Errata List and New Additions for the AIAA Education Series Text Book

Analytical Mechanics of Space Systems

2nd Edition

authored by H. Schaub & J. L. Junkins

Last updated on July 28, 2018

This file contains various typos that were found in the first edition, 2nd edition of the text book. Please use this page to update your book copy. Where possible, the changes are highlighted in red. If you find typos that are not listed here, please contact the author at

hanspeter.schaub@colorado.edu

and email the typo type, as well as the typo location within the manuscript. A revision history is provided at the end of the document.

- p. 16, 6th line from top (including eons): change text to:
  while the angular velocity of B relative to A is computed as
- p. 16, 11th line from top (including eons): change subscript of first term after equal sign to

$$\cdots = \dot{r}_A \hat{\boldsymbol{\imath}}_{r_A} + \cdots$$

- p. 22, 2nd line from top: Change sentence to "In this case the latitude angle $\phi(t)$ becomes..."
- p. 22, first equation after line 4 : On the right hand side, it should read $\cdots = -\dot{\phi}\hat{\boldsymbol{e}} + \cdots$
- p. 80, Eq. (3.1) : Change index on last line to 3:

$$\{\hat{\boldsymbol{n}}\} \equiv \begin{Bmatrix} \hat{\boldsymbol{n}}_1 \\ \hat{\boldsymbol{n}}_2 \\ \hat{\boldsymbol{n}}_3 \end{Bmatrix} \qquad \{\hat{\boldsymbol{b}}\} \equiv \begin{Bmatrix} \hat{\boldsymbol{b}}_1 \\ \hat{\boldsymbol{b}}_2 \\ \hat{\boldsymbol{b}}_3 \end{Bmatrix}$$

- p. 93, end of Ex. 3.2 : Replace the sentence, "Because ϕ is much larger than ψ and θ, the attitude of $\mathcal{B}$ could be described qualitatively to differ from $\mathcal{F}$ by a -57.6deg roll." with the new text:
  Note that orientation of $\mathcal{B}$ relative to $\mathcal{F}$ can be essentially described through a $(2-1)$ rotation sequence, because the initial 3-axis rotation is almost negligible.
- p. 108, first line: change first line to "Using Sheppard's method, ..."
- p. 109, 2nd and 3th equation from top: replace with

$$\beta_{0_{\mathcal{B}''/\mathcal{B}'}} = \cos\left(\frac{\theta}{2}\right) \qquad \beta_{1_{\mathcal{B}''/\mathcal{B}'}} = 0 \qquad \beta_{2_{\mathcal{B}''/\mathcal{B}'}} = \sin\left(\frac{\theta}{2}\right) \qquad \beta_{3_{\mathcal{B}''/\mathcal{B}'}} = 0$$

$$\beta_{0_{\mathcal{B}/\mathcal{B}''}} = \cos\left(\frac{\phi}{2}\right) \qquad \beta_{1_{\mathcal{B}/\mathcal{B}''}} = \sin\left(\frac{\phi}{2}\right) \qquad \beta_{2_{\mathcal{B}/\mathcal{B}''}} = 0 \qquad \beta_{3_{\mathcal{B}/\mathcal{B}''}} = 0$$

- p. 109, 4th equation from top: replace with

$$\begin{pmatrix}\beta_0\\ \beta_1\\ \beta_2\\ \beta_3\end{pmatrix} = \begin{bmatrix} c_3 & -s_3 & 0 & 0\\ s_3 & c_3 & 0 & 0\\ 0 & 0 & c_3 & s_3\\ 0 & 0 & -s_3 & c_3\end{bmatrix}\begin{bmatrix} c_2 & 0 & -s_2 & 0\\ 0 & c_2 & 0 & -s_2\\ s_2 & 0 & c_2 & 0\\ 0 & s_2 & 0 & c_2\end{bmatrix}\begin{pmatrix} c_1\\ 0\\ 0\\ s_1\end{pmatrix}$$

