Errata

Handbook of Marine Craft Hydrodynamics and Motion Control

Most recently revised on May 10, 2016

These are errata for the 2011 Edition of the Wiley textbook "*Handbook of Marine Craft Hydrodynamics and Motion Control*" by T. I. Fossen.

General Remarks

Section 2.4.1 and later The symbols β (no current) and β_r (with currents) are both used to denote the sideslip angle, However, it is also common to refer to these angles as the *crab angle* and *sideslip angle*, respectively. See http://www.fossen.biz/wiley/OceanCurrentTriangle.pdf

Errata for the 1st Edition, 2nd Printing (2014)

Page 293, Matlab code The matrix **H** should be transposed. Moreover, *K = place(A',H',p)'*

Page 400, Before Equation (12.227) The vector elements should be: $\mathbf{f} = [f_1, ..., f_n]^\top$

Errata for the 1st Edition, 1st Printing 1 (2011)

Page 62, Figure 4.2 The vector for the arm $\overline{GM}_T \sin(\phi)$ is hidden behind one layer in the drawing. Should point to the horizontal line starting in G and ending at the vertical line.

Page 68, Equation (4.48) Replace $\dot{z}$ with $\dot{w}$.

Page 72, Equation (4.78) Replace the moment of inertia I_x with I_y.

Page 86, Equation (5.22) The second term in the bracket $[\delta\phi, \delta\phi, \delta\psi]$ should read $\delta\theta$.

Page 89, Equation (5.46) Delete the incorrect term $-UL\delta\boldsymbol{\nu}$ after the last equal sign. Notice that (5.47) follows directly by time differentiation of (5.43).

Page 90, Equation (5.55) Replace the term $-\bar{\mathbf{A}}\dot{\boldsymbol{\xi}}$ with $-\bar{\mathbf{A}}\ddot{\boldsymbol{\xi}}$.

Page 96, Equation (5.69) The last term $... + c_3 x_3^3$ should not have a subscript. Moreover, it should read $... + c_3 x^3$.

Page 114, Equation (6.20) Replace $\dot{z}$ with $\dot{w}$.

Page 124, Equations (6.74)–(6.75) should read

$$T = \frac{T_n}{2\pi\zeta} \tag{1}$$

Hence, (6.75) becomes $159.2\,\text{s} \leq T \leq 238.8\,\text{s}$.

Page 133, Equation (6.115) The $\mathbf{L}$ matrix is only correct for linearization between BODY and SEAKEEPING. For linearization between BODY and NED, the correct expression for (6.115) is given by (7.39). This only affects $\mathbf{C}_A^*$.

Page 153, Figure 7.5 The arrow showing ψ should start from the dotted line indicating the North direction and not the body axes.

Page 174, Equation (7.213) There is one zero to much in the expression for $\mathbf{G}$. Should read:

$$\mathbf{G} = diag\{0, 0, 0, (z_g - z_b)W, (z_g - z_b)W, 0\}$$

Page 174, Equation (7.214) The last column vector only has five zeros. It should be six zeros.

Page 186, Equation (7.272) The second line in the damping matrix should replace M_v, M_p, M_r with K_v, K_p, K_r.

Page 212, Equations (8.83)–(8.84) The vector arguments η has replaced τ. Should read:

$$\boldsymbol{\tau}_{\text{wave1}} = \left[\tau_{\text{wave1}}^{\{1\}}, \tau_{\text{wave1}}^{\{2\}}, \tau_{\text{wave1}}^{\{3\}}, \tau_{\text{wave1}}^{\{4\}}, \tau_{\text{wave1}}^{\{5\}}, \tau_{\text{wave1}}^{\{6\}}\right]^\top$$
$$\boldsymbol{\tau}_{\text{wave2}} = \left[\tau_{\text{wave2}}^{\{1\}}, \tau_{\text{wave2}}^{\{2\}}, \tau_{\text{wave2}}^{\{3\}}, \tau_{\text{wave2}}^{\{4\}}, \tau_{\text{wave2}}^{\{5\}}, \tau_{\text{wave2}}^{\{6\}}\right]^\top$$

Page 299, Equation (11.57) The expression for the predictor should be corrected to:

$$\bar{\mathbf{x}}(k+1) = \hat{\mathbf{x}}(k) + hf(\hat{\mathbf{x}}(k), \mathbf{u}(k))$$

Page 300, Methods A and B The predictor line in the pseudo code should read: $\bar{\mathbf{x}}(k+1) = \hat{\mathbf{x}}(k) + hf(\hat{\mathbf{x}}(k), \mathbf{u}(k))$

Page 329, Figure 11.17. The gravity terms $\mathbf{g}^n$ should be positive and not negative.

