PRINCIPLES OF
GNSS, INERTIAL, AND MULTISENSOR INTEGRATED
NAVIGATION SYSTEMS

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Updates and Corrections to First Edition

LAST UPDATED: 27 July 2014

This document provides:
- Updates for information in the book that has become out of date;
- Corrections of errors in the book;
- Important additional notes and references.

To report an update or correction or to suggest an additional note or reference, please email the author at p.groves (at) ucl.ac.uk. No further updates or additions notes will be included here; readers are referred to the second edition updates page. However, corrections will continue to be posted.

Section(s)	Page(s)	Update/ correction/ addition
1.3.1	9-10	The Russian version of Omega, RSDN-20, also known as Alpha, was still operating at the time of writing, covering the North Eastern Hemisphere. Operation is likely to continue until the GLONASS constellation is completed. (16 Feb 2008)
1.3.2	10	There are both civil and military versions of Tsikada, with the latter known as Tsikada-M or Parus. The military version is still operational. Again, operation is likely to continue until the GLONASS constellation is completed. (16 Feb 2008 and 22 Jun 2008)
1.3.1-2	9-10	For information on historical navigation systems, including Omega, Decca, Loran-A and Transit, see on-line Appendix C. (10 May 2008)
2.2.3	29	Equation (2.21) should be $\mathbf{C}_\beta^\alpha = \mathbf{C}(\mathbf{q}_{\beta\alpha}) = \begin{pmatrix} q_{\beta\alpha 0}^2 + q_{\beta\alpha 1}^2 - q_{\beta\alpha 2}^2 - q_{\beta\alpha 3}^2 & 2(q_{\beta\alpha 1}q_{\beta\alpha 2} - q_{\beta\alpha 3}q_{\beta\alpha 0}) & 2(q_{\beta\alpha 1}q_{\beta\alpha 3} - q_{\beta\alpha 2}q_{\beta\alpha 0}) \\ 2(q_{\beta\alpha 1}q_{\beta\alpha 2} - q_{\beta\alpha 3}q_{\beta\alpha 0}) & q_{\beta\alpha 0}^2 - q_{\beta\alpha 1}^2 + q_{\beta\alpha 2}^2 - q_{\beta\alpha 3}^2 & 2(q_{\beta\alpha 2}q_{\beta\alpha 3} + q_{\beta\alpha 1}q_{\beta\alpha 0}) \\ 2(q_{\beta\alpha 1}q_{\beta\alpha 3} + q_{\beta\alpha 2}q_{\beta\alpha 0}) & 2(q_{\beta\alpha 2}q_{\beta\alpha 3} - q_{\beta\alpha 1}q_{\beta\alpha 0}) & q_{\beta\alpha 0}^2 - q_{\beta\alpha 1}^2 - q_{\beta\alpha 2}^2 + q_{\beta\alpha 3}^2 \end{pmatrix}.$ (8 Jan 2012)
2.2.3	30	Equation (2.22) should be $\begin{aligned} q_{\beta\alpha 0} &= \tfrac{1}{2}\sqrt{1 + C_{\beta 1,1}^\alpha + C_{\beta 2,2}^\alpha + C_{\beta 3,3}^\alpha} &&= \tfrac{1}{2}\sqrt{1 + C_{\alpha 1,1}^\beta + C_{\alpha 2,2}^\beta + C_{\alpha 3,3}^\beta} \\ q_{\beta\alpha 1} &= \frac{C_{\beta 2,3}^\alpha - C_{\beta 3,2}^\alpha}{4q_{\beta\alpha 0}} &&= \frac{C_{\alpha 3,2}^\beta - C_{\alpha 2,3}^\beta}{4q_{\beta\alpha 0}} \\ q_{\beta\alpha 2} &= \frac{C_{\beta 3,1}^\alpha - C_{\beta 1,3}^\alpha}{4q_{\beta\alpha 0}} &&= \frac{C_{\alpha 1,3}^\beta - C_{\alpha 3,1}^\beta}{4q_{\beta\alpha 0}} \\ q_{\beta\alpha 3} &= \frac{C_{\beta 1,2}^\alpha - C_{\beta 2,1}^\alpha}{4q_{\beta\alpha 0}} &&= \frac{C_{\alpha 2,1}^\beta - C_{\alpha 1,2}^\beta}{4q_{\beta\alpha 0}} \\ \mathbf{q}_{\beta\alpha} &= \mathbf{q}(\mathbf{C}_\beta^\alpha) \end{aligned}.$ (8 Jan 2012)

Section(s)	Page(s)	Update/ correction/ addition
2.2.8	35	After equation (2.49), the text should refer to (2.49), not (2.46). (22 June 2008)
2.3.2	37	The equation reference in the line before (2.57) should be to (2.55), not (2.53). (24 May 2009)
