.2.56)$$

The *6s* and the *12* are incorrect. The equation should read as follows:

$$\boldsymbol{VRF}(\boldsymbol{X^*}_{n+1,n}) = \begin{pmatrix} 1.25(1-\theta) & 0.5(1-\theta)^2/\tau \\ 0.5(1-\theta)^2/\tau & 0.25(1-\theta)^3/\tau^2 \end{pmatrix} \qquad (12.2.56)$$

Page 423

Equation (12.2.57) now reads

$$\boldsymbol{VRF}(\boldsymbol{X}^*_{n+1,n}) = \begin{pmatrix} 2.0625(1-\theta) & 1.6875(1-\theta)^2/\tau & 0.5(1-\theta)^3/\tau^2 \\ 1.6875(1-\theta)^2/\tau & 1.75(1-\theta)^3/\tau^2 & 0.5625(1-\theta)^4/\tau^3 \\ 0.5(1-\theta)^3/\tau^2 & 0.5625(1-\theta)^4/\tau^3 & 1.1875(1-\theta)^5/\tau^4 \end{pmatrix} \quad (12.2.57)$$

The coefficient *1.1875* is incorrect. The equation should read as follows:

$$\boldsymbol{VRF}(\boldsymbol{X}^*_{n+1,n}) = \begin{pmatrix} 2.0625(1-\theta) & 1.6875(1-\theta)^2/\tau & 0.5(1-\theta)^3/\tau^2 \\ 1.6875(1-\theta)^2/\tau & 1.75(1-\theta)^3/\tau^2 & 0.5625(1-\theta)^4/\tau^3 \\ 0.5(1-\theta)^3/\tau^2 & 0.5625(1-\theta)^4/\tau^3 & 0.1875(1-\theta)^5/\tau^4 \end{pmatrix} \quad (12.2.57)$$

Page 423

The second equation in (12.2.58) now reads

$$\sigma(x_1{}^*{}_{n+1\,,\,n}) = 1.5\left((13\theta^2 + 50\theta + 49)(1 - \theta)^3 2\tau^2(1 + \theta)^5\right)^{1/2} \approx 0.57\,m/sec \qquad (12.2.58)$$

The division sign (slash) is missing before the *2*. The equation should read as follows:

$$\sigma(x_1{}^*{}_{n+1\,,\,n}) = 1.5\left((13\theta^2 + 50\theta + 49)(1 - \theta)^3 / 2\tau^2(1 + \theta)^5\right)^{1/2} \approx 0.57\,m/sec \qquad (12.2.58)$$

Page 427

The sentence just below Figure 12.26 currently reads as follows:

> Smoothing in Cartesian coordinate solves another problem as well.

The word *coordinate* is incorrect. The sentence should read as follows:

> Smoothing in Cartesian coordinates solves another problem as well.

Page 449

The final line on the page currently reads as follows:

> Repeating the calculation for the remaining degrees $(0, 1, 3, 4)$, we obtain Figure 12.10.

The figure number is incorrect. The line should read as follows:

> Repeating the calculation for the remaining degrees $(0, 1, 3, 4)$, we obtain Figure 12.43

Page 455

The statement

"... we are approximating the orbit by..."

should read as follows:

"... we are approximating the orbits by..."

Page 458

In the final paragraph, the statement

"... and there is a problem needs to be..."

should read as follows:

"... and there is a problem that needs to be..."

Chapter 13

Page 474

Equation (13.1.9) currently reads as follows:

$$\left(c_j(n)\right)^2 \equiv \sum_{s=0}^{n} \left(p_i(s,n)\right)^2 \tag{13.1.9}$$

The term p_i on the right should be p_j. The equation should therefore read as follows:

$$\left(c_j(n)\right)^2 \equiv \sum_{s=0}^{n} \left(p_j(s,n)\right)^2 \tag{13.1.9}$$

Page 490

Equation (13.2.29) currently reads as follows:

$$(\boldsymbol{C}(n))^2 = \begin{pmatrix} 1/c_0(n)^2 & 0 \\ 0 & 1/c_0(n)^2 \end{pmatrix} = \begin{pmatrix} 1/(n+1) & 0 \\ 0 & 3n/(n+2)(n+1) \end{pmatrix} \tag{13.2.29}$$

The second term in the first matrix should be $1/c_1(n)^2$. The equation should therefore read as follows:

$$(\boldsymbol{C}(n))^2 = \begin{pmatrix} 1/c_0(n)^2 & 0 \\ 0 & 1/c_1(n)^2 \end{pmatrix} = \begin{pmatrix} 1/(n+1) & 0 \\ 0 & 3n/(n+2)(n+1) \end{pmatrix} \tag{13.2.29}$$

Page 491

The statement

The matrix $\boldsymbol{D}(\tau)$ was defined in (11.2.1).

should read as follows:

The matrix $\boldsymbol{D}(\tau)$ was defined in (12.2.11).