- p. 109, last set of equations of Example 3.9: replace with

$$\beta_0 = \sin\left(\frac{\phi}{2}\right)\sin\left(\frac{\theta}{2}\right)\sin\left(\frac{\psi}{2}\right) + \cos\left(\frac{\phi}{2}\right)\cos\left(\frac{\theta}{2}\right)\cos\left(\frac{\psi}{2}\right)$$
$$\beta_1 = \sin\left(\frac{\phi}{2}\right)\cos\left(\frac{\theta}{2}\right)\cos\left(\frac{\psi}{2}\right) - \cos\left(\frac{\phi}{2}\right)\sin\left(\frac{\theta}{2}\right)\sin\left(\frac{\psi}{2}\right)$$
$$\beta_2 = \cos\left(\frac{\phi}{2}\right)\sin\left(\frac{\theta}{2}\right)\cos\left(\frac{\psi}{2}\right) + \sin\left(\frac{\phi}{2}\right)\cos\left(\frac{\theta}{2}\right)\sin\left(\frac{\psi}{2}\right)$$
$$\beta_3 = \cos\left(\frac{\phi}{2}\right)\cos\left(\frac{\theta}{2}\right)\sin\left(\frac{\psi}{2}\right) - \sin\left(\frac{\phi}{2}\right)\sin\left(\frac{\theta}{2}\right)\cos\left(\frac{\psi}{2}\right)$$

- p. 114, after Eq. (3.121) : Change text to "where $\zeta = \sqrt{\text{trace}([C]) + 1} = 2\beta_0$"

- p. 121, below Eq. (3.148) : On the 4th and 5th line after this equation, change $\zeta = -1$ to $\zeta = 0$ on 2 locations in this paragraph.

- p. 139, Problem 3.15 : Should read "...given in Eq. (3.82)."

- p. 139, Problem 3.16 : Should read "Verify that Eq. (3.90) is indeed..." and "...given in Eq. (3.89)."

- p. 139, Problem 3.17 : Should read "... matrix $[C]$ in Eq. (3.72) written..."

- p. 140, Problem 3.18 : Should read "Starting with Eq. (3.97), verify..." and "... given in Eqs. (3.98) and (3.99)."

- p. 140, Problem 3.20 : Should read "Verify the transformation in Eq. (3.115) that..."

- p. 143, line before Eq. (4.2): Should read "... vector in Eq. (2.99) is ..."

- p. 144, 2 lines before Eq. (4.5): Should read "... of mass in Eq. (2.81), the ..."

- p. 146, 2nd to last equation on page : Should read

$$\boldsymbol{r}_{1/3} = \pm r\hat{\boldsymbol{b}}_1 \qquad \boldsymbol{r}_{2/4} = \pm r\hat{\boldsymbol{b}}_2$$

- p. 146, last equation on this page : The third matrix term should read

$$\cdots + (m_2 + m_4)\begin{bmatrix} r^2 & 0 & 0\\ 0 & 0 & 0\\ 0 & 0 & r^2\end{bmatrix}$$

- p. 150, 3rd line from bottom: Change to "Note that if $\ddot{\phi}$ were not 0, ..."

- p. 150, 2nd equation from top: Change to $\boldsymbol{L}_O = \boldsymbol{R}_c \times \boldsymbol{N} + \cdots$

- p. 156, 5th line of Example 4.4: Change sentence to "The gimbal frame $\mathcal{G} : \{\hat{\boldsymbol{g}}_1, \hat{\boldsymbol{g}}_2, \hat{\boldsymbol{g}}_3\}$ differs from to the inertial frame by a (3-1) sequential rotation with the angles (ϕ, θ)."

- p. 156, last equation on page: Change to $[GI] = [M_1(\theta)][M_3(\phi)]$

- p. 157, 2nd equation on page: Change to $\boldsymbol{\omega}_{\mathcal{G}/\mathcal{I}} = \omega_n \hat{\boldsymbol{g}}_1 + \omega_p \sin\theta \hat{\boldsymbol{g}}_2 + \omega_p \cos\theta \hat{\boldsymbol{g}}_3$

- p. 158, equation at top of page: Change to

$$\dot{\boldsymbol{H}} = \frac{{}^{\mathcal{G}}\mathrm{d}}{\mathrm{d}t}\left([I_W]\boldsymbol{\omega}_{\mathcal{W}/\mathcal{I}}\right) + \boldsymbol{\omega}_{\mathcal{G}/\mathcal{I}}\left([I_W]\boldsymbol{\omega}_{\mathcal{W}/\mathcal{I}}\right) = \boldsymbol{L}$$

- p. 165, equation at top of page: Reverse the arrows on the septratrix in Figure 4.9(b). The figure should be