2.3.2	41	R_E does not determine the rate of change of longitude for motion along the surface normal to a meridian; it determines the rate of change of the angle subtended at the rotation axis. Note that the rate of change of longitude for motion along a parallel at the surface is R_E cos$L$. (25 Jan 2009)
2.3.2	42	The sin L_b component of Equation (2.71) is numerically unstable. Therefore, the following should be used instead: $$\begin{aligned} \tan L_b &= \frac{z_{eb}^e\left[R_E(L_b)+h_b\right]}{\sqrt{x_{eb}^{e\,2}+y_{eb}^{e\,2}}\left[\left(1-e^2\right)R_E(L_b)+h_b\right]} \\ \tan \lambda_b &= \frac{y_{eb}^e}{x_{eb}^e} \\ h_b &= \frac{\sqrt{x_{eb}^{e\,2}+y_{eb}^{e\,2}}}{\cos L_b} - R_E(L_b) \end{aligned} .$$ (25 May 2009)
2.4.1	50	Equation (2.97) should be $$\begin{aligned} \mathbf{a}_{eb}^e &= \mathbf{C}_i^e\left(\mathbf{a}_{ib}^i - 2\mathbf{\Omega}_{ie}^i\mathbf{v}_{ib}^i + \mathbf{\Omega}_{ie}^i\mathbf{\Omega}_{ie}^i\mathbf{r}_{ib}^i\right) \\ \mathbf{a}_{ib}^i &= \mathbf{C}_e^i\left(\mathbf{a}_{eb}^e + 2\mathbf{\Omega}_{ie}^e\mathbf{v}_{eb}^e + \mathbf{\Omega}_{ie}^e\mathbf{\Omega}_{ie}^e\mathbf{r}_{eb}^e\right) \end{aligned} .$$ (19 February 2012)
2.4.3	51	Equation (2.103) should be $$\begin{aligned} \mathbf{a}_{eb}^n &= \mathbf{C}_i^n\left(\mathbf{a}_{ib}^i - 2\mathbf{\Omega}_{ie}^i\mathbf{v}_{ib}^i + \mathbf{\Omega}_{ie}^i\mathbf{\Omega}_{ie}^i\mathbf{r}_{ib}^i\right) \\ \mathbf{a}_{ib}^i &= \mathbf{C}_n^i\left(\mathbf{a}_{eb}^n + 2\mathbf{\Omega}_{ie}^n\mathbf{v}_{eb}^n\right) + \mathbf{C}_e^i\mathbf{\Omega}_{ie}^e\mathbf{\Omega}_{ie}^e\mathbf{r}_{eb}^e \end{aligned} .$$ (19 February 2012)
2.4.4	53	In (2.109), $\mathbf{I}_{bB}^b$ should be $\mathbf{l}_{bB}^b$. (3 July 2011)
2.Refs	53	Ref [4] has been superseded by Farrell, J. A., *Aided Navigation: GPS with High Rate Sensors*, New York: McGraw Hill, 2008. (11 April 2010)
3.2.3	65	In Figure 3.4, $\hat{\mathbf{x}}_{k-1}^-$ should be $\hat{\mathbf{x}}_{k-1}^+$. (29 April 2012)
3.2.4	68	Equation (3.23) is not generally correct. It only applies in the scalar case or where **F** is constant. For more information, see Kailath, T., *Linear Systems*, Englewood Cliffs, NJ: Prentice-Hall, 1980. (25 Jan 2009)
3.3.2	76	Table 3.1 assumes the covariance update is computed as $\left(\mathbf{I}-\mathbf{K}_k\mathbf{H}_k\right)\mathbf{P}_k^-$. However, if the number of measurements, *m*, is less than the number of states, *n*, it is more efficient to implement $\mathbf{P}_k^- - \mathbf{K}_k\left(\mathbf{H}_k\mathbf{P}_k^-\right)$, which requires $2mn^2$ multiplications. (25 Jan 2009)
3.3.2	76	The scalar form of the measurement update is always more efficient where $\mathbf{R}_k$ is diagonal, though the improvement is only significant where *m* is similar to or greater than *n*. In the scalar form, Equations (3.16) to (3.18) are repeated for each individual component of the measurement vector, noting that $\hat{\mathbf{x}}_k^-$ and $\mathbf{P}_k^-$ for the update with i^{th} measurement are the same as $\hat{\mathbf{x}}_k^+$ and $\mathbf{P}_k^+$ for the update with (i–1)th measurement. (25 Jan 2009)
3.3.2	76	Sparse matrix multiplication may also be used for the covariance update in cases where some of the columns of $\mathbf{H}_k$ are zero. (25 Jan 2009)
