Errata List for the AIAA Education Series Text Book

Analytical Mechanics of Space Systems

1^{st} Edition, 2^{nd} Printing

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This file contains various typos that were found in the first edition, 2^{nd} printing of the text book. Please use this page to update your book copy. If you find typos that are not listed here, please contact the author at schaub@vt.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. 37, Figure 2.4: Change figure title to "Planar pendulum illustration"
- p. 37, 1st line within Example 2.4: Change to "Consider the motion of a planar pendulum of length L ..."
- p. 42, 2nd to last equation: Last term in bracket is missing l and should read

$$\cdots - l\dot{\theta}^2 \sin\theta) = \cdots$$

- p. 45, Eq. (2.47) Left hand side should read $M\ddot{\boldsymbol{R}}_c = \cdots$
- p. 49, 4 lines before Eq. (2.63): change "... and the inertial force component..." to "... and the internal force component ..."
- p. 52, Figure 2.8 Replace figure with that in Figure 1

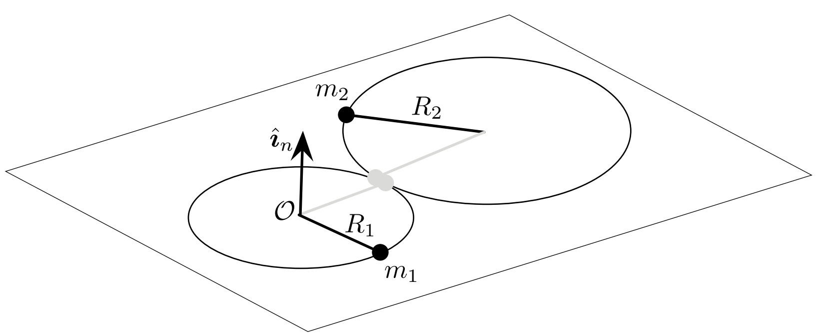

Figure 1: (Fig. 2.8) Illustration of two Particles Moving in a Circular Manner on a Level Plane

- p. 53, 1st equation Should read

$$T(t_0^-) = \frac{m_1}{2} v_1(t_0^-)^2 + \frac{m_2}{2} v_2(t_0^-)^2$$

- p. 53, line after 1st equation   Change this text to "while the momentum H about $\mathcal{O}$ along the plane normal direction $\hat{\boldsymbol{\imath}}_n$ is"

- p. 53, 2nd equation   Should read

$$H(t_0^-) = R_1 m_1 v_1(t_0^-) - R_1 m_2 v_2(t_0^-) = R_1(m_1 v_1(t_0^-) - m_2 v_2(t_0^-))$$

- p. 53, 3rd + 4th equation   Should read

$$\begin{aligned} T(t_0^+) &= \frac{m_1}{2} v_1(t_0^+)^2 + \frac{m_2}{2} v_2(t_0^+)^2 \\ H(t_0^+) &= R_1(m_1 v_1(t_0^+) - m_2 v_2(t_0^+)) \end{aligned}$$

- p. 53, 5th + 6th equation   Should read

$$\begin{aligned} v_1(t_0^+) &= \frac{m_1 v_1(t_0^-) - m_2(v_1(t_0^-) + 2 v_2(t_0^-))}{m_1 + m_2} \\ v_2(t_0^+) &= \frac{m_2 v_2(t_0^-) - m_1(v_2(t_0^-) + 2 v_1(t_0^-))}{m_1 + m_2} \end{aligned}$$

- p. 58, 8$^{\text{th}}$ line after Section 2.6:   change the word "aftward" to "backwards"

- p. 58, Section 2.6, 2nd paragraph: change text to " … we utilize Eq. (2.64) or (2.93), which state … "

- p. 74, before (3.14)   Reference should be "6", not "7"

- p. 74, after (3.14)   Reference should be "7", not "8"

- p. 77, before (3.22)   Reference should be "8", not "9"

- p. 77, before (3.27)   Reference should be "9", not "10"

- p. 80, end of first paragraph   Reference should be '11", not "12"

- p. 81, before (3.33)   Reference should be "10", not "11"

- p. 82, end of paragraph after (3.37)   Reference should be "4,12", not "5,13"

- p. 84, middle of paragraph after (3.47)   Reference should be "4,12", not "5,13"

- p. 85, Ex. 3.2   the (3,1) element of the $[BN]$ matrix should be 0.126826, remove the negative sign.

- p. 87, section 3.4   Reference should be "13,14", not "14,15"

- p. 88, first line   Reference should be "7", not "8"

- p. 91, last line   Reference should be "15", not "16"

- p. 92, before (3.81)   Reference should be "4,15", not "5,16"

- p. 93, before (3.84)   Reference should be "4", not "5"

- p. 94, before (3.88)   Reference should be "4,16–18", not "5,17–19"

- p. 97, before (3.94a) Reference should be "19", not "20"
- p. 99, Example 3.7 The values of the $[FN]$ matrix at the end are switched. It should state

$$[FN] = \begin{bmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} & 0 \\ 0 & 0 & 1 \\ \frac{\sqrt{3}}{2} & -\frac{1}{2} & 0 \end{bmatrix}$$

- p. 102, 3rd line from bottom Reference should be "20", not "21"
- p. 103, before (3.117) Reference should be "20", not "21"
- p. 104, before (3.118) Reference should be "3,20", not "4,21"
- p. 104, before (3.119) Reference should be "4,20", not "5,21"
- p. 104, before (3.123) Reference should be "4,21", not "5,22"
- p. 105, before (3.127) Reference should be "3", not "4"
- p. 105, before (3.129) Reference should be "4", not "5"
- p. 105, last line Reference should be "3,4,9,15,22", not "4,5,10,16,23"
- p. 106, middle of page Reference should be "3,9", not "4,10"
- p. 106, before (3.132) Reference should be "3,9,15", not "4,10,16"
- p. 107, before (3.134) Reference should be "4,20,23–25", not "5,21,24–26"
- p. 109, before (3.139) Reference should be "20,24", not "21,25"
- p. 110, before (3.143) Reference should be "4,20,24,25", not "5,21,25,26"
- p. 110, before (3.144) Reference should be "4,20", not "5,21"
- p. 111, before (3.147) Reference should be "4", not "5"
- p. 112, before (3.149) Reference should be "20,25", not "21,26"
- p. 112, before (3.150) Reference should be "4,20", not "5,21"
- p. 112, before (3.151) Reference should be "26", not "27"
- p. 113, before (3.154) Reference should be "4", not "5"
- p. 113, before (3.155) Reference should be "15,27", not "16,28"
- p. 113, middle of page Reference should be "15", not "16"
- p. 113, 2nd line from bottom Reference should be "15", not "16"
- p. 115, section 3.8.1 Reference should be "20", not "21"
- p. 116, section 3.8.2 Reference should be "27", not "28"
- p. 118, section 3.8.3 (2nd line) Reference should be "28", not "29"

