Orbital Mechanics for Engineering Students

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ERRATA

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Page 2 In Figure 1.1 change $\boldsymbol{\rho}$ to **r**.

Page 5 In Figure 1.2, above the shaded triangle, change *r* to *ρ*.

Page 7 In the line just below Equation (1.3), 6.6742×10^{11} should be changed to 6.6742×10^{-11}.

Page 14 The right side of Equation (a) should be $mv_o d\hat{\mathbf{k}}$.

Page 25 Equation (1.47) must be corrected to read as follows:

$$\frac{d\hat{\mathbf{j}}}{dt} = \boldsymbol{\omega}\times\hat{\mathbf{j}} = -\dot{\Lambda}\sin\phi\,\hat{\mathbf{i}} - \dot{\phi}\hat{\mathbf{k}}$$

Page 29 The equation $\left.F_{net}\right)_y = T - D = -2769\text{ N}$ should be corrected to read $\left.F_{\mathrm{net}}\right)_y = T - D = 1029\text{ N}$.

Page 35 In the second line below Equation (2.8), change $m_1\ddot{\mathbf{R}}_1 + m_2\ddot{\mathbf{R}}_2 = 0$ to read $m_1\ddot{\mathbf{R}}_1 + m_2\ddot{\mathbf{R}}_2 = \mathbf{0}$. That is, the zero on the right should be bold face.

Page 37 The line before Equation (2.14) should read, "Let the gravitational parameter μ be defined as".

Page 40 Correct Equation (2.17) to read

$$-\left(\frac{m_1}{m_1+m_2}\right)^3 \frac{\mu}{r_2^{\,3}}\mathbf{r}_2 = \ddot{\mathbf{r}}_2$$

Page 56 In Figure 2.17 the angle between the apse line and line *FB* should be labeled β (not *b*).

Page 57 In the first line change 2.61 to 2.60.

Page 62 Correct the 10th line up to read as follows: "(f) To find the orbit period, use Equation 2.72," .

Page 63 Correct the 4th line down to read as follows: "For the radial velocity component, use Equation 2.39,"

Page 63 Correct the 14th line down to read as follows: "(i) Use Equation 2.41 to calculate ..."

Page 66 In the 5th line up change $r = 2a/(1 + \cos\theta)$ to $r = p/(1 + \cos\theta)$.

Page 70 Equation 2.91 should read

$$r_p = \frac{h^2}{\mu}\frac{1}{1+e}$$

Page 71 In the line just after Equation 2.94, change "... analogous to Equation 2.63..." to "..analogous to Equation 2.62..."

Page 71 In the line just after Equation 2.96, change "... analogous to Equation 2.67..." to "..analogous to Equation 2.66..."

Page 101 The answer to Problem 2.7 should be 1111.4 km (not 1440 km).

Page 119 In Equation 3.16 change M to Me .

Page 125 Correct Equation 3.29 to read as follows

$$\tan\frac{\theta}{2} = \left[3M_p + \sqrt{\left(3M_p\right)^2 + 1}\right]^{\frac{1}{3}} - \left[3M_p + \sqrt{\left(3M_p\right)^2 + 1}\right]^{-\frac{1}{3}}$$

Page 133 In Figure 3.18 change $\theta_\infty = 117.1°$ to $\theta_\infty = 111.17°$.

Page 143 In the 5th line up change 253.53^2 to 253.53^3.

Page 144 In the 5th line down change 253.53^2 to 253.53^3.

Page 151 15 lines down. Change "holding in its solar orbit" to "holding it in its solar orbit."

Page 157 In the 3rd line above Figure 4.6 change "Equation 3.45" to "Equation 3.46".

Page 169 In the 6th line down replace $\mathbf{Z}$ with $\mathbf{Z}'$.

Page 188 The solution to Problem 4.5 should be 45°.

Page 195 In the 10th line up, change $\mathbf{v} \times \mathbf{h} = \mathbf{0}$ to $\mathbf{v} \cdot \mathbf{h} = 0$.

Page 199 The 12th line down should read

$$= \left(5.2925\hat{\mathbf{I}} - 6.3068\hat{\mathbf{J}} + 4.7534\vec{\mathbf{K}}\right) \times 10^6 \ \left(\text{km}^2\right)$$

Page 199 The 14th line down should read

$$= \left(8.1473\hat{\mathbf{I}} - 9.7096\hat{\mathbf{J}} + 7.3178\vec{\mathbf{K}}\right) \times 10^6 \ \left(\text{km}^2\right)$$

Page 199 The 9th line up should read

$$= \left(-1.3152\hat{\mathbf{I}} + 1.5673\hat{\mathbf{J}} - 1.1813\hat{\mathbf{K}}\right) \times 10^7 \ \left(\text{km}^2\right)$$

Page 199 The 6th line up should read

$$= 0.55667\hat{\mathbf{I}} - 0.66342\hat{\mathbf{J}} + 0.50000\hat{\mathbf{K}}$$

Page 199 The last equation on the page should read

$$\begin{aligned}\hat{\mathbf{u}}_{r_1} \cdot \hat{\mathbf{C}}_{23} &= \frac{-294.32\hat{\mathbf{I}} + 4265.1\hat{\mathbf{J}} + 5986.7\hat{\mathbf{K}}}{7356.5} \cdot \left(0.55667\hat{\mathbf{I}} - 0.66342\hat{\mathbf{J}} + 0.50000\hat{\mathbf{K}}\right) \\ &= -6.1181 \times 10^{-6}\end{aligned}$$