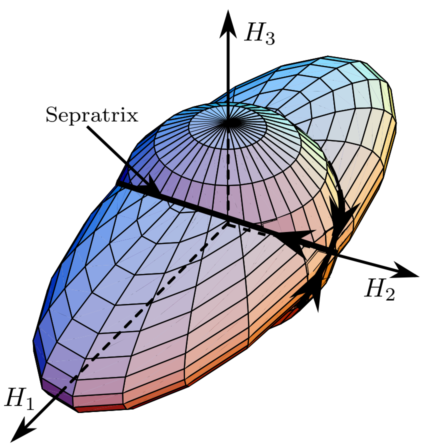

Figure 1: Figure 4.9(b)

- p. 169, first equation : Change to $\dot{\omega}_1 = \dot{\omega}_2 = \dot{\omega}_3 = 0$

- p. 170, 2nd line after Eq. (4.75) : "..., we substitute Eq. (4.75) into Eq. (3.56) and ..."

- p. 170, sentence after (4.77c) : replace the two "positives" with "negatives" to read: Having chosen the inertial angular momentum vector ${}^{\mathcal{N}}\boldsymbol{H}$ to be in the negative $\hat{\boldsymbol{n}}_3$ direction, the precession rate $\dot{\psi}$ will be a negative constant for an axisymmetric rigid body.

- p. 173, Eq. (4.83) : Should read "$\cdots [I_W](\dot{\Omega}\hat{\boldsymbol{b}}_1) + \cdots$"

- p. 175, Eq. (4.89b) and (4.89c) : Missing Ω term, should read:

$$\delta\dot{\omega}_2 = \left(\frac{I_3 - I_1}{I_2}\omega_{e_1} - \frac{I_{W_s}}{I_2}\Omega\right)\delta\omega_3$$
$$\delta\dot{\omega}_3 = \left(\frac{I_1 - I_2}{I_3}\omega_{e_1} + \frac{I_{W_s}}{I_3}\Omega\right)\delta\omega_2$$

- p. 175, Eq. (4.91): Missing Ω term, should read:

$$\delta\ddot{\omega}_2 = \left(\frac{I_3 - I_1}{I_2}\omega_{e_1} - \frac{I_{W_s}}{I_2}\Omega\right)\delta\dot{\omega}_3$$

- p. 176, 4 lines after (4.95): Should read

$$I_1 < I_3 \qquad I_1 < I_2 \qquad \Rightarrow \qquad \text{spin about axis of minimum inertia}$$

- p. 178, Last line of Example 4.7: Remove the "hat" symbols to read

$$\Omega < -300\text{rpm} \qquad \text{and} \qquad \Omega > 300\text{rpm}$$

- p. 182, First sentence after (4.108): Clarify sentence by replacing it with "The matrix $[I_s]$ contains the moments of inertia of all the fixed parts of the spacecraft (including the VSCMGs as point masses) about the overall spacecraft center of mass."

- p. 184, First sentence after (4.125): Change to "Let $\boldsymbol{L}_G$ be the torque vector that the spacecraft exerts onto the combined RW and CMG system; then..."

- p. 195, (4.171): Change superscript 3 to 2 to read:

$$\dot{\boldsymbol{\sigma}} = \frac{1}{4}[B(\boldsymbol{\sigma})]\boldsymbol{\omega} - \frac{\Omega}{4}\begin{pmatrix} 2\left(\sigma_1\sigma_2 + \sigma_3\right) \\ 2\sigma_2^2 + 1 - \sigma^2 \\ 2\left(\sigma_2\sigma_3 - \sigma_1\right) \end{pmatrix}$$

- p. 214, 2nd Equation: Add r to change 2nd expression to $y = r\sin\theta$

- p. 214, middle of page: In expression after the 3rd equal sign, remove an "r" to make the equation read

$$\delta\boldsymbol{R} = \delta x\hat{\boldsymbol{e}}_1 + \delta y\hat{\boldsymbol{e}}_2 = (-\sin\theta\hat{\boldsymbol{e}}_1 + \cos\theta\hat{\boldsymbol{e}}_2)r\delta\theta = (-y\hat{\boldsymbol{e}}_1 + x\hat{\boldsymbol{e}}_2)\delta\theta = r\delta\theta\hat{\boldsymbol{e}}_\theta$$

- p. 215, 3rd equation from bottom: Remove the "-" sign in the last term, and change to $\cdots = (f_{12}\hat{\boldsymbol{e}}_r)\cdot(L\delta\theta\hat{\boldsymbol{e}}_\theta)$