4.2.3	108	Equation (4.8) is wrong (superscripts). It should be $$\ddot{\mathbf{r}}_{ia}^b = \ddot{\mathbf{C}}_i^b\mathbf{r}_{ia}^i + 2\dot{\mathbf{C}}_i^b\dot{\mathbf{r}}_{ia}^i + \mathbf{a}_{ia}^b .$$ (6 February 2011)

Section(s)	Page(s)	Update/ correction/ addition
4.3	111	The sign is wrong in Equation (4.12). It should be $\Delta\mathbf{f}_{ib}^{b} = -\begin{pmatrix} \left[\left(\omega_{ib,y}^{b}\right)^2 + \left(\omega_{ib,z}^{b}\right)^2\right]\Delta x_b \\ \left[\left(\omega_{ib,z}^{b}\right)^2 + \left(\omega_{ib,x}^{b}\right)^2\right]\Delta y_b \\ \left[\left(\omega_{ib,x}^{b}\right)^2 + \left(\omega_{ib,y}^{b}\right)^2\right]\Delta z_b \end{pmatrix}$. (2 December 2012)
4.4.3	116	1 μg/√Hz = 9.80665×10^{-6} m $s^{-1.5}$. (8 Jan 2012)
4.4.5	118	Equation (4.18) is an approximation, neglecting products of IMU errors. (3 July 2011)
5.1.3	126	Equation (5.14) is wrong (superscripts). It should be $\mathbf{v}_{ib}^{i}(+) = \mathbf{v}_{ib}^{i}(-) + \boldsymbol{\upsilon}_{ib}^{i} + \boldsymbol{\gamma}_{ib}^{i}\tau_i$. (3 July 2011)
5.3.1	131	In equation (5.38), τ should be τ_i. (2 Jan 2008)
5.3.4	134	Equation (5.49) does not work at the poles for the longitude because 1/cosL_b approaches infinity. (25 Jan 2009)
5.3.5	135	Equation (5.49) should not be used for the position update in the wander azimuth implementation. Instead the latitude and longitude should be updated using $\mathbf{C}_e^n(+) \approx \mathbf{C}_w^n(+)\left(\mathbf{I}_3 - \tfrac{1}{2}\left(\boldsymbol{\Omega}_{ew}^{w}(+) + \boldsymbol{\Omega}_{ew}^{w}(-)\right)\tau_i\right)\mathbf{C}_n^w(-)\mathbf{C}_e^n(-)$, where $\mathbf{C}_e^n(-)$ is obtained from $L_b(-)$ and $\lambda_b(-)$ using Equation (2.99), $\boldsymbol{\Omega}_{ew}^{w}(+/-)$ is computed using Equations (5.37), and $L_b(+)$ and $\lambda_b(+)$ may be obtained from $\mathbf{C}_e^n(+)$ using $L_b = \arctan\left(-C_{e3,3}^{n}/C_{e1,3}^{n}\right)$ and $\lambda_b = \arctan2\left(-C_{e2,1}^{n}, C_{e2,2}^{n}\right)$. (31 Jan 2009)
5.4.2	138	Equation (5.62) should be $\mathbf{C}_{b+}^{b-} \approx \mathbf{I}_3 + \left(1 - \frac{\left\|\boldsymbol{\alpha}_{ib}^{b}\right\|^2}{6}\right)\left[\boldsymbol{\alpha}_{ib}^{b} \wedge\right] + \left(\frac{1}{2} - \frac{\left\|\boldsymbol{\alpha}_{ib}^{b}\right\|^2}{24}\right)\left[\boldsymbol{\alpha}_{ib}^{b} \wedge\right]^2$. (8 Jan 2012)
5.4.2	138	Equation (5.63) is sometimes known as Rodrigues' formula. (22 June 2008)
5.4.2	139-40	In equations (5.65–67), (5.69) and (5.71), τ should be τ_i. (25 Jan 2009)
5.4.2	139	Equations (5.66) and (5.67) should be. (31 Aug 2013) $\mathbf{C}_b^n(+) \approx \mathbf{C}_b^n(-)\mathbf{C}_{b+}^{b-} - \left(\boldsymbol{\Omega}_{ie}^{n}(-) + \boldsymbol{\Omega}_{en}^{n}(-)\right)\mathbf{C}_b^n(-)\tau_i$. (5.66) $\mathbf{C}_b^n(+) = \left[\mathbf{I}_3 - \left(\boldsymbol{\Omega}_{ie}^{n}(-) + \tfrac{1}{2}\boldsymbol{\Omega}_{en}^{n}(-) + \tfrac{1}{2}\boldsymbol{\Omega}_{en}^{n}(+)\right)\tau_i\right]\mathbf{C}_b^n(-)\mathbf{C}_{b+}^{b-}$. (5.67)
5.4.3	142	Equations (5.79) should be. (27 Jul 2014) $\begin{aligned}\overline{\mathbf{C}}_b^i &= \frac{1}{\tau_i}\mathbf{C}_b^i(-)\int_{t}^{t+\tau_i}\sum_{r=0}^{\infty}\frac{\left\{\left(t'/\tau_i\right)\left[\boldsymbol{\alpha}_{ib}^{b} \wedge\right]\right\}^r}{r!}dt' \\ &= \mathbf{C}_b^i(-)\sum_{r=0}^{\infty}\frac{\left[\boldsymbol{\alpha}_{ib}^{b} \wedge\right]^r}{(r+1)!}\end{aligned}$. (5.79) (The lower limit of the integral has been corrected).