Page 200 Lines 2 through 18 should be corrected to read as follows:

$$
\begin{aligned}
\mathbf{N} &= r_1\mathbf{C}_{23} + r_2\mathbf{C}_{31} + r_3\mathbf{C}_{12} \\
&= 7356.5\left[\left(8.1473\hat{\mathbf{I}} - 9.7096\hat{\mathbf{J}} + 7.3178\vec{\mathbf{K}}\right)\times 10^6\right] \\
&\quad + 7441.7\left[\left(-1.3152\hat{\mathbf{I}} + 1.5673\hat{\mathbf{J}} - 1.1813\hat{\mathbf{K}}\right)\times 10^7\right] \\
&\quad + 7598.9\left[\left(5.2925\hat{\mathbf{I}} - 6.3068\hat{\mathbf{J}} + 4.7534\hat{\mathbf{K}}\right)\times 10^6\right]
\end{aligned}
$$

or

$$
\mathbf{N} = \left(2.2811\hat{\mathbf{I}} - 2.7186\hat{\mathbf{J}} + 2.0481\hat{\mathbf{K}}\right)\times 10^9 \ \left(\text{km}^3\right)
$$

so that

$$
\begin{aligned}
N &= \sqrt{\left[2.2811^2 + (-2.7186)^2 + 2.0481^2\right]\times 10^{18}} \\
&= 4.0975\times 10^9 \ \left(\text{km}^3\right)
\end{aligned}
$$

$$
\begin{aligned}
\mathbf{D} &= \mathbf{C}_{12} + \mathbf{C}_{23} + \mathbf{C}_{31} \\
&= \left[\left(5.295\hat{\mathbf{I}} - 6.3068\hat{\mathbf{J}} + 4.7534\hat{\mathbf{K}}\right)\times 10^6\right] + \left[\left(8.1473\hat{\mathbf{I}} - 9.7096\hat{\mathbf{J}} + 7.3178\hat{\mathbf{K}}\right)\times 10^6\right] \\
&\quad + \left[\left(-1.3152\hat{\mathbf{I}} + 1.5673\hat{\mathbf{J}} - 1.1813\hat{\mathbf{K}}\right)\times 10^6\right]
\end{aligned}
$$

or

$$
\mathbf{D} = \left(2.8797\hat{\mathbf{I}} - 3.4321\hat{\mathbf{J}} + 2.5856\hat{\mathbf{K}}\right)\times 10^5 \ \left(\text{km}^2\right)
$$

so that

$$
\begin{aligned}
D &= \sqrt{\left[2.8797^2 + (-3.4321)^2 + 2.5856^2\right]\times 10^{10}} \\
&= 5.1728\times 10^5 \ \left(\text{km}^2\right)
\end{aligned}
$$

Page 200 Line 3 from the bottom should be corrected to read

$$
\mathbf{S} = -34\ 276\hat{\mathbf{I}} + 478.57\hat{\mathbf{J}} + 38\ 810\hat{\mathbf{K}} \ \left(\text{km}^2\right)
$$

Page 201 The first 3 lines should be corrected to read as follows:

$$
= \sqrt{\frac{398\ 600}{\left(4.0975\times 10^9\right)\left(5.1728\times 10^3\right)}}
\times\left[\frac{\begin{vmatrix} \hat{\mathbf{I}} & \hat{\mathbf{J}} & \hat{\mathbf{K}} \\ 2.8797\times 10^5 & -3.4321\times 10^5 & 2.5856\times 10^5 \\ -1365.5 & 3637.6 & 6346.8 \end{vmatrix}}{7441.7} + \left(-34\ 276\hat{\mathbf{I}} + 478.57\hat{\mathbf{J}} + 38\ 810\hat{\mathbf{K}}\right)\right]
$$

or

$$\mathbf{v}_2 = -6.2174\hat{\mathbf{I}} + -4.0122\hat{\mathbf{J}} + 1.5990\hat{\mathbf{K}} \ (\text{km/s})$$

Page 204 4 lines below Equation 5.31b, change "...whereas $\Delta\theta$, Δt, r and r_0 are given" to "...whereas $\Delta\theta$, Δt, r_1 and r_2 are given."

Page 214 In the first sentence, "Figure 1.9" should be "Figure 1.11".

Page 216 In the line just before Equation (5.51) change "universal time are found" to "universal time is found"

Page 219 The 12th line up should be corrected to read $R_p = R_e\sqrt{1-e^2}$.

Page 223 In the last sentence of Example 5.7, "... computed in Example 4.2 ..." should read "... computed in Example 4.1 ..."

Page 223 The last line of the first paragraph of Section 5.7 should be corrected to read

"Therefore, the matrix of the transformation from *ENZ* to *SEZ* is $\left[\mathbf{R}_3(-90°)\right]$, where $\left[\mathbf{R}_3(\phi)\right]$ is found in Equation 4.34."

Page 225 At the end of the second line of Example 5.8, change "(12 hr 42 min)" to "(14 hr 20 min)".

Page 241 Equation 5.114 should read

$$\rho_3 = \frac{1}{D_0}\left[\frac{6\left(D_{13}\dfrac{\tau_3}{\tau_1} - D_{23}\dfrac{\tau}{\tau_1}\right)r_2^{\,3} + \mu D_{13}\left(\tau^2 - \tau_3^{\,2}\right)\dfrac{\tau_3}{\tau_1}}{6r_2^{\,3} + \mu\left(\tau^2 - \tau_1^{\,2}\right)} - D_{33}\right]$$

Page 241 The equation following Equation 5.115b should be corrected to read as follows

$$r_2^{\,2} = \left(A + \frac{\mu B}{r_2^{\,2}}\right)^2 + 2E\left(A + \frac{\mu B}{r_2^{\,2}}\right) + R_2^{\,2}$$

Page 245 Correct the line following "Step 6:" to read as follows

$$E = \mathbf{R}_2 \cdot \hat{\boldsymbol{\rho}}_2 = 3867.5 \text{ km}$$

Page 245 Change 3875.8 to 3867.5 in the two lines following Step 7.