- p. 219, Eq. (5.35): Change to $\boldsymbol{f}_1 = -kx\hat{\boldsymbol{n}}_1 - m_1 g\hat{\boldsymbol{n}}_2 \qquad \boldsymbol{f}_2 = \cdots$

- p. 220, 2nd line of Eq. (5.42): Change to

$$\cdots = [(-kx)\hat{\boldsymbol{n}}_1 - (m_1 g)\hat{\boldsymbol{n}}_2]\cdot[\hat{\boldsymbol{n}}_1] + [-m_2 g\hat{\boldsymbol{n}}_2]\cdot[\hat{\boldsymbol{n}}_1]$$

- p. 222, third equation from bottom of page: Change to $\cdots = mr(2\dot{r}\dot{\theta} + r\ddot{\theta}) = \cdots$

- p. 222, 2nd equation from bottom of page: Change to $\ddot{\theta} = -2\frac{\dot{r}}{r}\dot{\theta}$

- p. 223, third equation from top of page: Change to

$$\cdots = mr(2\dot{r}\dot{\theta} + r\ddot{\theta}) = 0 \qquad \Rightarrow \qquad \ddot{\theta} = -2\frac{\dot{r}}{r}\dot{\theta}$$

- p. 246, 2nd equation from top of page: Change to

$$\mathcal{L} = T - V = \frac{1}{2}m(\dot{r}^2 + r^2\dot{\theta}^2) + mgr\cos\theta - \frac{1}{2}k(r - r_0)^2$$

- p. 254, last of 1st set of equations: Change to $\Psi_N(\boldsymbol{q}) = \theta_N - \theta_{N-1} - \delta\theta = 0$

- p. 255, third text block from bottom of page: Change to "... and the rigid shape constraints Ψ_2 to Ψ_N, which require..."
- p. 256, Eq. (5.196): reverse the index on A to read: $\cdots = Q_x + \sum_{i=1}^m \lambda_i A_{i1} = \lambda_1$
- p. 256, Eq. (5.197): reverse the index on A to read: $\cdots = Q_{\theta_1} + \sum_{i=1}^m \lambda_i A_{i2} = -r\lambda_1 - \lambda_2$
- p. 256, Eq. (5.198): reverse the index on A to read: $\cdots = Q_{\theta_2} + \sum_{i=1}^m \lambda_i A_{i3} = \lambda_2 - \lambda_3$
- p. 256, Eq. (5.199): reverse the index on A to read: $\cdots = Q_{\theta_k} + \sum_{i=1}^m \lambda_i A_{i(k+1)} = \lambda_k - \lambda_{k+1}$
- p. 256, Eq. (5.200): reverse the index on A to read: $\cdots = Q_{\theta_N} + \sum_{i=1}^m \lambda_i A_{in} = \lambda_N$
- p. 258, 2nd to last equation from bottom of page: Add the "-" sign to the last two expressions to read:

$$Q_y = \sum_{i=1}^{N} \boldsymbol{f}_i \cdot \frac{\partial \dot{\boldsymbol{R}}_i}{\partial \dot{y}} = \sum_{i=1}^{N} (-m_i g \hat{\boldsymbol{n}}_2) \cdot \hat{\boldsymbol{n}}_2 = -\left(\sum_{i=1}^{N} m_i\right) g = -Mg$$

- p. 275, Eq. (5.260) : square the mass to read

$$\ddot{r} + \omega^2 r - \frac{p_\theta^2}{m^2 r^3} = 0$$

- p. 278, Eq. (5.271) : Reverse the arrow to point to the right, i.e. "$\Rightarrow$"
- p. 300, Eq. (6.38) : On the right hand side, change mc to mc^2 by adding the square over the c variable
- p. 300, Eq. (6.39) : 2nd line, change right hand side to $t_f < \frac{10}{\omega^2}$, 3rd line change right hand side to $t_f > \frac{10}{\omega^2}$
- p. 300, Eq. (6.40) : change the partial symbol to a del symbol to read: $\mathcal{B} = \sum_{i=1}^N m_i \dot{\boldsymbol{R}}_i \cdot \delta \boldsymbol{R}_i$
- p. 301, Eq. (6.43) : add a dot to read: $\mathcal{B} = \sum_{i=1}^N m_i \dot{\boldsymbol{R}}_i \cdot \delta \boldsymbol{R}_i \equiv \sum_{j=1}^N \frac{\partial T}{\partial \dot{q}_j} \delta q_j$
- p. 306, Eq. (6.63) : add the dt term to the integral to read: $m \int_0^t (\dot{q}\delta\dot{q} - g\delta q)\mathrm{d}t = m\left(\dot{q}\delta\dot{q}\right)\Big|_0^t$
- p. 307, 2nd line from bottom : Replace Eqn. (6.62) with (6.44)
- p. 309, lines 8 + 10 after Eq. (6.72) : Replace Eqn. (6.62) with (6.44)
- p. 310, Eq. (6.75) : change the "x" to "l" to read:

$$\mathcal{L} = \mathcal{L}_D(t, \boldsymbol{q}(t), \dot{\boldsymbol{q}}(t)) + \mathcal{L}_B\left(t, \boldsymbol{q}(t), \dot{\boldsymbol{q}}(t), \boldsymbol{w}(t,l), \dot{\boldsymbol{w}}(t,l), \boldsymbol{w}'(t,l), \dot{\boldsymbol{w}}'(t,l)\right) \cdots$$

- p. 311, Eq. (6.79) : last line of this equation, add the "prime" symbol to read:

$$+ \int_{t_0}^{t_f} \left[\frac{\partial \hat{\mathcal{L}}}{\partial \boldsymbol{w}''} \delta \boldsymbol{w}' \Big|_0^l + \left\{ \frac{\partial \mathcal{L}_B}{\partial \boldsymbol{w}'(l)} - \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\partial \mathcal{L}_B}{\partial \dot{\boldsymbol{w}}'(l)} \right) \right\} \delta \boldsymbol{w}'(l) + \boldsymbol{f}_2^T \delta \boldsymbol{w}'(l) \right] \mathrm{d}t = 0$$

- p. 312, Eq. (6.83) : Add the "prime" symbol in the denominator to read

$$\frac{\partial \hat{\mathcal{L}}}{\partial \boldsymbol{w}''} \delta \boldsymbol{w}' \Big|_0^l + \left\{ \frac{\partial \mathcal{L}_B}{\partial \boldsymbol{w}'(l)} - \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\partial \mathcal{L}_B}{\partial \dot{\boldsymbol{w}}'(l)} \right) \right\} \delta \boldsymbol{w}'(l) + \boldsymbol{f}_2^T \delta \boldsymbol{w}'(l) = 0$$

- p. 316, middle of page : Add 1/2 to both terms to read:

$$\hat{\mathcal{L}} = \frac{1}{2}\rho A(\dot{v} + x\dot{\theta})^2 - \frac{1}{2}EI(v'')^2$$

- p. 313, last line before equations at bottom of page: add minus sign to change to "$\delta\mathcal{L} = \delta T - \delta V$, we take the first variations of the energy expressions:"

- p. 316, 2nd and 3rd equation from bottom of page : Add the missing "A" and "L" terms to read

$$I_{\text{hub}}\ddot{\theta} + \int_{r_0}^{L} \rho A x(\ddot{v} + x\ddot{\theta})\mathrm{d}x + m_{\text{tip}}L(L\ddot{\theta} + \ddot{v}(L,t)) + I_{\text{tip}}(\ddot{\theta} + \ddot{v}(L,t)) = 0$$

$$\rho A(\ddot{v} + x\ddot{\theta}) + EIv'''' = 0$$

- p. 317, 1st equation on top of page : Change to: $EIv'''(L,t) = m_{\text{tip}}(L\ddot{\theta} + \ddot{v}(L,t))$

- p. 385, Eq. (8.86) : add brackets to read

$$\boldsymbol{u} = -K\boldsymbol{\epsilon} - [P]\delta\boldsymbol{\omega} + [I](\dot{\boldsymbol{\omega}}_r - \boldsymbol{\omega} \times \boldsymbol{\omega}_r) + [\tilde{\boldsymbol{\omega}}][I]\boldsymbol{\omega} - \boldsymbol{L}$$

- p. 389, Eq. (8.100) : change to "$\cdots + 2K\ln(1 + \boldsymbol{\sigma}^T\boldsymbol{\sigma}) + \cdots$"

- p. 400, Eq. (8.134) : change last part to

$$\cdots - \sum_{i=M+1}^{N} u_{\max_i}\omega_i \cdot \operatorname{sgn}(\omega_i)$$

- p. 408, sentence before Eq. (8.160) : change to "... within Example 4.8 and are..."