5.5.2	147	Equations (5.87) should be. (27 Jul 2014) $\mathbf{f}_{ib}^{b} = -\mathbf{C}_n^b\mathbf{g}_b^n(L_b, h_b)$. (5.87)

Section(s)	Page(s)	Update/ correction/ addition
5.5.2	148	Equation (5.89) is wrong (in the left-hand equation). It should be $\theta_{nb} = \arctan\left(\frac{f_{ib,x}^{b}}{\sqrt{f_{ib,y}^{b\ 2} + f_{ib,z}^{b\ 2}}}\right), \qquad \phi_{nb} = \arctan 2\left(-f_{ib,y}^{b}, -f_{ib,z}^{b}\right).$ (7 August 2011)
5.6	152	Equation (5.96) is wrong (in the second row). It should be $\delta\mathbf{C}_{\alpha}^{\beta} = \tilde{\mathbf{C}}_{\alpha}^{\beta}\mathbf{C}_{\beta}^{\alpha} = \mathbf{C}_{\alpha}^{\beta}\left(\delta\mathbf{C}_{\beta}^{\alpha}\right)^{\mathrm{T}}\mathbf{C}_{\beta}^{\alpha}$ $\left(\delta\mathbf{C}_{\beta}^{\alpha}\right)^{\mathrm{T}} = \mathbf{C}_{\beta}^{\alpha}\tilde{\mathbf{C}}_{\alpha}^{\beta}$. (12 June 2010)
5.6.2	155	In the last row of Table 5.2, ‘accelerometer’ should be ‘gyro’. (22 June 2008)
5.8	158-159	Inertial navigation using a single *z*-axis gyro and a full accelerometer triad is viable for land vehicles if the fact that the direction of travel of a non-steering axle is constrained to the vehicle body frame *x*-axis is exploited; this is known as a non-holonomic constraint. (25 Jan 2009)
6.1.2	164	In Figure 6.3, the second $t_{st,j}$ should be $t_{sa,j}$. (20 Sep 2009)
6.1.3	167-168	The spread spectrum technique used for GNSS is direct sequence spread spectrum (DSSS). Other methods include frequency hopping, time hopping and chirping. (16 Feb 2008)
6.2	171	GPS Block III satellites will not have the capability to implement selective availability. (2 Jan 2008)
6.2	171	The 36 satellite maximum refers to the number of ranging codes. The current Operational Control Segment is limited to 31 satellites, but this will be increased under the OCX control segment update of the GPS III program. (16 Feb 2008)
6.2.1	172	The launch of the first GPS Block IIF satellite has been delayed to February 2009. (2 Jan 2008) and further delayed to 2010. (20 Sep 2009)
6.2.1	172	The GPS Block III satellites will be divided into three generations, Blocks IIIA, IIIB and IIIC, with different capabilities. (2 Jan 2008) Current plans are to commission 12 Block IIF, 8 Block IIIA, 8 Block IIIB and 16 Block IIIC satellites. (16 Feb 2008)
6.2.1	173	As of September 2007, the number of GPS uplink stations has been increased from 4 to 21 by incorporating the capability to command satellites through the 17 Air Force Satelite Control Network (AFSCN) stations. (2 Jan 2008)
6.2.2	173	GPS L5 signals commenced on satellite IIR 20(M) in April 2009, ahead of the block IIF launches. (20 Sep 2009)
6.2.2 & 6.4.2	173 & 184	MBOC also stands for multiplexed binary offset carrier. (2 Jan 2008)
6.2.2	173	The GPS L1C implementation of MBOC will be a time-multiplexed BOC (TMBOC), such that 4 out of every 33 spreading code chips are modulated with the $\mathrm{BOC_s}(6,1)$ sub-carrier and the remaining 29 chips with the $\mathrm{BOC_s}(1,1)$ sub-carrier. (2 Jan 2008)
6.2.4	178	In Table 6.3, the WAAS satellites at longitudes −178° and −142° closed in 2007. (2 Jan 2008)
6.2.4	178	In Table 6.3, GAGAN started testing in 2007. (12 Jan 2008)
6.2.4	178	The Russian SBAS system, GLONASS System of Differential Corrections and Monitoring (SDCM) has been testing since 2007 and carries both GPS and GLONASS differential corrections and integrity alerts. (18 October 2008)

<table>
<tr><th>Section(s)</th><th>Page(s)</th><th>Update/ correction/ addition</th></tr>
<tr><td>6.3.2</td><td>180-181</td><td>The following GLONASS CDMA signals are currently proposed for introduction across three generations of GLONASS satellite: K1, K2, and KM:
<table>
<tr><th>Signal</th><th>Carrier Frequency (MHz)</th><th>Modulation and Chipping Rate (× 1.023 Mchip s^{-1})</th><th>Navigation Message Rate (symbol s^{-1})</th><th>Satellite Blocks</th></tr>
<tr><td>L1OC-d</td><td>1600.995, Note 1</td><td>BSPK 1</td><td>TBD</td><td>From K2</td></tr>
<tr><td>L1OC-p</td><td>1600.995, Note 1</td><td>$BOC_s(1,1)$</td><td>None</td><td>From K2</td></tr>
<tr><td>L1SC</td><td>1600.995</td><td>$BOC_s(5,2.5)$</td><td>RAU</td><td>From K2</td></tr>
<tr><td>L1OCM-d</td><td>1575.42</td><td>$BOC_s(1,1)$</td><td>TBD</td><td>From KM</td></tr>
<tr><td>L1OCM-p</td><td>1575.42</td><td>$BOC_s(1,1)$</td><td>TBD</td><td>From KM</td></tr>
<tr><td>L2OC</td><td>1248.06, Note 1</td><td>$BOC_s(1,1)$</td><td>None</td><td>From K2 or KM</td></tr>
<tr><td>L2SC-a</td><td>1248.06, Note 1</td><td>BSPK 1</td><td>RAU</td><td>From K2</td></tr>
<tr><td>L2SC-b</td><td>1248.06</td><td>$BOC_s(5,2.5)$</td><td>RAU</td><td>From K2</td></tr>
<tr><td>L3OC-d</td><td>1202.025</td><td>BPSK 10</td><td>200</td><td>From K1</td></tr>
<tr><td>L3OC-p</td><td>1202.025</td><td>BPSK 10</td><td>None</td><td>From K1</td></tr>
<tr><td>L5OCM-d</td><td>1176.45</td><td>BPSK 10</td><td>TBD</td><td>From KM</td></tr>
<tr><td>L5OCM-p</td><td>1176.45</td><td>BPSK 10</td><td>TBD</td><td>From KM</td></tr>
</table>
Note 1: A time division multiplex of alternating chips is proposed for the two L1OC signals and for L2OC and L2SC-a.
(RAU = restricted to authorized users)
Test broadcasts of the L3 signals commenced in 2012. (2 December 2012)</td></tr>
<tr><td>6.3.2</td><td>181</td><td>GLONASS is now using its final channel allocation of −7 to +6. (18 October 2008)</td></tr>
<tr><td>6.4.2</td><td>184</td><td>In Table 6.5, the first set of signal names was used during the signal design process, while the second set of signal names was adopted as the official signal names during 2007. (2 Jan 2008)</td></tr>
<tr><td>6.4.2</td><td>184</td><td>The two Galileo PRS signals will use time-division data multiplexing (see Section 6.2.2) with navigation data modulated on alternate bits only. (2 Jan 2008)</td></tr>
<tr><td>6.4.2</td><td>184</td><td>The Galileo implementation of MBOC is known as a composite BOC (CBOC). The sum or difference of a $\sqrt{10/11}$ amplitude $BOC_s(1,1)$ sub-carrier and a $\sqrt{1/11}$ amplitude $BOC_s(6,1)$ sub-carrier is applied to each spreading-code chip. (2 Jan 2008)</td></tr>
<tr><td>6.5.1</td><td>187</td><td>The Chinese GNSS is now known as Beidou, instead of Compass. (23 February 2013)</td></tr>
</table>

<table>
<tr><th>Section(s)</th><th>Page(s)</th><th>Update/ correction/ addition</th></tr>
<tr><td>6.5.1</td><td>187-188</td><td>
The Beidou (Compass) signal plans have been modified as follows:
<table>
<tr><th>Name</th><th>Carrier frequency (MHz)</th><th>Modulation</th><th>Data (symbols/sec)</th><th>Service</th></tr>
<tr><td>$\mathrm{B1\text{-}C_D}$</td><td>1575.42</td><td>MBOC (see below)</td><td>100</td><td>Open</td></tr>
<tr><td>$\mathrm{B1\text{-}C_P}$</td><td>1575.42</td><td>MBOC (see below)</td><td>No</td><td>Open</td></tr>
<tr><td>$\mathrm{B1_D}$</td><td>1575.42</td><td>$\mathrm{BOC_s}(14,2)$</td><td>100</td><td>Authorized</td></tr>
<tr><td>$\mathrm{B1_P}$</td><td>1575.42</td><td>$\mathrm{BOC_s}(14,2)$</td><td>No</td><td>Authorized</td></tr>
<tr><td>$\mathrm{B2a_D}$</td><td>1176.45</td><td>BPSK 10</td><td>50</td><td>Open</td></tr>
<tr><td>$\mathrm{B2a_P}$</td><td>1176.45</td><td>BPSK 10</td><td>No</td><td>Open</td></tr>
<tr><td>$\mathrm{B2b_D}$</td><td>1207.14</td><td>BPSK 10</td><td>100</td><td>Open</td></tr>
<tr><td>$\mathrm{B2b_P}$</td><td>1207.14</td><td>BPSK 10</td><td>No</td><td>Open</td></tr>