- p. 118, section 3.8.3 (3rd line) Reference should be “29”, not “30”
- p. 119, section 3.8.4 (4th line) Reference should be “14”, not “15”
- p. 120, before (3.186) Reference should be “30”, not “31”
- p. 121, before (3.193) Reference should be “3”, not “4”
- p. 122, ref. 19: change reference author to “Sheppard, S. W. ”
- p. 125, Problem 3.12 Replace $[\hat{\boldsymbol{e}}]$ with $[\tilde{\boldsymbol{e}}]$
- p. 129, Eq. (4.10): missing a subscript 2, should read

$$\boldsymbol{r} = r_1\hat{\boldsymbol{b}}_1 + r_2\hat{\boldsymbol{b}}_2 + r_3\hat{\boldsymbol{b}}_3$$

- p. 130, Eq. (4.17): Change equation to

$$\boldsymbol{H}_O = M\boldsymbol{R}_c \times (\boldsymbol{\omega} \times \boldsymbol{R}_c) + [I_c]\boldsymbol{\omega}$$

- p. 131, 4th line from top: Change sentence to “... the inertia matrix $\mathcal{B}$ about O is given...”
- p. 133, Example 4.1: After the first equation on the top of p. 133, change the text to: The normal force is defined as $\boldsymbol{N} = N\hat{\boldsymbol{e}}_3$, the surface friction force is $\boldsymbol{F_f} = F_f\hat{\boldsymbol{e}}_\phi$, and the gravity force is given by $\boldsymbol{F}_g = -mg\hat{\boldsymbol{e}}_3$. Note that at the hinge point only the torques $\boldsymbol{\tau}_\phi = \tau_\phi\hat{\boldsymbol{e}}_\phi$ and $\boldsymbol{\tau}_3 = \tau_3\hat{\boldsymbol{e}}_3$ are applied. The external torque about point O is

$$\begin{aligned}\boldsymbol{L}_O &= \boldsymbol{R}_c \times (\boldsymbol{R}_c + \boldsymbol{N}) + \boldsymbol{\tau}_\phi + \boldsymbol{\tau}_3 + (\boldsymbol{R}_c - r\hat{\boldsymbol{e}}_3) \times \boldsymbol{F}_f \\ &= rF_f\hat{\boldsymbol{e}}_L + (L(mg - N) + \tau_\phi)\,\hat{\boldsymbol{e}}_\phi + (\tau_3 + R_cF_f)\hat{\boldsymbol{e}}_3\end{aligned}$$

  Note that by taking the moments about point O the reaction forces of the pin joint O do not appear. Using Euler's equation $\dot{\boldsymbol{H}}_O = \boldsymbol{L}_O$ and equating vector components, we find

$$\begin{aligned}N &= mg + \frac{I_s}{r}\dot{\phi}^2 + \frac{\tau_\phi}{L} \\ \tau_3 &= 0 \\ F_f &= 0\end{aligned}$$

  To express τ_ϕ, we compute all moments and torque about the disk center of mass and find

$$\begin{aligned}\boldsymbol{H}_c &= [I_c]\boldsymbol{\omega}_{\mathcal{B}/\mathcal{N}} = -I_s\frac{L}{r}\dot{\phi}\hat{\boldsymbol{e}}_L + I_t\dot{\phi}\hat{\boldsymbol{e}}_3 \\ \boldsymbol{L}_c &= F_f r\hat{\boldsymbol{e}}_L - \tau_\phi\hat{\boldsymbol{e}}_\phi - \tau_3\hat{\boldsymbol{e}}_3\end{aligned}$$

  Using $\tau_3 = F_f = 0$ and $\dot{\boldsymbol{H}}_c = \boldsymbol{L}_c$, we find

$$\tau_\phi = I_s\frac{L}{r}\dot{\phi}^2$$

  Note that if $\dot{\phi}$ were not 0, then we would have a non-zero F_f term. Finally, the normal force magnitude is expressed as

$$N = mg + 2\frac{I_s}{r}\dot{\phi}^2$$

The polar moment of inertia of a circular disk of mass m and radius r is

$$I_s = \frac{m}{2} r^2$$

which allows N to be written as

$$N = m\left(g + r\dot{\phi}^2\right)$$

- p. 140, Ex. 4.3, 2nd equation from bottom: Should read $\ddot{\boldsymbol{r}}_c = -(R+r)\dot{\theta}^2\hat{\boldsymbol{e}}_r + (R+r)\ddot{\theta}\hat{\boldsymbol{e}}_\theta$
- p. 147, Fig 4.7: The sepratrix arrow directions were corrected, as shown in Fig. 2 of this document.

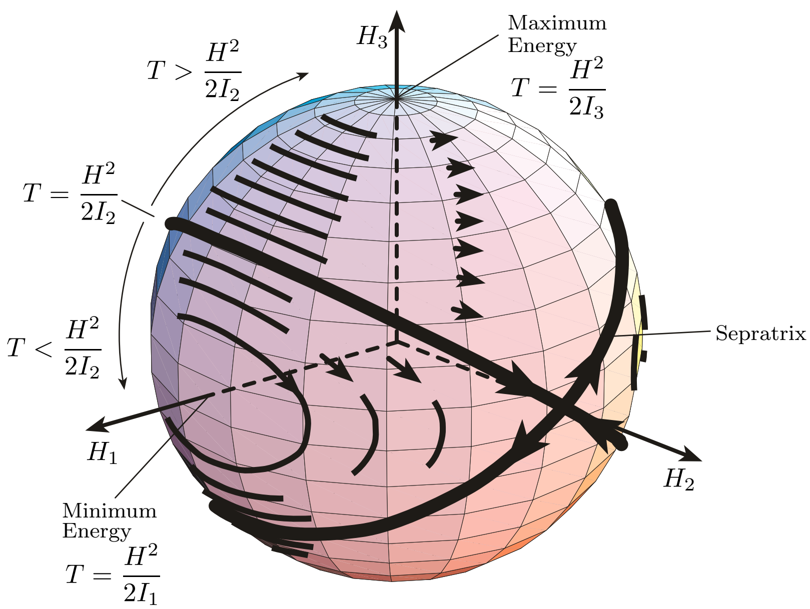

Figure 2: (Fig. 4.7) A Family of Energy Ellipsoid and Momentum Sphere Intersections