- p. 409, Eq. (8.168) : The first line bracketed term should remove the "$-\boldsymbol{\omega}_r$" term to read $\cdots - [\tilde{\boldsymbol{\omega}}]([I_{\text{RW}}]\boldsymbol{\omega} + [G_s]\boldsymbol{h}_s)$

- p. 412, sentence before (8.176) : Change to "... unit vectors in Eqs. (4.118)–(4.120), the ..."

- p. 412, Eq. (8.177) : The derivative of $\delta\boldsymbol{\omega}$ should be a body frame derivative, not an inertial derivative. Change equation to read

$$[I]\frac{{}^{\mathcal{B}}\mathrm{d}(\delta\boldsymbol{\omega})}{\mathrm{d}t} = -K\boldsymbol{\sigma} - [P]\delta\boldsymbol{\omega} - \frac{1}{2}\frac{{}^{\mathcal{B}}\mathrm{d}}{\mathrm{d}t}[I]\delta\boldsymbol{\omega}$$

- p. 458, 3rd equation in Example 9.3: make the subscript bold to read

$$\nabla_{\boldsymbol{r}}V = \cdots$$

- p. 458, 4th equation in Example 9.3: make the subscript bold to read

$$\nabla_{\boldsymbol{r}}V = \cdots$$

- p. 458, text above Eq. (9.65): change to:
  ... of $\ddot{\boldsymbol{r}}$ and $-\nabla_{\boldsymbol{r}}$, we find the ...

- p. 458, Eq. (9.65): add minus sign to change to:

$$\ddot{r} = r\dot{\theta}^2 - \frac{\mu}{r^2}$$

- p. 435, Problem 8.12: Change text to "... a large unmodeled external torque vector of..."
- p. 465, Table 9.2: Change Pluto's radius from 2.90×10^3 to 1.20×10^3
- p. 479, 1st line after (9.149): Change text to "... are illustrated in Fig. 9.9."
- p. 493, 9th line: Change text to "...of the brilliant Italian astronomer and mathematician Lagrange."
- p. 498, Eq. (10.31): change the mass subscript to read:

$$m_3 \boldsymbol{r}_2 \times \boldsymbol{r}_3 \left(\frac{1}{r_{23}^3} - \frac{1}{r_{12}^3} \right) = 0$$

- p. 498, Eq. (10.32): change the mass subscript to read:

$$m_1 \boldsymbol{r}_3 \times \boldsymbol{r}_1 \left(\frac{1}{r_{13}^3} - \frac{1}{r_{23}^3} \right) = 0$$

- p. 502, 3rd sentence from top: Change text to "Subtracting Eq. (10.44) from Eq. (10.45) and Eq. (10.45) from Eq. (10.46) yields"
- p. 513, Eq. (10.91): Add $+ \overset{\circ}{z}{}^2$ to read

$$v^2 = (\overset{\circ}{x}{}^2 + \overset{\circ}{y}{}^2 + \overset{\circ}{z}{}^2) = \cdots$$

- p. 515, last paragraph of Example 10.5: Change the order of L_1, L_2 and L_3 to read "As expected, the L_1 point is between the Earth-moon system, the L_3 is on the "backside" of Earth, and L_2 is on the ...."
- p. 525, (10.115): change to $\lambda_x = \pm\sqrt{2E+1}$
- p. 525, (10.116): change to $\lambda_y = \pm\sqrt{E-1}$
- p. 582, (12.86c): change to

$$\frac{\mathrm{d}\omega}{\mathrm{d}t} = \frac{3}{2} J_2 n \frac{p}{r^2 e \eta^3} \left(\frac{r_{\text{eq}}}{r} \right)^2 \left[2re\cos^2 i \sin^2\theta - (p+r)\sin f \sin^2 i \sin(2\theta) + p\cos f (1 - 3\sin^2 i \sin^2\theta) \right]$$

- p. 582, (12.86f): change to

$$\frac{\mathrm{d}M_0}{\mathrm{d}t} = \frac{3}{2} J_2 n \frac{p}{r^2 e \eta^2} \left(\frac{r_{\text{eq}}}{r} \right)^2 \left[(p+r)\sin f \sin^2 i \sin(2\theta) + (2re - p\cos f)(1 - 3\sin^2 i \sin^2\theta) \right]$$

- p. 582, After (12.86f): Add the statement "where $\eta = \sqrt{1-e^2}$. Taking the partial..."
- p. 583, end of paragraph after Eq. (12.87): The critical inclination angle should be $i_{\text{crit}} = 63.4349$ deg