Page 330, Equation (11.219) The accelerometer reads -1 g (acceleration upwards) when stationary. Hence, the sign of the acceleration should be corrected such that:

$$\mathbf{a}_{imu}^b = \mathbf{R}_n^b(\boldsymbol{\Theta})(\dot{\mathbf{v}}_{m/n}^n - \mathbf{g}^n) + \mathbf{b}_{acc}^b + \mathbf{w}_{acc}^b$$

This error is propagated to Equations (11.230), (11.233), (11.237), (11.256) and (11.263) which all should multiply $\mathbf{g}^n$ with -1.

Page 337, Equations (11.264)–(11.266) The sign of $\mathbf{g}^n$ in (11.264) should be corrected such that $\mathbf{a}^b_{imu} = -\mathbf{R}^b_n(\boldsymbol{\Theta})\mathbf{g}^n$. Hence, (11.265)–(11.266) should read:

$$\begin{aligned} \mathbf{a}^b_{\text{imu}} &\approx -\mathbf{R}^b_n(\boldsymbol{\Theta})\mathbf{g}^n \\ &\Updownarrow \\ \begin{bmatrix} a_x \\ a_y \\ a_z \end{bmatrix} &\approx -\mathbf{R}^b_n(\boldsymbol{\Theta}) \begin{bmatrix} 0 \\ 0 \\ g \end{bmatrix} = \begin{bmatrix} g\sin(\theta) \\ -g\cos(\theta)\sin(\phi) \\ -g\cos(\theta)\cos(\phi) \end{bmatrix} \end{aligned}$$

Page 337, Equation (11.267) Should read (only the expression for a_x/g is sign corrected):

$$\frac{a_y}{a_z} \approx \tan(\phi), \quad \frac{a_x}{g} \approx \sin(\theta), \quad \frac{a_y^2 + a_z^2}{g^2} \approx \cos^2(\theta)$$

Page 338, Equation (11.275), Figure 11.18 The $\mathbf{q}$ and $\hat{\mathbf{q}}$ arguments in the rotation matrices have switched places. Should read:

$$\dot{\hat{\mathbf{q}}} = \mathbf{T}_q(\hat{\mathbf{q}}) \underbrace{\mathbf{R}^n_b(\hat{\mathbf{q}})^\top \mathbf{R}^n_b(\mathbf{q})}_{\mathbf{R}^\top(\tilde{\mathbf{q}})} \left[\boldsymbol{\omega}^b_{\text{imu}} - \hat{\mathbf{b}}^b_{\text{gyro}} + \mathbf{K}_p \tilde{\boldsymbol{\varepsilon}}\, \text{sgn}(\tilde{\eta})\right]$$

The same is the case for the expression in Figure 11.18.

Page 339, Text below Equation (11.287) Barabalat's lemma gives convergence of $\boldsymbol{\varepsilon}$ to zero. Uniform observability gives exponentially stability since ULAS = ULES in a linear system $\dot{\mathbf{x}} = \mathbf{A}(t)\mathbf{x}$. The results are, however, not global since the quaternions have two equilibria (topological limitation).

Page 341, Figure 11.19 The gain $\frac{1}{2}K_i$ should be multiplied with -1 as in Formula (11.302).

Page 342 The components m_x, m_y, m_z in (11.306) and (11.308) should be m^b_x, m^b_y, m^b_z and m^n_x, m^n_y, m^n_z, respectively since these vectors are in BODY and NED.

Page 420, Equation below (13.15) The matrix elements $-d/m$ and $-k/m$ should change places.

Page 383, Equation (12.145). The term $T_d s$ in the numerator on the second line should be replaced by $T_i s$.

Page 467, Equation 13.297. The sign in front of $\frac{\partial \alpha_1}{\partial z_1}$ should be positive and not negative.

Page 527, Equation (13.617) The kinematic equation is based on (2.45) on page 27. Hence, (13.617) should read:

$$\dot{\theta} = q\cos(\phi) - r\sin(\phi) \approx q$$

Page 547, Equation (B.47) The first line misses the sampling time h. Should read:

$$\mathbf{x}_1 = h\mathbf{f}(\mathbf{x}(k), \mathbf{u}(k), t_k)$$

Page 547, Equation (B.48) The variables defined below (B.50) should be $a = -1/T, b = 1/T, c = -1$ and $d = 1$. Consequently, the discrete-time model (B.51)–(B.52) has two sign errors:

$$\ldots \; - (\exp(-h/T) - 1)u(k)$$

$$y(k) = -x(k) + u(k)$$