Page 491

The statement

> See Project 12.2 in the supplementary material for comments regarding denormalization in the computer programs.

should read as follows:

> See Projects 12.2 and 13.3 in the supplementary material for comments regarding denormalization in the computer programs.

Page 492

The statement

> When *m* = *0* or *1* it is possible to form theses expansions by hand

The word *theses* is incorrect. The statement should read as follows:

> When *m* = *0* or *1* it is possible to form these expansions by hand

Page 492

The statement

> where **Φ**(*1*) is the transition matrix defined in (2.3.17)

should read as follows:

> where **Φ**(*1*) is the transition matrix defined in (2.3.14)

Page 492

Equation (13.2.39) currently reads as follows:

$$\boldsymbol{S}^*(\boldsymbol{X}^*_{n+1,\,n}) = \boldsymbol{\Phi}(\tau)\,\boldsymbol{S}^*(\boldsymbol{X}^*_{n+1,\,n})\boldsymbol{\Phi}(\tau)^T \tag{13.2.39}$$

The subscript in $\boldsymbol{X}^*_{n+1,n}$ on the right is incorrect. The equation should read as follows:

$$\boldsymbol{S}^*(\boldsymbol{X}^*_{n+1,\,n}) = \boldsymbol{\Phi}(\tau)\,\boldsymbol{S}^*(\boldsymbol{X}^*_{n,\,n})\boldsymbol{\Phi}(\tau)^T \tag{13.2.39}$$

Page 501

Equation (13.3.18) currently reads as follows:

$$e_n = \sum_{k=0}^{\infty} \left(y_{n-k} - \sum_{j=0}^{m} (\beta_j)_n \varphi_j(k, \theta) \right)^2 \theta^k \qquad (13.3.18)$$

The equation should read as follows:

$$e_n = \sum_{k=0}^{\infty} \left(y_{n-k} - \sum_{j=0}^{m} \beta_{j,n} \varphi_j(k, \theta) \right)^2 \theta^k \qquad (13.3.18)$$

Page 501

Equation (13.3.19) currently reads as follows:

$$\sum_{k=0}^{\infty} \left(y_{n-k} - \sum_{j=0}^{m} (\beta_j)_n \varphi_j(k, \theta) \right) \theta^k \varphi_i(k, \theta) = 0 \qquad 0 \le i \le m \qquad (13.3.19)$$

The equation should read as follows:

$$\sum_{k=0}^{\infty} \left(y_{n-k} - \sum_{j=0}^{m} \beta_{j,n} \varphi_j(k, \theta) \right) \theta^k \varphi_i(k, \theta) = 0 \qquad 0 \le i \le m \qquad (13.3.19)$$

Page 501

Equation (13.3.20) currently reads as follows:

$$\sum_{j=0}^{m} (\beta_j)_n \sum_{k=0}^{\infty} \varphi_i(k, \theta) \varphi_j(k, \theta) \theta^k = \sum_{k=0}^{\infty} \varphi_i(k, \theta) \theta^k y_{n-k} \qquad 0 \le i \le m \qquad (13.3.20)$$

The equation should read as follows:

$$\sum_{i=0}^{m} \beta_{j,n} \sum_{k=0}^{\infty} \varphi_i(k, \theta) \varphi_j(k, \theta) \theta^k = \sum_{k=0}^{\infty} \varphi_i(k, \theta) \theta^k y_{n-k} \qquad 0 \le i \le m \qquad (13.3.20)$$

Page 501

Equation (13.3.21) currently reads as follows:

$$\sum_{j=0}^{m} (\beta_j)_n \delta_{i,j} = \sum_{k=0}^{\infty} \varphi_i(k, \theta)\theta^k y_{n-k} \qquad 0 \le i \le m \tag{13.3.21}$$

The equation should read as follows:

$$\sum_{j=0}^{m} \beta_{j,n} \delta_{i,j} = \sum_{k=0}^{\infty} \varphi_i(k, \theta)\theta^k y_{n-k} \qquad 0 \le i \le m \tag{13.3.21}$$