- p. 591, Eq. 138 2nd line should start with a "+", not a negative sign, to read:

$$\frac{\mathrm{d}\omega}{\mathrm{d}t} = \frac{\partial \omega}{\partial \boldsymbol{v}} \boldsymbol{a}_d = -\frac{1}{he}\left(\frac{r}{p}(\cos f + e) + e\right) \boldsymbol{r}^T \boldsymbol{a}_d$$
$$+ \frac{r}{h^2 e}(p+r)\sin f \boldsymbol{v}^T \boldsymbol{a}_d - \frac{r \sin\theta}{h \tan i} \hat{\boldsymbol{\imath}}_h^T \boldsymbol{a}_d$$

- p. 611, Eq. (12.254): The 2nd line is missing a "+" at the beginning

- p. 612, Problem 12.3: Clarify Problem by adding two sub-problems:
  Repeat Example 12.2, but treat $e_1 = y_0$ and $e_2 = g$ as invariants of the motion. Develop the necessary differential equations which $e_1(t)$ and $e_2(t)$ must satisfy.

  a) Use the Lagrangian matrix method in Eq. (12.27)
  b) Even though $e_2 = g$ is not a state, see if using the Lagrangian bracket method to develop the variational equations yields the same result. Comment on weather the brackets explicitly depend on time in this case.

- p. 612, Reference 2: Change to "McCuskey, S. W., *Introduction to Celestial Mechanics*, ..."

- p. 692, Eq. (14.74): Change to "$\cdots -2\alpha\nu(1+2\kappa_1 + \kappa_2)y(t)\cdots$"

- p. 696, Eq. (14.104): Reverse the r/r_0 ratio to read:

$$\delta f = \underbrace{-\frac{3}{2}\frac{a\eta}{r^2}(M - M_0)}_{A}\delta a + \underbrace{\left(\frac{r_0}{r}\right)^2}_{B}\delta f_0$$
$$+ \underbrace{\left(\sin f(2 + e\cos f) - \sin f_0(2 + e\cos f_0)\left(\frac{r_0}{r}\right)^2\right)\frac{1}{\eta^2}}_{C}\delta e$$

- p. 697, Eq. (14.107): Reverse the r/r_0 ratio to read:

$$B = \left(\frac{r_0}{r}\right)^2$$

- p. 697, Eq. (14.108): Reverse the r/r_0 ratio to read:

$$C = \frac{1}{\eta^2\sqrt{q_1^2+q_2^2}}\Big((\sin\theta q_1 - \cos\theta q_2)(2 + q_1\cos\theta + q_2\sin\theta)$$
$$-(\sin\theta_0 q_1 - \cos\theta_0 q_2)(2 + q_1\cos\theta_0 + q_2\sin\theta_0)\left(\frac{r_0}{r}\right)^2\Big)$$

- p. 698, Eq. (14.114): The a should be δa to read $\delta\boldsymbol{e} = (\delta a, \delta M, \delta i, ...$

- p. 712, Eq. (14.149): The first term in the square brackets is missing a factor of η, should read

$$J_2 \frac{3}{2L^7\eta^5}\left[\frac{7\eta}{L}\cos i \delta L + \cdots\right.$$

- p. 740, line before Eq. (14.232): change text to "...to the negative semi-definite quantity"

- p. 743, Eq. (14.241): change the location of the 2nd square symbol to make the equation read

$$\Delta v_h = \frac{h}{r}\sqrt{\Delta i^2 + \Delta\Omega^2 \sin^2 i}$$

- p. 744, line before Eq. (14.242): change text to "... in Eq. (14.239) into Eq. (14.186e), the $\Delta\Omega$ correction..."

- p. 748, Eq. (14.265): Should read $V(\Delta\boldsymbol{x}, \Delta\boldsymbol{v}) = ...$

- p. 749, Eq. (14.269): Change $\boldsymbol{\Delta x}$ and $\boldsymbol{\Delta y}$ to $\boldsymbol{x}$ and $\boldsymbol{y}$:

$$\boldsymbol{u} = -\begin{bmatrix} A_1 + K & A_2 + P \end{bmatrix} \left(\begin{pmatrix} \boldsymbol{x} \\ \boldsymbol{v} \end{pmatrix} - [A(\boldsymbol{e})]\delta\boldsymbol{e}^* \right)$$