<tr><td colspan="5">Above four signals together comprise an AltBOC(15,10) signal at 1191.795 MHz</td></tr>
<tr><td>B3</td><td>1268.52</td><td>QPSK 10</td><td>500</td><td>Authorized</td></tr>
<tr><td>$\mathrm{B3\text{-}A_D}$</td><td>1268.52</td><td>$\mathrm{BOC_c}(15,2.5)$</td><td>100</td><td>Authorized</td></tr>
<tr><td>$\mathrm{B3\text{-}A_P}$</td><td>1268.52</td><td>$\mathrm{BOC_c}(15,2.5)$</td><td>No</td><td>Authorized</td></tr>
</table>
MBOC signals are $\frac{10}{11}\,\mathrm{BOC_s}\,(1,1)$, $\frac{1}{11}\,\mathrm{BOC_s}\,(6,1)$
Note that the Open service signals match the common GPS, Galileo and QZSS frequencies and modulations. (11 April 2010)
For the current regional implementation, a simpler frequency scheme is being implemented:
<table>
<tr><th>Name</th><th>Carrier frequency (MHz)</th><th>Modulation</th><th>Service</th></tr>
<tr><td>B1I</td><td>1561.098</td><td>BPSK 2</td><td>Open</td></tr>
<tr><td>B1Q</td><td>1561.098</td><td>BPSK 2</td><td>Authorized</td></tr>
<tr><td>B2I</td><td>1207.14</td><td>BPSK 10</td><td>Open</td></tr>
<tr><td>B2Q</td><td>1207.14</td><td>BPSK 10</td><td>Authorized</td></tr>
<tr><td>B3</td><td>1268.52</td><td>BPSK 10</td><td>Authorized</td></tr>
</table>
(25 August 2010)
</td></tr>
<tr><td>6.5.3</td><td>188</td><td>The inclined IRNSS satellite orbits are geosynchronous, not geostationary. (11 April 2010)</td></tr>
<tr><td>6.6.3</td><td>190</td><td>GPS will broadcast GPS-GLONASS and GPS-Galileo time conversion data on the L1C signal navigation data message (Block IIIA satellites onwards). (2 Jan 2008)</td></tr>
<tr><td>6.6.3</td><td>190</td><td>On 20 September 2007, GLONASS switched to the PZ-90.02 datum, which is much closer to the ITRF than its predecessor. Conversion is by an ~0.4 m origin shift. (2 Jan 2008)</td></tr>
<tr><td>7.1.1</td><td>200</td><td>In Equation (7.6), v_o should be v. (22 June 2008)</td></tr>
<tr><td>7.1.2</td><td>204</td><td>In Equation (7.28), L should be l. (12 Jan 2008)</td></tr>
<tr><td>7.1.4</td><td>209</td><td>In Equation (7.50), the $\delta\rho$ terms are the errors in the pseudo-ranges estimated from the navigation solution, not the pseudo-range measurement errors. (20 Sep 2009)</td></tr>
<tr><td>7.1.4</td><td>210</td><td>Equation (7.57) is wrong. It should be
$$\mathbf{G}_n^{\mathrm{T}}\mathbf{G}_n = \begin{pmatrix} g_{NN} & g_{NE} & g_{ND} & g_{NT} \\ g_{NE} & g_{EE} & g_{ED} & g_{ET} \\ g_{ND} & g_{ED} & g_{DD} & g_{DT} \\ g_{NT} & g_{ET} & g_{DT} & n \end{pmatrix}.$$
(20 Sep 2009)</td></tr>
<tr><td>7.2.2</td><td>213</td><td>New chip-scale atomic clock (CSAC) technology achieves one part in 10^{10} frequency stability over a second and one part in10^{11} over an hour, equivalent to 1 meter per hour pseudo-range drift. Reference:
Kitching, J., “Time for a Better Receiver: Chip-Scale Atomic Frequency Reference,” *GPS World*, November 2007, pp. 52-57. (16 Feb 2008)</td></tr>
</table>

Section(s)	Page(s)	Update/ correction/ addition
7.2.3	215	Equation (7.60) is wrong. It should be $\Delta f_{ca} = -\frac{f_{ca}}{c}\frac{\partial \rho_R}{\partial t_{sa}} \approx -\frac{f_{ca}}{c}\dot{\rho}_R$ Note that there are additional frequency shifts due to relativistic time dilation as described in [38]. (16 Feb 2008)
7.2.4	217	Equation (7.62) is wrong. It should be $\begin{array}{l} I_C(t_{sa}) = \cos\left[2\pi\left(f_{IF} + \Delta\tilde{f}_{ca}\right)t_{sa} + \tilde{\phi}_{ca}\right] \\ Q_C(t_{sa}) = \sin\left[2\pi\left(f_{IF} + \Delta\tilde{f}_{ca}\right)t_{sa} + \tilde{\phi}_{ca}\right] \end{array}.$ (20 Sep 2009)