Page 246 Change the caption of Figure 5.15 to read, "Graph of the polynomial *F(x)* in Step 8."

Page 246 The last 2 lines should be corrected to read as follows:

$$\rho_3 = \frac{1}{-0.0015198} \times \left\{\frac{\begin{matrix} 6\left(887.10\dfrac{119.47}{-118.10} - 889.60\dfrac{237.58}{-118.10}\right)9241.8^3 \\ +\,398\,600\cdot 887.10\left(237.58^2 - 119.47^2\right)\dfrac{119.47}{-118.10}\end{matrix}}{6\cdot 9241.8^3 + 398\,600\left[237.58^2 - (-118.10)^2\right]} - 892.13\right\}$$
$$= 4172.8 \text{ km}$$

Page 247 The 6th and 7th lines from the top should be corrected to read as follows:

$$\begin{aligned}\mathbf{r}_3 &= \left(3429.9\hat{\mathbf{I}} + 3490.1\hat{\mathbf{J}} + 4078.5\hat{\mathbf{K}}\right) + 4172.8\left(0.41841\hat{\mathbf{I}} + 0.87007\hat{\mathbf{J}} - 0.26059\hat{\mathbf{K}}\right)\\ &= 5175.8\hat{\mathbf{I}} + 7120.8\hat{\mathbf{J}} + 2991.1\hat{\mathbf{K}} \ (\text{km})\end{aligned}$$

Page 247 The two lines after the words "Step 12:" should be corrected to read

$$\begin{aligned}\mathbf{v}_2 &= \frac{-0.996\,40\left(6096.9\hat{\mathbf{I}} + 5907.5\hat{\mathbf{J}} + 3522.9\hat{\mathbf{K}}\right) + 0.996\,48\left(5175.8\hat{\mathbf{I}} + 7120.8\hat{\mathbf{J}} + 2991.1\hat{\mathbf{K}}\right)}{0.996\,48 \cdot 119.33 - 0.996\,40(-117.97)}\\ &= -3.8800\hat{\mathbf{I}} + 5.1156\hat{\mathbf{J}} - 2.2397\hat{\mathbf{K}} \ (\text{km/s})\end{aligned}$$

Page 247 The line just before Example 5.12 should be corrected to read

$$\underline{\mathbf{v}_2 = -3.8800\hat{\mathbf{I}} + 5.1156\hat{\mathbf{J}} - 2.2397\hat{\mathbf{K}} \ (\text{km/s})}$$

Page 247 The third line up should be corrected to read

$$v_2 = \|\mathbf{v}_2\| = \sqrt{(-3.8800)^2 + 5.1156^2 + (-2.2397)^2} = 6.7999 \text{ km/s}$$

Page 247 The last line should be corrected to read as follows:

$$\alpha = \frac{2}{r_2} - \frac{{v_2}^2}{\mu} = \frac{2}{9241.8} - \frac{6.7999^2}{398\,600} = 1.0040 \times 10^{-4} \ \text{km}^{-1}$$

Page 248 The lines between "Step 3:" and Step 4:" should be corrected to read as follows:

$$\begin{aligned}v_{r2} &= \frac{\mathbf{v}_2 \cdot \mathbf{r}_2}{r_2} = \frac{(-3.8800) \cdot 5659.1 + 5.1156 \cdot 6533.8 + (-2.2397) \cdot 3270.1}{9241.8}\\ &= 0.44829 \ \text{km/s}\end{aligned}$$

Page 248 The lines between "Step 4:" and "Step 5:" should be corrected to read as follows:

The universal Kepler's equation at times t_1 and t_3, respectively, becomes

$$\begin{aligned}\sqrt{398\,600}\tau_1 &= \frac{9241.8 \cdot 0.44829}{\sqrt{398\,600}} {\chi_1}^2 C\left(1.0040 \times 10^{-4} {\chi_1}^2\right)\\ &\quad + \left(1 - 1.0040 \times 10^{-4} \cdot 9241.8\right) {\chi_1}^3 S\left(1.0040 \times 10^{-4} {\chi_1}^2\right) + 9241.8\chi_1\end{aligned}$$

$$\begin{aligned}\sqrt{398\,600}\tau_3 &= \frac{9241.8 \cdot 0.44829}{\sqrt{398\,600}} {\chi_3}^2 C\left(1.0040 \times 10^{-4} {\chi_3}^2\right)\\ &\quad + \left(1 - 1.0040 \times 10^{-4} \cdot 9241.8\right) {\chi_3}^3 S\left(1.0040 \times 10^{-4} {\chi_3}^2\right) + 9241.8\chi_3\end{aligned}$$

or

$$631.35\tau_1 = 6.5622{\chi_1}^2 C\left(1.0040 \times 10^{-4} {\chi_1}^2\right) + 0.072085{\chi_1}^3 S\left(1.0040 \times 10^{-4} {\chi_1}^2\right) + 9241.8\chi_1$$

$$631.35\tau_3 = 6.5622{\chi_3}^2 C\left(1.0040 \times 10^{-4} {\chi_3}^2\right) + 0.072085{\chi_3}^3 S\left(1.0040 \times 10^{-4} {\chi_3}^2\right) + 9241.8\chi_3$$