- p. 158, Eq.(4.113): 2nd term of right hand side should be $-\boldsymbol{\omega} \times J_s \hat{\boldsymbol{g}}_s(\omega_s + \Omega)$
- p. 159, Eq. 4.116b: Should begin with $\boldsymbol{\tau}_t = \cdots$
- p. 159, Eq. 4.199: Add brackets inside the summation terms to read $\sum_{i=1}^{N}\left(\dot{\gamma}u_{g_i} + \Omega_i u_{s_i}\right)$
- p. 161, Eq. 4.126: The last line of this equation should read

$$\approx \frac{1}{R_c^3}\left(1 - 3\frac{\boldsymbol{R}_c \cdot \boldsymbol{r}}{R_c^2} - \frac{3}{2}\left(\frac{\boldsymbol{r}\cdot\boldsymbol{r}}{R_c^2}\right) + \frac{15}{2}\left(\frac{\boldsymbol{R}_c \cdot \boldsymbol{r}}{R_c^2}\right)^2 + \cdots\right)$$

- p. 162, last sentence before Eq. 4.127: Change to "Substituting up to first order terms of Eq. (4.126) into Eq. (4.125) yields"
- p. 163, sentence before Eq. 4.136: " ... the resulting product, dropping terms higher than 2^{nd} order results in the gravity force vector $\boldsymbol{F}_G$ being expressed as"

- p. 163, Eq. 4.136: change equation to:

$$\boldsymbol{F}_G = -\frac{GM_e}{R_c^3}\left[\int_{\mathcal{B}} \boldsymbol{r}\mathrm{d}m - \frac{3}{R_c^2}\int_{\mathcal{B}}(\boldsymbol{r}\cdot\boldsymbol{R}_c)\boldsymbol{r}\mathrm{d}m + \boldsymbol{R}_c\int_{\mathcal{B}}\mathrm{d}m - \frac{3}{R_c^2}\int_{\mathcal{B}}(\boldsymbol{R}_c\cdot\boldsymbol{r})\boldsymbol{R}_c\mathrm{d}m \right.$$
$$\left. - \frac{3}{2R_c^2}\int_{\mathcal{B}}\boldsymbol{R}_c(\boldsymbol{r}\cdot\boldsymbol{r})\mathrm{d}m + \frac{15}{2R_c^4}\int_{\mathcal{B}}(\boldsymbol{R}_c\cdot\boldsymbol{r})^2\boldsymbol{R}_c\mathrm{d}m\right]$$

- p. 163, paragraph prior to Eq. 4.137: Change to "Note that the first and third term in the ... "

- p. 163, Eq. 4.137: Change equation to:

$$\boldsymbol{F}_G = -\frac{GM_e}{R_c^3}\left[m\boldsymbol{R}_c - \frac{3}{R_c^2}\int_{\mathcal{B}}\Big(\boldsymbol{r}\times(\boldsymbol{r}\times\boldsymbol{R}_c) + r^2\boldsymbol{R}_c\Big)\mathrm{d}m - \frac{3}{2R_c^2}\int_{\mathcal{B}} r^2\boldsymbol{R}_c\mathrm{d}m \right.$$
$$\left. + \frac{15}{2R_c^4}\int_{\mathcal{B}}\boldsymbol{R}_c\cdot\Big(\boldsymbol{r}\times(\boldsymbol{r}\times\boldsymbol{R}_c) + r^2\boldsymbol{R}_c\Big)\boldsymbol{R}_c\mathrm{d}m\right]$$

- p. 164, top of page: delete the text "where the last term in the parenthesis is zero due to the definition of the center of mass."

- p. 164, top of page: Change 2nd sentence to "Using the definition of the inertia matrix in Eq. (4.14), as well as $\hat{\boldsymbol{\imath}}_r = \boldsymbol{R}_c/R_c$ and $\int_{\mathcal{B}} r^2\mathrm{d}m = \frac{1}{2}\mathrm{tr}([I])$, the gravity force vector of a rigid ... "

- p. 164, Eq. 4.138: Change equation to

$$\boldsymbol{F}_G = -\frac{\mu m}{R_c^3}\left(1 + \frac{3}{mR_c^2}\Big([I] + \frac{1}{2}\Big(\mathrm{tr}([I]) - 5(\hat{\boldsymbol{\imath}}_r^T[I]\hat{\boldsymbol{\imath}}_r)\Big)[I_{3\times3}]\Big)\right]\boldsymbol{R}_c$$

- p. 164, after Eq. 4.138: add "where $\mu = GM_e$."

- p. 183, Eq. 5.21: summation limit, should read $\cdots + \sum_{k=1}^{n}\frac{\partial\boldsymbol{R}}{\partial q_k}\dot{q}_k, \cdots$

- p. 184, Eq. 5.23: summation limit, should read $\cdots + \sum_{k=1}^{n}\dot{q}_k v_{ik}, \cdots$

- p. 187, Eq. 5.38: should read

$$[\boldsymbol{f}_1 - m_1\dot{\boldsymbol{V}}_1]\cdot\boldsymbol{v}_{11} + [\boldsymbol{f}_2 - m_2\dot{\boldsymbol{V}}_2]\cdot\boldsymbol{v}_{21} = 0$$
$$[\boldsymbol{f}_1 - m_1\dot{\boldsymbol{V}}_1]\cdot\boldsymbol{v}_{12} + [\boldsymbol{f}_2 - m_2\dot{\boldsymbol{V}}_2]\cdot\boldsymbol{v}_{22} = 0$$