7.2.4	218	Equation (7.63) is wrong. It should be $\begin{array}{l} I_0(t_{sa}) = A_0 C(t_{st}) D(t_{st}) \cos\left[2\pi\left(\Delta f_{ca} - \Delta\tilde{f}_{ca}\right)t_{sa} + \phi_{ca} + \delta\phi_{IF} - \tilde{\phi}_{ca}\right] + w_{I0}(t_{sa}) \\ Q_0(t_{sa}) = A_0 C(t_{st}) D(t_{st}) \sin\left[2\pi\left(\Delta f_{ca} - \Delta\tilde{f}_{ca}\right)t_{sa} + \phi_{ca} + \delta\phi_{IF} - \tilde{\phi}_{ca}\right] + w_{Q0}(t_{sa}) \end{array}.$ (20 Sep 2009)
7.2.4.1	222	Single lobe BOC processing requires filtering out of the other lobe to prevent waveform distortion. (20 Sep 2009)
7.2.4.2	223	The power spectral density, n_0, used here is single-sided and is thus multiplied by the single-sided bandwidth to obtain the noise power. Single-sided PSD is twice the double-sided PSD (which is multiplied by the double-sided bandwidth to obtain the same noise power. (20 Sep 2009)
7.3.2	231	Equation (7.89) is wrong. It should be $N = \frac{x}{\underset{x \to 0}{\mathrm{Lim}}\,\mathrm{E}\left[D(x)\right]}$. (2 December 2012)
7.3.3	236	Equation (7.101) is wrong. It should be $N = \frac{\delta\phi_{ca}}{\underset{\delta\phi \to 0}{\mathrm{Lim}}\,\mathrm{E}\left[\Phi(\delta\phi_{ca})\right]}$. (2 December 2012)
7.3.3	238	Equation (7.106) is wrong. It should be $N = \frac{\delta f_{ca}}{\underset{\delta\phi \to 0}{\mathrm{Lim}}\,\mathrm{E}\left[F(\delta f_{ca})\right]}$. (2 December 2012)
7.3.3	234-240	In this section, ϕ_{ca} is defined differently from the rest of the book. (4 Sep 2011)
7.3.3	235	In Figure 7.19, the lower of the two $\Delta\tilde{f}_{ca,k}^{+}$ should be $\Delta\tilde{\dot{f}}_{ca,k}^{+}$. (12 Jan 2008)
7.3.3	236-237	The carrier phase discriminator Φ_{QOI} and carrier frequency discriminator F_{COD} can produce very large outlying values when the denominator is close to zero, which can happen in poor signal to noise conditions. Therefore, both discriminators should be implemented with an output limiter to prevent these outliers from severely disrupting tracking. (25 Jan 2009)
7.3.3	236	Equation (7.102) should be $\begin{array}{l} N_{IQP} = \frac{1}{2\sigma_{IQ}^2\left(\tilde{c}/\tilde{n}_0\right)\tau_a} \\ N_{DDQ} = N_{QC} = \frac{1}{\sigma_{IQ}\sqrt{2\left(\tilde{c}/\tilde{n}_0\right)\tau_a}} \\ N_{QOI} = N_{ATAN} = N_{ATAN2} = 1 \end{array}.$ (7 Jan 2012)
7.3.3	238	Equation (7.107) should be $\begin{array}{l} N_{DDC} = N_{CP} = \frac{1}{4\pi\sigma_{IQ}^2\left(\tilde{c}/\tilde{n}_0\right)\tau_a^2} \\ N_{COD} = N_{ATAN} = N_{ATAN2} = \frac{1}{2\pi\tau_a} \end{array}.$ (7 Jan 2012)

Section(s)	Page(s)	Update/ correction/ addition
7.3.7	244	Equation (7.128) is wrong. Considering the Doppler shift only, it should be $\frac{\partial \tilde{\rho}_R}{\partial t_{sa}} = -\frac{c}{f_{ca}} \Delta \tilde{f}_{ca}, \quad \tilde{\dot{\rho}}_R \approx -\frac{c}{f_{ca}} \Delta \tilde{f}_{ca}$. For users with a high velocity (with respect to the Earth), the measured frequency shift, $\Delta \tilde{f}_{ca}$, should first be corrected for the effects of residual relativistic time dilation as described in [38]. (16 Feb 2008)
7.3.7	244	Equation (7.129) should be $\Delta \tilde{\rho}_{ADR}(t_{sa}) = \int_{t_o}^{t_{sa}} \frac{\partial \tilde{\rho}_R}{\partial t_{sa}}(t) dt$. (16 Feb 2008)
7.4.2	248	The dry component of the troposphere propagation delay varies with the weather with a standard deviation of about 3%. (20 Sep 2009)
7.4.2	248	Unsmoothed ionosphere free combination of dual frequency measurements results in increased multipath errors as well as tracking errors. (22 June 2008)
7.4.3	253	Equation (7.158) should be $\delta\rho_{w\_lag,j} = \frac{\left(\tilde{\dot{\rho}}_R - \dot{\rho}_R\right)\tau_a}{K_{co}} = \frac{\tilde{\dot{\rho}}_R - \dot{\rho}_R}{4B_{L\_CO}}$ $x_{lag} = \frac{f_{co}}{4B_{L\_CO}c}\left(\tilde{\dot{\rho}}_R - \dot{\rho}_R\right)$ (31 August 2013)