Page 501

Equation (13.3.22) currently reads as follows:

$$\beta_{i,n} = \sum_{k=0}^{\infty} \varphi_i(k, \theta)\theta^k y_{-k} \qquad 0 \le i \le m \tag{13.3.22}$$

An *n* is missing in the subscript after the *y*. The equation should read as follows:

$$\beta_{i,n} = \sum_{k=0}^{\infty} \varphi_i(k, \theta)\theta^k y_{n-k} \qquad 0 \le i \le m \tag{13.3.22}$$

Page 504

Equation (13.3.38) currently reads as follows:

$$z_i{}^*{}_{n-s,n} = \sum_{j=0}^{m} (-1)^i/i \;\; d^i/ds^i \varphi_j(s, \theta)\Big|_{s=-1} \left(\sum_{k=0}^{\infty} \varphi_j(k, \theta)\theta^k y_{n-k}\right) \qquad 0 \le i \le m \tag{13.3.38}$$

A factorial symbol is missing after /*i*. The equation should read as follows:

$$z_i{}^*{}_{n-s,n} = \sum_{j=0}^{m} (-1)^i/i!\, d^i/ds^i \varphi_j(s, \theta)\Big|_{s=-1} \left(\sum_{k=0}^{\infty} \varphi_j(k, \theta)\theta^k y_{n-k}\right) \qquad 0 \le i \le m \tag{13.3.38}$$

Page 505

Equation (13.3.40) currently reads as follows:

$$[\boldsymbol{L}(\theta)]_j \equiv \theta^j / c(j, \theta) \qquad 0 \le i, j \le m \qquad (13.3.40)$$

The term $c(j, \theta)$ is squared, and so the equation should read as follows:

$$[\boldsymbol{L}(\theta)]_j \equiv \theta^j / (c(j, \theta))^2 \qquad 0 \le i, j \le m \qquad (13.3.40)$$

Page 510

The matrix element $p_{1,4}$ currently reads as follows:

$$p_{1,4} = -20s/n + 90(2s-1)/n^{(2)} - 140(3s^2 - 6s + 2)/n^{(3)} + 70(4s^3 - 18s^2 + 22s - 6)/n^{(4)}$$

The s appearing in $-20s/n$ is incorrect. The expression should read as follows:

$$p_{1,4} = -20/n + 90(2s-1)/n^{(2)} - 140(3s^2 - 6s + 2)/n^{(3)} + 70(4s^3 - 18s^2 + 22s - 6)/n^{(4))}$$

Page 512

The heading currently reads as follows:

$$3.\ \text{The matrix } [\boldsymbol{P}(n,n)]_{i,j} = 1/i!\ d^i/ds^i(p_j(s,n)\Big|_{s=n} \qquad 0 \le i,j \le 4$$

The extra bracket before the p_j is incorrect. The heading should read as follows:

$$3.\ \text{The matrix } [\boldsymbol{P}(n,n)]_{i,j} = 1/i!\ d^i/ds^i\, p_j(s,n)\Big|_{s=n} \qquad 0 \le i,j \le 4$$

Page 516

In Appendix 13.5, in the first row of the matrix the second term currently reads as follows:

$\theta^2(1 - bs)$

The term should read as follows:

$\theta(1 - bs)$

Page 516

In Appendix 13.5, in the first row of the matrix the fourth term currently reads as follows:

$$-\theta^3\big(1 - 3bs + 3b^2(s^2-s)/2 - b^3(s^3-3s^2+2s)/6\big)$$

The minus sign before the θ^3 is incorrect. The term should read as follows:

$$\theta^3\big(1 - 3bs + 3b^2(s^2-s)/2 - b^3(s^3-3s^2+2s)/6\big)$$

Page 527

The References in the book currently end at *Reference 202.*

The following references should be added:

203: Cramér-Rao Bound
http://en.wikipedia.org/wiki/Cram%C3%A9r%E2%80%93Rao_bound

204: Cross Validated, http://stats.stackexchange.com/questions/38382/why-doesnt-the-cramer-rao-lower-bound-apply

205: The Discovery of Ceres, http://www.keplersdiscovery.com/Asteroid.html

206: Lecture 3, Some Linear Algebra,
http://www.math.utah.edu/~davar/math6010/2011/SomeLinearAlgebra.pdf

207: Projection Matrix, http://mathworld.wolfram.com/ProjectionMatrix.html

Note: We have reproduced all references obtained from the Internet as PDFs. They can be downloaded as a *ZIP* file from the supplementary material.