Applying Algorithm 3.3 to each of these equations yields

$$\chi_1 = -8.0908\ \sqrt{\text{km}}$$
$$\chi_3 = 8.1375\ \sqrt{\text{km}}$$

Page 248 The lines between "Step 5:" and the bottom of the page should be corrected to read as follows:

$$f_1 = 1 - \frac{{\chi_1}^2}{r_2} C\left(\alpha {\chi_1}^2\right) = 1 - \frac{(-8.0908)^2}{9241.8} \cdot \overbrace{C\left[1.0040\times 10^{-4}(-8.0908)^2\right]}^{0.49973} = 0.99646$$

$$g_1 = \tau_1 - \frac{1}{\sqrt{\mu}} {\chi_1}^3 S\left(\alpha {\chi_1}^2\right) = -118.1 - \frac{1}{\sqrt{398\ 600}}(-8.0908)^3 \cdot \overbrace{S\left[1.0040\times 10^{-4}(-8.0908)^2\right]}^{0.16661} = -117.96\text{ s}$$

and

$$f_3 = 1 - \frac{{\chi_3}^2}{r_2} C\left(\alpha {\chi_3}^2\right) = 1 - \frac{8.1375^2}{9241.8} \cdot \overbrace{C\left(1.0040\times 10^{-4}\cdot 8.1375^2\right)}^{0.49972} = 0.99642$$

Page 249 The first two lines should be corrected to read as follows:

$$g_3 = \tau_3 - \frac{1}{\sqrt{\mu}} {\chi_3}^3 S\left(\alpha {\chi_3}^2\right) = -118.1 - \frac{1}{\sqrt{398\ 600}} 8.1375^3$$
$$\times \overbrace{S\left(1.0040\times 10^{-4}\cdot 8.1375^2\right)}^{0.16661} = 119.33$$

Page 249 Line 9 should be corrected to read as follows:

$$g_3 = \frac{119.33 + 119.33}{2} = 119.33\text{ s}$$

Page 249 In the two lines following Step 6, change 119.3 to 119.33.

Page 249 Line 5 up should be corrected to read

$$= 6105.2\hat{\mathbf{I}} + 5915.3\hat{\mathbf{J}} + 3521.1\hat{\mathbf{K}}\ (\text{km})$$

Page 249 Line 3 up should be corrected to read

$$= 5666.1\hat{\mathbf{I}} + 6543.7\hat{\mathbf{J}} + 3267.5\hat{\mathbf{K}}\ (\text{km})$$

Page 250 Line 4 down should be corrected to read

$$= -3.8919\hat{\mathbf{I}} + 5.1306\hat{\mathbf{J}} - 2.2472\hat{\mathbf{K}}\ (\text{km/s})$$

Page 250 Line 11 down should be corrected to read

$$\mathbf{v}_2 = -3.8856\hat{\mathbf{I}} + 5.1214\hat{\mathbf{J}} - 2.2434\hat{\mathbf{K}}\ (\text{km/s})$$

Page 250 In Table 5.2 there are three corrections to be made, shown in bold face in Step 1 below:

Step	χ_1	χ_3	f_1	g_1	f_3	g_3	ρ_1	ρ_2	ρ_3

1	**–8.0908**	**8.1375**	0.99647	–117.97	0.99641	119.33	**3650.6**	3877.2	4186.2
2	–8.0818	8.1282	0.996 47	–117.96	0.996 42	119.33	3643.8	3869.9	4178.3
3	–8.0871	8.1337	0.996 47	–117.96	0.996 42	119.33	3644.0	3870.1	4178.6
4	–8.0869	8.1336	0.996 47	–117.96	0.996 42	119.33	3644.0	3870.1	4178.6

Page 256 Delete the first three sentences of Section 6.2. In other words, Section 6.2 should begin with the fourth sentence, "Impulsive maneuvers are those in which brief firings of ... ".

Page 259 Two lines above Equation (b) change $h_2 = 64\ 690$ km to $h_2 = 64\ 690\ \text{km}^2/\text{s}$.

Page 263 In the next to the last line change "6.415 km/s" to "5.749 km/s."

Page 265 The caption for Figure 6.8 should read, "Circular earth orbits for which the bi-elliptical transfer is either less efficient or more efficient than the Hohman transfer."

Page 270 12 lines up, change $\theta_A = 90°$ to $\theta_B = 90°$.

Page 272 3 lines up, change $a = \left(\dfrac{T\sqrt{\mu}}{2\pi}\right)$ to $a_2 = \left(\dfrac{T_2\sqrt{\mu}}{2\pi}\right)$.

Page 281 In Equation (b) change $h_2 = 64\ 694$ to $h_2 = 64\ 694\ \text{km}^2/s$.

Page 282 3 lines up, change

"The formula for radial velocity, $v_r = (\mu/h)e\sin\theta$, applied to orbit 2 at point *I*, where

$$v_{r_2} = v_{r_1} + \Delta v_r \quad \text{and} \quad \theta_2 = \theta_1 - \eta_1, \quad \text{yields"}$$

to

"The formula for radial velocity, $v_r = (\mu/h)e\sin\theta$, applied to orbit 2 at point *I*, where $v_{r_2} = v_{r_1} + \Delta v_r$ and $\theta_2 = \theta_1 - \eta_1$, yields"

Page 284 In the third line from the bottom, change "Figure 6.18" to "Figure 6.19" .

Page 288 In the line after (c), change "...*B* and *C′* is..." to "...*B* and *C′* are..." .