- p. 187, Eq. 5.39: Lower right element should read $v_{22} = r\hat{\boldsymbol{e}}_\theta$

- p. 189, section 5.3.3 Replace "rheonomic" with "scleronomic"

- p. 190, Eq. 5.50: 3rd equation should read $\ddot{\boldsymbol{R}} = -(R\dot{\theta}^2)\hat{\boldsymbol{e}}_r + (R\ddot{\theta})\hat{\boldsymbol{e}}_\theta$

- p. 191, Eq. 5.52: Should read $\boldsymbol{F}_c = \cdots$

- p. 194, Eq. 5.66: Replace L with R and change equation to

$$x^2 + y^2 - R^2 = 0$$

- p. 194, line before Eq. 5.67: Shoud read "...two time derivatives of Eq. (5.66) as"
- p. 195, Eq. 5.77: Should read

$$B(x,y,z,t) = \frac{\partial \psi}{\partial t}$$
$$A_1(x,y,z,t) = \frac{\partial \psi}{\partial x}, \qquad A_2(x,y,z,t) = \frac{\partial \psi}{\partial y}, \qquad A_3(x,y,z,t) = \frac{\partial \psi}{\partial z}$$

- p. 195, Eq. 5.78: Should read
- p. 203: replace text after Eq. (5.123) and right before (5.126) with: "Substituting Eq. (5.123) into (5.122) and solving for λ yields:

$$\lambda = -1 \pm 5\sqrt{2} \qquad (5.124)$$

  Substituting these two λ values into Eq. (5.123) yields the following stationary points:"
- p. 211, first equation on page: Should read

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

- p. 207, Ex. 5.8, 3rd line: should read "$\cdots$ unstretched length is d."
- p. 212, middle of page: T and V should read as

$$T = \frac{1}{2}(m_1 + m_2)\dot{x}^2 + \frac{1}{2}m_2[r^2\dot{\theta}^2 + 2\dot{x}r\dot{\theta}\cos\theta]$$
$$V = \frac{1}{2}kx^2 + m_2 gr(1 - \cos\theta)$$

- p. 218, Eq. (5.183): Change last term to $B_1 = -\Omega$
- p. 219, between Eq. (5.191) and (5.192): should read "for vectors ${}^{\mathcal{F}}\{\partial \boldsymbol{R}_i/\partial t\}$"
- p. 219–220, Eq. (5.192), (5.193), (5.194): partial derivative sign missing in ${}^{\mathcal{F}}\left\{\dfrac{\partial \boldsymbol{R}_i}{\partial t}\right\}$
- p. 241, after (6.16): Remove the "[" symbol. Should read "is an extremum for a large..."
- p. 242, equation after (6.18): Remove subscript "j", should read $\delta W = \sum_{i=1}^{N} \boldsymbol{F}_i \cdot \delta \boldsymbol{R}_i$
- p. 243, Eq. (6.21): change 2nd equal sign to the "$\approx$" symbol
- p. 247, Eq. (6.37) : On the right hand side, change mc to mc^2 by adding the square over the c variable
- p. 247, Eq. (6.38) : 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. 247, last equation of page): change 2nd summation limit from N to n, should read

$$\mathcal{B} = \sum_{i=1}^{N} m_i \dot{\boldsymbol{R}}_i \cdot \sum_{j=1}^{n} \frac{\partial \boldsymbol{R}_i}{\partial q_j} \delta q_j$$

- p. 248, Eq. (6.40): change 1st summation limit from N to n, should read

$$\mathcal{B} = \sum_{j=1}^{n} \sum_{i=1}^{N} m_i \dot{\boldsymbol{R}}_i \cdot \frac{\partial \boldsymbol{R}_i}{\partial q_j} \delta q_j$$

- p. 248, Eq. (6.42): change 2nd summation limit from N to n, should read

$$\mathcal{B} = \sum_{i=1}^{N} m_i \dot{\boldsymbol{R}}_i \cdot \delta \boldsymbol{R}_i \equiv \sum_{j=1}^{n} \frac{\partial T}{\partial q_j} \delta q_j$$

- p. 248, Eq. (6.43): change 2nd summation limit from N to n, should read

$$\int_{t_0}^{t_f} (\delta T + \delta W) \mathrm{d}t = \left(\sum_{j=1}^{n} \frac{\partial T}{\partial q_j} \delta q_j \right) \Bigg|_{t_0}^{t_f}$$

- p. 249, Eq. (6.49): The partial derivative of u should be with respect to t and not x, equation should read:

$$\delta \int_{t_0}^{t_f} (T - V) \mathrm{d}t = \delta \int_{t_0}^{t_f} \Big[\underbrace{\frac{1}{2} \int_0^L \rho A \left(\frac{\partial u(x,t)}{\partial t} \right)^2 \mathrm{d}x}_{T} - \underbrace{\frac{1}{2} \int_0^L EA \left(\frac{\partial u(x,t)}{\partial x} \right)^2 \mathrm{d}x}_{V} \Big] \mathrm{d}t$$

- p. 252, 1st line: should read " … these into Eq. (6.43) with … "

- p. 252, Eq. (6.61): should read $\cdots = m(\dot{q}\delta q)\Big|_0^t$

- p. 252, line before Eq. (6.65): should read "... of terms of δa_i yields"

- p. 255, 2nd line after Eq. (6.72): change bracketed term to $\{\boldsymbol{q}, \dot{\boldsymbol{q}}, \boldsymbol{w}, \dot{\boldsymbol{w}}, \boldsymbol{w}', \boldsymbol{w}''\}$

- p. 255, 3rd line after Eq. (6.72): change to "... is a function with similar a argument list as..."