- p. 749, Eq. (14.270): Change $\boldsymbol{\Delta x}$ and $\boldsymbol{\Delta v}$ to $\boldsymbol{x}$ and $\boldsymbol{v}$:

$$\begin{bmatrix} A_1 + K & P \end{bmatrix} \left(\begin{pmatrix} \boldsymbol{x} \\ \boldsymbol{v} \end{pmatrix} - [A(\boldsymbol{e})]\delta\boldsymbol{e}^* \right)$$

- p. 749, bottom of page, reference 1: should be "Vol. 21"

- p. 752, HW 14.2: Change the last part of the HW statement paragraph to read "$\cdots$, $e_d = e + 00001$ and $\omega_d = \omega - 0.01$deg. "

- p. 767, Box showing e expression in terms of p and a: reverse the sign to read

$$\sqrt{1 - \frac{p}{a}}$$

- p. 779, Eq. (G.1): change to $\alpha = a/R$

- p. 779, Eq. (G.3): change to $\rho = R/p$

- p. 779, after Eq. (G.5): Add text:
  where R is the current orbit radius. The non-zero matrix...

- p. 780, Eq. (G.6j): change to $A^{-1}_{41} = \frac{1}{\rho R}(3\cos\theta + 2\nu\sin\theta)$

- p. 780, Eq. (G.6k): change to $A^{-1}_{42} = -\frac{1}{R}\left(\frac{\nu^2 \sin\theta}{\rho} + q_1 \sin 2\theta - q_2 \cos 2\theta\right)$

- p. 780, Eq. (G.6m): change to $A^{-1}_{44} = \frac{\sin\theta}{\rho V_t}$

- p. 780, Eq. (G.6n): change to $A^{-1}_{45} = \frac{1}{\rho V_t}(2\cos\theta + \nu\sin\theta$

- p. 780, Eq. (G.6p): change to $A^{-1}_{51} = \frac{1}{\rho R}(3\sin\theta - 2\nu\cos\theta)$

- p. 780, Eq. (G.6q): change to $A^{-1}_{52} = \frac{1}{R}\left(\frac{\nu^2 \cos\theta}{\rho} + q_2 \sin 2\theta + q_1 \cos 2\theta\right)$

- p. 780, Eq. (G.6s): change to $A^{-1}_{54} = -\frac{\cos\theta}{\rho V_t}$

- p. 780, Eq. (G.6t): change to $A^{-1}_{55} = \frac{1}{\rho V_t}(2\sin\theta - \nu\cos\theta)$

Revision History

- October 11, 2009: page 744
- Nov. 17, 2009: page 740
- Nov. 19, 2009: page 749, 743
- Dec 1, 2009: page 300
- Dec 4, 2009: page 169
- Dec 15, 2009: page 515
- Jan 22, 2010: page 22
- Feb 4, 2010: pages 139, 140
- Feb 21, 2010: pages 146
- Feb 24, 2010: pages 146, 150, 156, 157
- March 8, 2010: pages 109
- March 9, 2010: pages 170, 748
- March 31, 2010: pages 157
- April 2nd, 2010: pages 173
- April 5, 2010: pages 143, 144, 150, 175
- April 17, 2010: pages 176
- April 21, 2010: pages 582, 612
- April 27, 2010: pages 178
- May 6, 2010: pages 389
- June 17, 2010: pages 493
- Sept. 27, 2010: pages 409, 412
- Oct. 2, 2010: pages 214
- Oct. 5, 2010: pages 222, 223
- Oct. 6, 2010: pages 692
- Oct. 21, 2010: pages 246, 223, 214
- Oct. 24, 2010: pages 254, 255
- Nov 30, 2010: pages 258, 300, 301, 306, 311, 312, 316, 317
- Jan 25, 2011: page 93

- Mar 31, 2011: page 158
- April 15, 2011: page 184, 195
- April 20, 2011: page 385
- August 29, 2011: page 465
- September 11, 2011: page 612
- September 27, 2011: page 752
- October 4, 2011: page 525, 611, 698, 712
- October 8, 2011: page 479
- December 1, 2011: page 165
- January 11, 2012: page 80
- January 29, 2012: page 108
- March 9, 2012: page 170
- April 16, 2012: pages 307, 309
- April 26, 2012: pages 182
- Aug 16, 2012: pages 275, 278
- October 30, 2012: pages 215, 412
- November 5, 2012: pages 256
- January 22, 2013: pages 16, 22
- July 3, 2013: page 749
- October 9, 2013: pages 458, 498, 502, 767
- December 5, 2013: page 513
- December 19, 2013: page 583
- April 22, 2014: page 696, 697