Page 294 In the line just below Figure 6.27 change "tilted away from the earth's axis" to "tilted away from the earth's equator".

Page 298 The end of the last line should read $h = 67\ 792\ \text{km}^2/\text{s}$.

Page 304 In Problem 6.2 change the second sentence and the answer to read as follows:

"... a maximum altitude of 160 km during the next orbit? {–668 m/s}"

Page 309 In Problem 6.18 change "...rotates the apse line at an angle η" to "...rotates the apse line through an angle η ".

Page 312 In Problem 6.24, change "*W* = 45°" to " $\Omega = 45°$ " and change "*w* = 30°" to " $\omega = 45°$ ".

Page 314 Change the answer to Problem 6.30 to read as follows:

{Ans.: (a) 210.6° or 329.4°; (b) 212.9° or 327.1°; 206.7° or 333.3°}

Page 317 The ***r*** in the denominator on the right side of Equation 7.1 should be plain italic (*not* bold) face.

Page 323 In the line just after Equation 7.11, change “Equation 5.52” to “Equation 5.44”.

Page 330 In Figure 7.6 change $\delta\omega_0^+$ to δw_0^+ and change $\delta\omega_f^-$ to δw_f^-.

Page 331 5th line up, change “Algorithm 4.1” to “Algorithm 4.2.”

Page 339 5th line up, correct the equation so that it reads as follows:

$$\mathbf{v}_B = \hat{\mathbf{k}} \times \left\{ \sqrt{\frac{\mu}{r_o}} \frac{\mathbf{r}_o}{r_o} + \frac{\sqrt{\mu/r_o}}{r_o} \delta\mathbf{r} - \frac{3}{2} \frac{\sqrt{\mu/r_o}}{r_o} \left[\left(\frac{\mathbf{r}_o}{r_o} \right) \cdot \delta\mathbf{r} \right] \frac{\mathbf{r}_o}{r_o} \right\}$$

Page 343 In the last sentence of Problem 7.8 change “space shuttle” to “spacecraft”.

Page 343 In Problem 7.9, change the fourth sentence from

“For a Hohmann transfer orbit ($\delta u_0^+ = 0$), find”

to

“If $\delta u_0^+ = 0$, find”.

Page 343 In Problem 7.9, correct the answer to part (a) to read as follows:

$$\left\{ \delta\mathbf{r}_0 \right\} = \lfloor \delta r \quad (3\pi/4)\delta r \quad 0 \rfloor^T$$

Page 348 5 lines up, change “so that the velocity of the space vehicle” to “so that the speed of the space vehicle”.

Page 349 In Figure 8.1, change $\mathbf{V}_A$ to $\mathbf{V}_A^{(v)}$ and change $\mathbf{V}_D$ to $\mathbf{V}_D^{(v)}$.

Page 350 In Figure 8.2, change $\mathbf{V}_A$ to $\mathbf{V}_A^{(v)}$ and change $\mathbf{V}_D$ to $\mathbf{V}_D^{(v)}$. Move the symbol $\mathbf{V}_2$ to the right so that it is closer to the downward arrow it represents (as in Figure 8.1).

Page 353 8 lines down, change “radians ahead of planet 2.” to “radians ahead of planet 1.”

Page 354 4 lines up, change 253.8 to 258.8.

Page 356 In Figure 8.6, the subscript on m_v should be the same font as in the body of the text. See, for example, Equation 8.22.

Page 362 2 lines up, change “Figure 8.11” to “Figure 8.9”.

Page 363 6th line from top of the first paragraph, change “Figure 3.23” to “Figure 2.23”.

Page 363 7th line of the second paragraph, change “Figure 8.12” to “Figure 8.10”.

Page 367 Correct Equation 8.48 to read as follows:

$$\frac{\delta V_D^{(v)}}{V_D^{(v)}} = \frac{\mu_1}{V_D^{(v)} v_\infty r_p} \frac{\delta r_p}{r_p} + \frac{v_\infty + \dfrac{2\mu_1}{r_p v_\infty}}{V_D^{(v)}} \frac{\delta v_p}{v_p}$$

Page 367 Correct Equation 8.49 to read as follows:

$$\frac{\delta R_2}{R_2}=\frac{2}{1-\dfrac{R_1\left[V_D^{(v)}\right]^2}{2\mu_{\text{sun}}}}\left(\frac{\mu_1}{V_D^{(v)}v_\infty r_p}\frac{\delta r_p}{r_p}+\frac{v_\infty+\dfrac{2\mu_1}{r_p v_\infty}}{V_D^{(v)}}\frac{\delta v_p}{v_p}\right)$$

Page 367 4 lines up, correct so that it reads as follows:

$$\mu_1=\mu_{\text{earth}}=398\ 600\ \text{km}^3/\text{s}^2$$

Page 370 In Figure 8.14 delete the horizontal word "Asymptote" which sits atop the vertical word "Asymptote."

Page 377 Equation 8.78 must be corrected to read

$$V_{\perp_1}=\frac{\mu_{\text{sun}}}{h_1}\left(1+e_1\cos\theta\right)$$

Page 380 6th line up should read,

"Evaluating the orbit formula, Equation 2.35, at aphelion of orbit 1 yields"

Page 381 6 lines down, change "Equation 8.78" to "Equations 2.21 and 2.39".

Page 386 10 lines down, change "...departed at an angle of 30°..." to "...departed the solar system at an angle of 30°...".