- p. 255, 2nd line of Eq. (6.73): At the end of equation, change to

$$\cdots, \boldsymbol{w}'(t,x), \boldsymbol{w}''(t,x))\mathrm{d}x$$

- p. 256, Eq. (6.74c): change to

$$\hat{\mathcal{L}} = \hat{T}(\boldsymbol{q}, \dot{\boldsymbol{q}}, \boldsymbol{w}(x), \dot{\boldsymbol{w}}(x), \boldsymbol{w}'(x), \boldsymbol{w}''(x)) - \hat{V}(\boldsymbol{q}, \boldsymbol{w}(x), \boldsymbol{w}'(x))$$

- p. 256, first line of Eq. (6.76): Should start with $\int_{t_0}^{t_f} \delta \mathcal{L} \, \mathrm{d}t = \cdots$

- p. 256, end of second line of Eq. (6.76): Should end with

$$\cdots + \frac{\partial \mathcal{L}}{\partial \boldsymbol{w}'} \delta \boldsymbol{w}' + \frac{\partial \mathcal{L}}{\partial \boldsymbol{w}''} \delta \boldsymbol{w}'' \Bigg) \mathrm{d}x$$

- p. 257, 2nd line after Eq. (6.77): change to "... on the variables $\boldsymbol{q}$, $\dot{\boldsymbol{q}}$, $\boldsymbol{w}$, $\dot{\boldsymbol{w}}$, $\boldsymbol{w}'$, $\boldsymbol{w}''$, and $\dot{\boldsymbol{w}}$."
- p. 259, 1st equation top of page: Should read $\int_{t_0}^{t_f} \delta \mathcal{L} \, \mathrm{d}t = 0$
- p. 259, (6.85): , equation should start out with $\delta V = \cdots$
- p. 302, last 2 equations in the example: The (2,2) element of the matrix should read $-\frac{c}{m}$ in these last two equations.
- p. 307, 3rd line from top of page: should read $\dot{V} \leq -\lambda V$
- p. 307, Theorem 8.5: The V derivative should be with respect to time, thus it should read $\frac{\mathrm{d}^i V(\boldsymbol{x})}{\mathrm{d}t^i}$ and $\frac{\mathrm{d}^k V(\boldsymbol{x})}{\mathrm{d}t^k}$
- p. 312, 1st equation on the page: the last term should read $\cdots - 2P\delta\dot{\boldsymbol{x}}^T \delta\dddot{\boldsymbol{x}}$
- p. 312, Eq. (8.19): move the [bracket to read $[M(\boldsymbol{q})]\ddot{\boldsymbol{q}} = -[\dot{M}(\boldsymbol{q}, \dot{\boldsymbol{q}})]\dot{\boldsymbol{q}} + \cdots$
- p. 313, Eq. (8.28): remove the 1/2 term to read $\dot{V} = \delta\dot{\boldsymbol{q}}^T \left(-\frac{1}{2}[\dot{M}](\dot{\boldsymbol{q}} + \dot{\boldsymbol{q}}_r) + \cdots \right)$
- p. 315, Eq. (8.36): Replace $\cdots + \omega \times \boldsymbol{\omega}_r - \cdots$ with $\cdots + [I]\boldsymbol{\omega} \times \boldsymbol{\omega}_r - \cdots$
- p. 315, Eq. (8.40): Should read $\dot{\boldsymbol{p}} = -\frac{\partial \mathcal{H}}{\partial \dot{\boldsymbol{q}}} + \boldsymbol{Q}$
- p. 317, 1st equation in Example 8.8: The (2,3) matrix element should read $m_3 l_1 l_3 \cos(\theta_3 - \theta_1)$
- p. 326, line before Eq. (8.78): "Combining Eqs. (8.33) and (8.67)..."
- p. 326, Eq. (8.78): Should read $V(\delta\boldsymbol{\omega}, \boldsymbol{\sigma}) = \frac{1}{2}\delta\boldsymbol{\omega}^T[I]\delta\boldsymbol{\omega} + 2K\ln(1 + \boldsymbol{\sigma}^T\boldsymbol{\sigma})$
- p. 331, 5th line from top of page: Should read "...torque vector $\Delta\boldsymbol{L} = (0.05, 0.10, -0.10)^T$ N·m is added."
- p. 332, Eq. (8.98): Should read $V(\delta\boldsymbol{\omega}, \boldsymbol{\sigma}, \boldsymbol{z}) = ...$
- p. 336, Eq. (8.113): The terms $\boldsymbol{\sigma}_i$ and $\delta\boldsymbol{\omega}_i$ should not be bold
- p. 336, Eq. (8.115): Remove the "$-2P_i^2$" term
- p. 336, Eq. (8.116): Remove the "$-2P_i^2$" term
- p. 342, Eq. (8.124): Change the end of the equation to read ... $+ K\boldsymbol{\sigma} + \boldsymbol{L})$
- p. 342, Eq. (8.125): The 2nd line on the right hand side should read

$$u_{\max_i} \cdot \operatorname{sgn}(u_{\mathrm{us}_i}) \qquad \text{for } |u_{\mathrm{us}_i}| > u_{\max_i}$$

- p. 342, Eq. (8.126): Change the equation to read ... $- K\boldsymbol{\sigma} - \boldsymbol{L})_i| \leq u_{\max_i}$

- p. 343, 2nd line: Start sentence with "Assuming no external torque $\boldsymbol{L}$, this allows $\dot{V}$ ..."
- p. 346, line before Eq. (8.141): change $[\dot{T}]\omega$ to $[\dot{T}]\boldsymbol{\omega}$
- p. 346, Eq. (8.141): Change equation to $[\dot{T}]\boldsymbol{\omega} = \cdots$
- p. 346, line after Eq. (8.141): change $[\dot{T}]\omega$ to $[\dot{T}]\boldsymbol{\omega}$
- p. 350, Table 8.4: The units of $[P]$ should be "rad/s", and the units for K should be "rad^2/s^2"
- p. 351, Eq. (8.160): There is a dot missing over the $\boldsymbol{\omega}$, the equation should read $u_{s_i} = J_{s_i}(\dot{\Omega}_i + \hat{\boldsymbol{g}}_{s_i}^T \dot{\boldsymbol{\omega}})$
- p. 352, Eq. (8.164): Should read $\dot{V} = -\delta\boldsymbol{\omega}^T[P]\delta\boldsymbol{\omega}$
- p. 354, Eq. (8.171): Should read "... $+2K\ln(1+\boldsymbol{\sigma}^T\boldsymbol{\sigma})$"
- p. 355, Eq. (8.174): Last bracket term should read $\cdots(\hat{\boldsymbol{g}}_{s_i}\hat{\boldsymbol{g}}_{t_i}^T + \hat{\boldsymbol{g}}_{t_i}\hat{\boldsymbol{g}}_{s_i}^T)$. The transpose on the 2nd $\hat{\boldsymbol{g}}_{t_i}$ should be removed.
- p. 355, Eq. (8.174): γ_i should be $\dot{\gamma}_i$
- p. 362, Eq. (8.196): Should read $\dot{\boldsymbol{\eta}} = \left([I_{2N\times 2N}] - [\hat{W}][Q]^T\left([Q][\hat{W}][Q]^T\right)^{-1}[Q]\right)\boldsymbol{d} = \cdots$
- p. 363, Eq. (8.203): Remove "≤ 0", should read $\dot{V}_e = -k_e\boldsymbol{e}^T[\tau][\tau]\boldsymbol{e}$
- p. 363, Eq. (8.206): Should read $\dot{\boldsymbol{\eta}} = k_e\left([Q]^T\left([Q][Q]^T\right)^{-1}[Q] - [I_{2N\times 2N}]\right)[A]\begin{pmatrix}\Delta\boldsymbol{\Omega}\\ \Delta\boldsymbol{\gamma}\end{pmatrix}$
- p. 364, Eq. (8.207): Should read $\dot{\boldsymbol{\eta}} = k_e\left([\hat{W}][Q]^T\left([Q][\hat{W}][Q]^T\right)^{-1}[Q] - [I_{2N\times 2N}]\right)[A]\begin{pmatrix}\Delta\boldsymbol{\Omega}\\ \Delta\boldsymbol{\gamma}\end{pmatrix}$
- p. 365, Tabe 8.5: The units of $\dot{\gamma}(t_0)$ should read "rad/s"
- p. 368, Eq. (8.213): change last term to $\cdots - \frac{\sigma_1}{\sigma_3^2}\frac{\partial\sigma_3}{\partial\gamma_i}$, it is missing a square in the first denominator
- p. 368, Eq. (8.216): last term in equation should read $\cdots + \hat{\boldsymbol{g}}_{t_i}J_{s_i}\left(\frac{\partial\hat{\boldsymbol{g}}_{s_i}}{\partial\gamma_i}^T\boldsymbol{\omega}\right)$
- p. 368, Eq. (8.218): last term in equation should read $\cdots + \hat{\boldsymbol{g}}_{t_i}J_{s_i}\omega_{t_i}$
- p. 369, Tabe 8.6: The units of $\dot{\gamma}(t_0)$ should read "rad/s"
- p. 375, Problem 8.4 (c): Sentence should start with "Use higher order derivatives of the Lyapunov..."
- p. 376, Problem 8.8 (b): First sentence should read "... reference motion $x_r(t)$ and $\dot{x}_0 = 0$ m/s."
- p. 396, Ex. 9.1: 2nd equation should read $hP = 2A = 2\pi ab$
- p. 396, Ex. 9.1: After Eq. (9.68), it should read " ... that the term P^2/a^3 is a constant."

- p. 397, Eq. (9.75): Should end with $-\frac{\mu\alpha}{2}$
- p. 415, before Figure 9.11: In this second printing the typesetters forgot to add the second title here, as well as two lines of text? Please insert:

  9.5.3 Lagrange/Gibbs F and G Solution
  The orbit plane is defined through the two initial condition vector $\boldsymbol{r}(t_0)$ and $\dot{\boldsymbol{r}}(t_0)$ as shown in Fig. 9.11. Because *any* orbit position vector $\boldsymbol{r}(t)$ and velocity...

- p. 419, Eq. (9.180): Should read $F\dot{G} - G\dot{F} = 1$
- p. 420, bottom of page: Typesetting error. Remove the title "Reference" and the 4 references listed at the bottom of page 420, they are repeated again at the top of page 421.
- p. 422, top of page: the first part of the problem statement of 9.5 is missing. It should read: **9.5:** Consider two spacecraft (A and B) in the same circular orbit of radius a. Spacecraft B is initially θ radians of true anomaly ahead of A. It is desired that the spacecraft A "catch up" (or rendezvous) with B by transferring temporarily onto a "chase" orbit, then transferring back onto the original circular orbit. Referring to Fig. P9.5, two options are being considered:

  Option 1: Use an Interior Orbit Spacecraft A decreases its velocity (by amount Δv_1), so that it transfers at apogee onto a judicious chase orbit. Upon return to apogee, it increases its velocity by Δv_1 to rendezvous with spacecraft B and maintain again a circular orbit of radius a.

  Option 2: Use an Exterior Orbit Spacecraft A increases...
- p. 426, 4th line after Eq. (10.16): Should read "$\cdots$ motion of (m_1, m_2, m_3) will remain coplanar forever, $\cdots$"
- p. 427, 1st line after Eq. (10.22): Should read "The resulting condition $\boldsymbol{r}_i \times \ddot{\boldsymbol{r}}_i = 0$ dictates that the $\cdots$"
- p. 434, Eq. (10.55): Change equation (10.55) to:

$$\det([B]) = m_3 \left(\frac{\omega^2}{G} - \frac{M}{\rho^3} \right)^2$$

- p. 442, 2nd line after Eq. (10.76): Should read "Think of C as a relative energy measure."
- p. 453, Eq. (10.97): Left hand side should read $\overset{\circ\circ}{\boldsymbol{r}} + 2[\tilde{\boldsymbol{\Omega}}] \overset{\circ}{\boldsymbol{r}} + [\tilde{\boldsymbol{\Omega}}]^2 \boldsymbol{r} = \cdots$
- p. 453, After Eq. (10.97): Change end of line to "..., and $\boldsymbol{\Omega} = (0, 0, 1)^T$ is ..."
- p. 454, Eq. (10.99): Missing a 2, should read $\delta\overset{\circ\circ}{\boldsymbol{r}} + 2[\tilde{\boldsymbol{\Omega}}]\delta\overset{\circ}{\boldsymbol{r}} + [\tilde{\boldsymbol{\Omega}}]^2 \delta\boldsymbol{r} = \cdots$
- p. 454, Eq. (10.101): The ρ_2^3 term should be ρ_2^5. (second line, in the denominator)
- p. 455, Eq. (10.109): Equation should read $\lambda_{5,6}^2 = -E$
- p. 469, Eq. (11.13): Change γ^2 to γ, term 3 should read ...$(3\cos^2\gamma - 1)$...