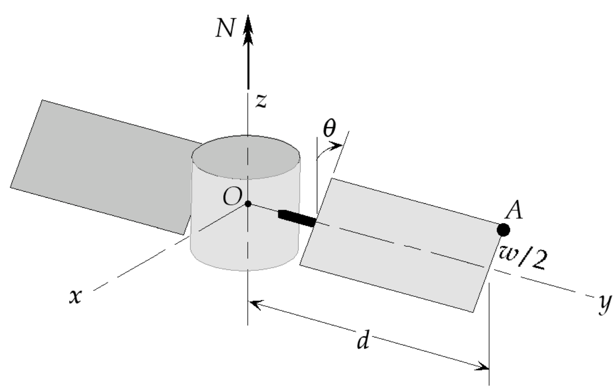
Page 388 In column 5 of Table 8.1 $\dot{\Omega}$ should not be bold face.

Page 398 In the answer to Problem 8.1, change $v_\infty=30\ \text{km/s}$ to $v_\infty=1.578\ \text{km/s}$.

Page 398 The answer to Problem 8.2 should be 13.08 km/s.

Page 402 Three lines above Equation 9.7, change "Equation 1.30" to "Equation 1.28".

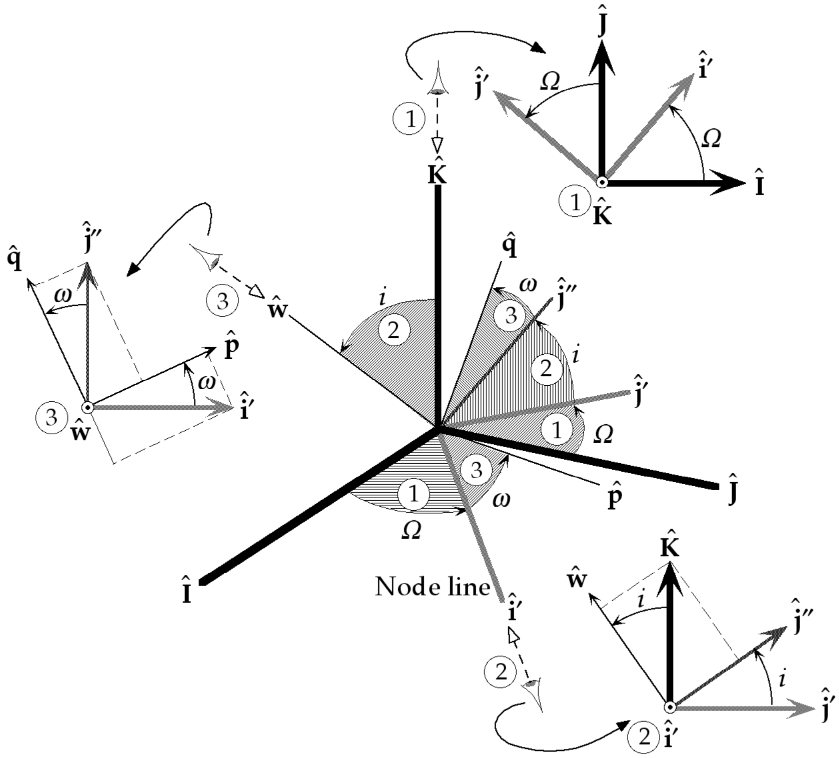
Page 405 Add an "*O*" to Figure 9.4, as shown below.



Page 434 4 lines down should read

$$\begin{vmatrix}0.1522-\lambda & -0.03975 & 0.12\\ -0.03975 & 0.07177-\lambda & 0.04057\\ 0.012 & 0.04057 & 0.1569-\lambda\end{vmatrix}=0$$

Page 449 In Figure 9.22 add the words "Node line" as shown below.



Page 449 Change the caption of Figure 9.22 to read as follows:

"**Figure 9.22** The Euler angles (see Figure 4.15)."

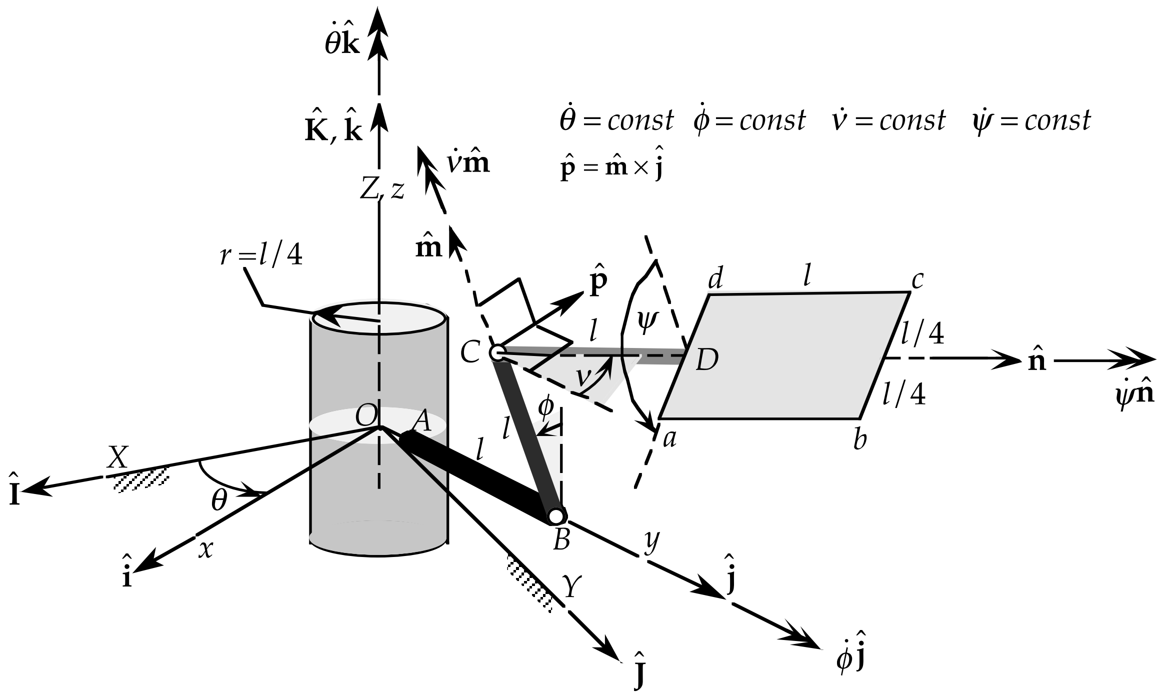
Page 450 Correct lines 9 and 10 from the top so that they read as follows:

$$\hat{\mathbf{j}}'' = \cos\theta\hat{\mathbf{j}}' + \sin\theta\hat{\mathbf{K}}$$
$$\hat{\mathbf{k}} = -\sin\theta\hat{\mathbf{j}}' + \cos\theta\hat{\mathbf{K}}$$

Page 454 10 lines up from the bottom change "At t = 0 find..." to "At t = 10 find...".

Page 455 Six lines from the top, change "...at $t = 0$ yields" to "...at $t = 10$ yields"

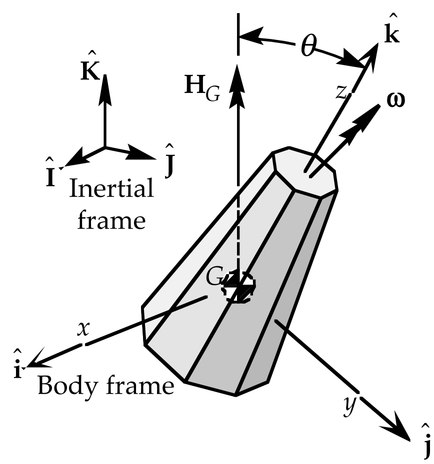
Page 464 Correct Figure P.9.2 so that it appears as follows:



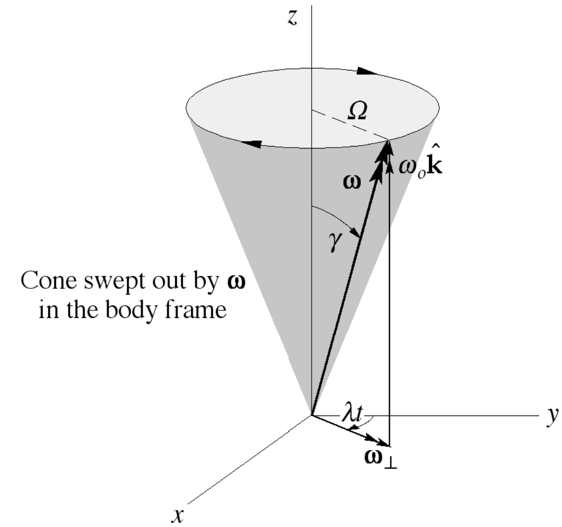
Page 469 In the first line change "The airplane in Problem 9.11" to "The airplane in Problem 9.13".

Page 469 The solution to Problem 9.16 should be $20\hat{\mathbf{i}}\ \mathrm{rad/s^2}$.

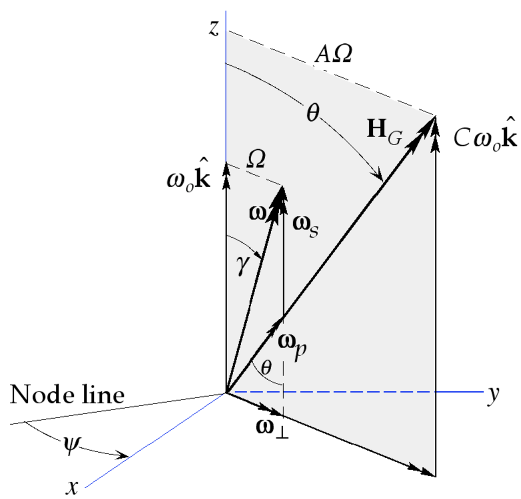
Page 477 In Figure 10.1 label the angle θ, as shown below:



Page 479 Correct Figure 10.2 as shown below (λt is shown in the wrong direction in the text).



Page 481 Correct Figure 10.3 so it appears as shown below.



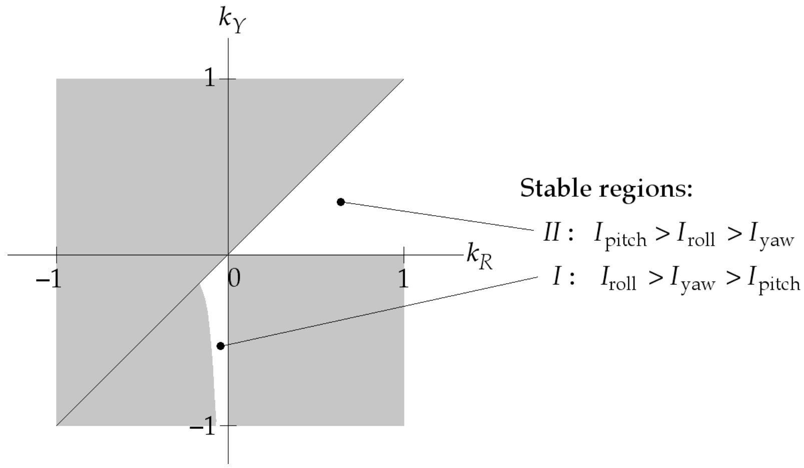
Page 493 In the sentence just below Equation (10.52) delete the words "of rotation".