- p. 470, Eq. (11.19): right hand side should read $= \frac{G}{2r^3} \cdots$
- p. 471, Eq. (11.24): first term in integral should read $[x^2(\eta^2 + \zeta^2) + \cdots$
- p. 479, Eq. (11.61): change equation to $J_k = -\frac{A_k}{r_{\text{eq}}^k GM}$
- p. 481, Eqs. (11.65)–(11.68): There are some sign errors and one coefficient error in these equations. Replace with:

$$\boldsymbol{a}_{J_3} = \frac{1}{2} J_3 \left(\frac{\mu}{r^2}\right) \left(\frac{r_{\text{eq}}}{r}\right)^3 \begin{pmatrix} 5\left(7\left(\frac{z}{r}\right)^3 - 3\left(\frac{z}{r}\right)\right)\frac{x}{r} \\ 5\left(7\left(\frac{z}{r}\right)^3 - 3\left(\frac{z}{r}\right)\right)\frac{y}{r} \\ 3\left(1 - 10\left(\frac{z}{r}\right)^2 + \frac{35}{3}\left(\frac{z}{r}\right)^4\right) \end{pmatrix}$$

$$\boldsymbol{a}_{J_4} = \frac{5}{8} J_4 \left(\frac{\mu}{r^2}\right) \left(\frac{r_{\text{eq}}}{r}\right)^4 \begin{pmatrix} \left(3 - 42\left(\frac{z}{r}\right)^2 + 63\left(\frac{z}{r}\right)^4\right)\frac{x}{r} \\ \left(3 - 42\left(\frac{z}{r}\right)^2 + 63\left(\frac{z}{r}\right)^4\right)\frac{y}{r} \\ \left(15 - 70\left(\frac{z}{r}\right)^2 + 63\left(\frac{z}{r}\right)^4\right)\frac{z}{r} \end{pmatrix}$$

$$\boldsymbol{a}_{J_5} = \frac{J_5}{8} \left(\frac{\mu}{r^2}\right) \left(\frac{r_{\text{eq}}}{r}\right)^5 \begin{pmatrix} 3\left(35\left(\frac{z}{r}\right) - 210\left(\frac{z}{r}\right)^3 + 231\left(\frac{z}{r}\right)^5\right)\frac{x}{r} \\ 3\left(35\left(\frac{z}{r}\right) - 210\left(\frac{z}{r}\right)^3 + 231\left(\frac{z}{r}\right)^5\right)\frac{y}{r} \\ \left(693\left(\frac{z}{r}\right)^6 - 945\left(\frac{z}{r}\right)^4 + 315\left(\frac{z}{r}\right)^2 - 15\right) \end{pmatrix}$$

$$\boldsymbol{a}_{J_6} = -\frac{J_6}{16} \left(\frac{\mu}{r^2}\right) \left(\frac{r_{\text{eq}}}{r}\right)^6 \begin{pmatrix} \left(35 - 945\left(\frac{z}{r}\right)^2 + 3465\left(\frac{z}{r}\right)^4 - 3003\left(\frac{z}{r}\right)^6\right)\frac{x}{r} \\ \left(35 - 945\left(\frac{z}{r}\right)^2 + 3465\left(\frac{z}{r}\right)^4 - 3003\left(\frac{z}{r}\right)^6\right)\frac{y}{r} \\ \left(245 - 2205\left(\frac{z}{r}\right)^2 + 4851\left(\frac{z}{r}\right)^4 - 3003\left(\frac{z}{r}\right)^6\right)\frac{z}{r} \end{pmatrix}$$

- p. 505, Eq. (12.69): 2nd line of the 3x1 matrix. The $\dfrac{\partial e}{\partial a}$ term should be $\dfrac{\partial E}{\partial a}$
- p. 510, Eq. (12.86c): This equation should read:

$$\begin{aligned} \frac{\mathrm{d}\omega}{\mathrm{d}t} &= \frac{3}{2} J_2 n \frac{a^3}{eb^3} \left(\frac{r_{\text{eq}}}{r}\right)^2 \Big[e + \cos f \left(1 + \frac{p}{r} e \cos f\right) + \frac{1}{2}\Big(4e\cos^2 i - 3e(3 + \cos 2f)\sin^2 i \\ &\quad + \cos f(-3 - e^2 + (3 + 5e^2)\cos(2i) + 6e^2 \sin^2 f \sin^2 i)\Big)\sin^2\theta - \frac{p^2}{r^2}\sin f \sin^2 i \sin(2\theta)\Big] \end{aligned}$$

- p. 510, Eq. (12.86e): Last term has the closing bracket off. This equation should read:

$$\begin{aligned} \frac{\mathrm{d}e}{\mathrm{d}t} = -\frac{3}{2} J_2 n \frac{a^2}{br} \left(\frac{r_{eq}}{r}\right)^2 \Big[&\frac{p}{r}\sin f(1 - 3\sin^2\theta \sin^2 i) \\ &+ (e + \cos f(2 + e\cos f))\sin(2\theta)\sin^2 i\Big] \end{aligned}$$

- p. 510, Eq. (12.86f): This equation should read:

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

- p. 512, Eq. (12.95): The term $\dfrac{\partial R}{\partial \boldsymbol{s}}$ should be $\dfrac{\partial R}{\partial \boldsymbol{e}}$
- p. 516, Eq. (12.120): The left hand side of this equation should read $reh\dfrac{\partial f}{\partial \boldsymbol{v}} = \cdots$
- p. 517, Eq. (12.126): The left hand side is missing a negative sign and should read $-\sin E(1 + e\cos f)\frac{\partial E}{\partial \boldsymbol{v}} = \cdots$
- p. 520, Eq. (12.145): The first fraction to the right of the equal sign should be $1/h$. The final equation will read as $\frac{\mathrm{de}}{\mathrm{d}t} = \frac{1}{h}\Big(\cdots\Big)$
- p. 520, After Eq. (12.145): Change sentence to "After making use of the orbit equation in Eq. (9.6) and the semi-latus rectum relation in Eq. (9.9), the eccentricity ... "
- p. 522, Eq. (12.156): Change equation to $\boldsymbol{a} = a_r\hat{\boldsymbol{\imath}}_r + a_\theta\hat{\boldsymbol{\imath}}_\theta + a_h\hat{\boldsymbol{\imath}}_h = a_n\hat{\boldsymbol{\imath}}_n + a_v\hat{\boldsymbol{\imath}}_v + a_h\hat{\boldsymbol{\imath}}_h$
- p. 541, Problem 12.1 In the problem statement, change the equation reference from 11.57 to 11.64.
- p. 542, Problem 12.8 Remove the word "optimal"
- p. 621, Problem 14.122a Equation should read $u(f) \approx \frac{\delta a}{a} - \cdots$
- p. 660, line before Eq. (14.232): change text to "...to the negative semi-definite quantity"
- p. 663, 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. 667, Eq. (14.259): Second line of this equation should have the $\boldsymbol{x}$ replace with $\boldsymbol{v}$ and read
$$+\begin{bmatrix} 0 & 2\dot{\theta} & 0 \\ -2\dot{\theta} & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}\boldsymbol{v} + \cdots$$
- p. 688, 3rd line from top:
$$\tan\frac{f}{2} = \sqrt{\frac{e+1}{e-1}}\tanh\frac{H}{2} \qquad \tanh\frac{H}{2} = \sqrt{\frac{e-1}{e+1}}\tan\frac{f}{2}$$
- p. 697, Eq. (G.1): change to $\alpha = a/R$
- p. 697, Eq. (G.3): change to $\rho = R/p$
- p. 697, after Eq. (G.5): Add text:
where R is the current orbit radius. The non-zero matrix...
- p. 698, Eq. (G.6j): change to $A^{-1}_{41} = \frac{1}{\rho R}(3\cos\theta + 2\nu\sin\theta)$
- p. 698, Eq. (G.6k): change to $A^{-1}_{42} = -\frac{1}{R}\Big(\frac{\nu^2\sin\theta}{\rho} + q_1\sin 2\theta - q_2\cos 2\theta\Big)$

- p. 698, Eq. (G.6m): change to $A_{44}^{-1} = \frac{\sin\theta}{\rho V_t}$
- p. 698, Eq. (G.6n): change to $A_{45}^{-1} = \frac{1}{\rho V_t}(2\cos\theta + \nu\sin\theta$
- p. 698, Eq. (G.6p): change to $A_{51}^{-1} = \frac{1}{\rho R}(3\sin\theta - 2\nu\cos\theta)$
- p. 698, Eq. (G.6q): change to $A_{52}^{-1} = \frac{1}{R}\left(\frac{\nu^2\cos\theta}{\rho} + q_2\sin 2\theta + q_1\cos 2\theta\right)$
- p. 698, Eq. (G.6s): change to $A_{54}^{-1} = -\frac{\cos\theta}{\rho V_t}$
- p. 698, Eq. (G.6t): change to $A_{55}^{-1} = \frac{1}{\rho V_t}(2\sin\theta - \nu\cos\theta)$

Revision History

- May 31 , 2005: started new errata sheet for 2nd printing
- May 31 , 2005: page 396, Ex. 9.1, p. 420
- June 5 , 2005: pages 187, 190, 203, 207, 212, 219–220
- July 10, 2005: pages 426, 427
- Sept. 12, 2005: page 422, 396
- Sept 30, 2005: page 419
- Oct. 3, 2005: page 415
- Nov 14, 2005: page 187, Eq. 5.38
- Nov 14, 2005: page 189
- Nov 28, 2005: pages 252, 256, 259
- Jan. 5, 2006: pages 315, 336
- Jan. 6, 2006: pages 346
- Jan. 12, 2006: pages 159
- Jan. 13, 2006: pages 355
- Jan. 16, 2006: pages 363, 364
- Feb. 2, 2006: page 315
- Feb. 8, 2006: page 307
- Feb. 9, 2006: pages 74, 77, 80, 81, 82, 84, 87, 88, 91, 92, 93, 94, 98, 102, 104, 105, 106, 107, 109, 110, 111, 112, 113, 115, 116, 118, 119, 120, 121 (bad day, I found that the entire chapter 3 seemed to have all reference numbers greater than 2 shifted by +1???)
- Feb. 28, 2006: page 336
- March 6, 2006: pages 469, 470

- March 29, 2006: pages 312, 313
- April 26, 2006: adjusted corrections on page 362, 363
- May 10, 2006: pages 302, 312
- May 15, 2006: pages 517, 519, 453, 454
- July 23, 2006: pages 621
- Sept. 4, 2006: page 397
- Sept. 11, 2006: page 58
- March 15, 2007: updated Example 4.1 on p. 133
- March 27, 2007: page 471, Eq. (11.24)
- March 31, 2007: page 350, Table 8.4
- April 11, 2007: page 479, Eq. (11.61)
- Feb. 2, 2008: page 351, Eq. (8.160)
- Feb. 14, 2008: page 99, Example 3.7
- Feb. 16, 2008: page 125, Problem 3.12
- April 8, 2008: p. 375, Problem 8.4 (c)
- April 11, 2008: Eq. (8.78), (8.98), (8.164), Problem 8.8(b)
- April 21, 2008: p. 342, 343
- April 21, 2008: p. 342 Eq. (8.125)
- June 19, 2008: p. 191, 194, 203
- July 17, 2008: p. 242
- July 18, 2008: p. 252
- July 21, 2008: p. 259 (6.85)
- September 5, 2008: p. 37
- September 8, 2008: p. 122
- September 9, 2008: p. 354
- September 25, 2008: p. 365, 369
- October 1, 2008: p. 159
- October 9, 2008: p. 368
- October 11, 2008: p. 45

- October 14, 2008: p. 195
- October 23, 2008: p. 368
- October 29, 2008: p. 243
- November 11, 2008: p. 218, 241, 248, 249, 252
- November 12, 2008: p. 255, 256
- November 21, 2008: p. 42, 194
- January 15, 2009: p. 481
- March 9, 2009: p. 49
- April 13, 2009: p. 326, 434
- April 20, 2009: p. 331
- April 22, 2009: p. 131
- October 6, 2009: p. 697, 698
- Nov 11, 2009: p. 660
- Nov 19, 2009: p. 663
- Dec 1, 2009: p. 247