Page 515 In the line after Equation (b) change "10.118" to "10.119."

Page 519 Correct the last line so that it reads as follows (eliminate the overhead dot in the third equality):

$$\left\{\boldsymbol{\omega}^{(r)}\right\} = \begin{Bmatrix} \omega_x^{(r)} \\ \omega_y^{(r)} \\ \omega_z^{(r)} \end{Bmatrix} \qquad \left\{\dot{\boldsymbol{\omega}}^{(r)}\right\} = \begin{Bmatrix} \dot{\omega}_x^{(r)} \\ \dot{\omega}_y^{(r)} \\ \dot{\omega}_z^{(r)} \end{Bmatrix} \qquad \left\{\boldsymbol{\omega}_{rel}^{(p)}\right\} = \begin{Bmatrix} 0 \\ 0 \\ \omega_p \end{Bmatrix} \qquad \left\{\dot{\boldsymbol{\omega}}_{\text{rel}}^{(p)}\right\} = \begin{Bmatrix} 0 \\ 0 \\ \dot{\omega}_p \end{Bmatrix}$$

Page 539 In Figure 10.29, the line from the Roman numeral *I* should extend into the small white region, as shown below:



Page 544 The answer to Problem 10.5 should be $6.167 \; \text{rad}/\text{s}^2$.

Page 545 In the second line of Problem 10.8 change “centroid” to “center of mass”.

Page 547 In Problem 10.14 the answer should be 1.045 rad/s (not 0.628 rad/s).

Page 547 In Problem 10.15, change the last two lines so they read as follows:

“the satellite to precess at 5 revolutions per second?
{Ans.: 6740 N · m · s} ”

Page 549 In the second line of Problem 10.17, change “2 revolutions per second” to “2 radians per second”.

Page 615 Change line 13 so it reads as follows:

```
r2 = [-1365.5 3637.6 6346.8];
```

Page 616 Replace **Output from** `Example_5_01` with the following;

```
-----------------------------------------------------
 Example 5.1: Gibbs Method


 Input data:

  Gravitational parameter (km^3/s^2)  = 398600

  r1 (km) = [-294.32  4265.1  5986.7]
  r2 (km) = [-1365.5  3637.6  6346.8]
  r3 (km) = [-2940.3  2473.7  6555.8]

 Solution:

  v2 (km/s) = [-6.2174  -4.01217  1.59898]

  Orbital elements:
    Angular momentum (km^2/s)  = 56190.9
    Eccentricity               = 0.100104
    Inclination (deg)          = 60.0005
    RA of ascending node (deg) = 40.0014
    Argument of perigee (deg)  = 30.0741
    True anomaly (deg)         = 49.9257
    Semimajor axis (km)        = 8001.44
    Period (s)                 = 7123.01
```

Page 633 Change the last three lines so they read as follows (replace `tau3` with `tau1` in the last line):

```
%...Equation 5.114:
rho3 = 1/Do*((6*(D(1,3)*tau3/tau1 - D(2,3)*tau/tau1)*x^3 ...
               + mu*D(1,3)*(tau^2 - tau3^2)*tau3/tau1) ...
               /(6*x^3 + mu*(tau^2 - tau1^2)) - D(3,3));
```

Page 639 The output from `Example_5_11` should be changed where necessary to read as follows:

```
( **Number of Gauss improvement iterations = 14)

-----------------------------------------------------
 Example 5.11: Orbit determination by the Gauss method

 Radius of earth (km)               = 6378
 Flattening factor                  = 0.00335278
 Gravitational parameter (km^3/s^2) = 398600

 Input data:

 Latitude (deg)                = 40
 Altitude above sea level (km) = 1

 Observations:
              Right                                     Local
   Time (s)   Ascension (deg)   Declination (deg)   Sidereal time (deg)
        0      43.5365            -8.7833              44.5065
    118.1      54.4196           -12.0739              45.0000
    237.6      64.3178           -15.1054              45.4992

 Solution:

 Without iterative improvement...


 r (km)                          = [5659.03, 6533.74, 3270.15]
 v (km/s)                        = [-3.8797, 5.11565, -2.2397]

   Angular momentum (km^2/s)     = 62705.3
   Eccentricity                  = 0.097562
   RA of ascending node (deg)    = 270.023
   Inclination (deg)             = 30.0105
   Argument of perigee (deg)     = 88.654
   True anomaly (deg)            = 46.3163
   Semimajor axis (km)           = 9959.2
   Periapse radius (km)          = 8987.56
   Period:
     Seconds                     = 9891.17
     Minutes                     = 164.853
     Hours                       = 2.74755
     Days                        = 0.114481

 With iterative improvement...


 r (km)                          = [5662.04, 6537.95, 3269.05]
 v (km/s)                        = [-3.88542, 5.12141, -2.2434]

   Angular momentum (km^2/s)     = 62816.7
```

```
   Eccentricity                   = 0.0999909
   RA of ascending node (deg)     = 269.999
   Inclination (deg)              = 30.001
   Argument of perigee (deg)      = 89.9723
   True anomaly (deg)             = 45.0284
   Semimajor axis (km)            = 9999.48
   Periapse radius (km)           = 8999.62
   Period:
     Seconds                      = 9951.24
     Minutes                      = 165.854
     Hours                        = 2.76423
     Days                         = 0.115176
-----------------------------------------------------
```