7.4.4	254	Reflections off water are also a significant cause of multipath. (10 May 2008)
7.5.3	272	Equation (7.212) should be $\begin{aligned} \delta z_{rj,k}^{-} &= \dot{\rho}_{Cj,k} - \hat{\dot{\rho}}_{Cj,k}^{-} + w_{mrj,k} \\ &\approx \dot{\rho}_{Rj,k} - \hat{\dot{\rho}}_{Rj,k}^{-} + w_{mrj,k} \\ &= -\frac{c}{f_{ca}} \delta \tilde{f}_{caj,k} \end{aligned}$. (29 April 2012)
7.5.4	273	Note that the *combined* satellite clock and ephemeris range error SD is now 1.0 m for GPS and 1.8 m for GLONASS. These figures will continue to reduce. The target for the GPS III satellites and control segment is 0.25 m. (20 Sep 2009)
7.5.4	273-274	In Table 7.6, the residual troposphere error SD is wrong; 0.2 m is the zenith value not the average value, which is about 0.6 m. Consequently, the smallest position error SDs in Table 7.7 should be increased by about 10% (the larger values are unaffected). (20 Sep 2009)
8.3	289-294	A new book on assisted and high-sensitivity GNSS is: Van Diggelen, F., *A-GPS: Assisted GPS, GNSS, and SBAS*, Norwood, MA: Artech House, April 2009. (11 Apr 2010)
8.4.2	295	Receivers with multiple narrowly-spaced correlators are sometimes known as rake receivers. (16 Feb 2008)
9.1-9.3	303-312	The reissued book, Forssell, B., *Radionavigation Systems*, Norwood, MA: Artech House, February 2008 (originally published 1991), provides information on Loran-C, VOR, DME, and direction finding with NDB. It also provides information on historical systems, such as Decca, Omega and Transit. (12 Jan 2008)

Section(s)	Page(s)	Update/ correction/ addition
9.1	304	Historical DME ranging accuracy was of order 500 m (1σ). With modern equipment, an accuracy or about 100 m is typical. A 20 m accuracy is only obtainable where the interrogator and transponder are close. (27 Sep 2009)
9.1	303-305	RSBN, a Russian acronym for Radio engineers' system of short-range navigation, is a similar system to VOR, DME and TACAN. It provides both two-way ranging and bearing information (with respect to true north). It uses the 116–118 MHz band for angular positioning and the 873–1001 MHz band for both ranging and angular positioning. Coverage and accuracy are similar to VOR, DME and TACAN. RSBN is used in Eastern Europe, Russia and surrounding countries by both military and civil users, though some airlines have switched to VOR and DME. (25 Jan/ 27 Sep 2009)
9.2.2	308	The majority of the Eurofix bits are used for error correction. The bit rate available for message content is 18.7–37.4 bit s^{-1}, depending on GRI.
9.2.3	308	Equation (9.3) should be: $\tilde{\rho}_{Cj} = s\left(L_{tj}, \lambda_{tj}; \hat{L}_a, \hat{\lambda}_a\right) + \delta\hat{\rho}_{rc} + \delta\rho_{\varepsilon j}^{+}$ where $s\left(L_{tj}, \lambda_{tj_t}; \hat{L}_a, \hat{\lambda}_a\right) \approx u\left(L_{tj}, \lambda_{tj}; \hat{L}_a, \hat{\lambda}_a\right)$ $\times\sqrt{\frac{1}{2}\left(R_N^2(L_{tj}) + R_N^2(\hat{L}_a)\right) + \frac{\sin^2\psi_{nu}}{2}\left[\frac{\cos^2\hat{L}_a}{\cos^2 L_{jt}}\left(R_E^2(L_{tj}) - R_N^2(L_{tj})\right) + R_E^2(\hat{L}_a) - R_N^2(\hat{L}_a)\right]^2}$, $u\left(L_{tj}, \lambda_{tj_t}; \hat{L}_a, \hat{\lambda}_a\right) \approx \arccos\left[\sin L_{tj} \sin\hat{L}_a + \cos L_{tj} \cos\hat{L}_a \cos\left(\lambda_{tj} - \hat{\lambda}_a\right)\right]$ and $\psi_{nu} \approx \begin{cases} \arcsin\left(\frac{\sin\left(\lambda_{tj} - \hat{\lambda}_a\right)}{\sin\left[u\left(L_{tj}, \lambda_{tj}; \hat{L}_a, \hat{\lambda}_a\right)\right]\cos L_{tj}}\right) & L_{tj} \geq \hat{L}_a \\ \pi - \arcsin\left(\frac{\sin\left(\lambda_{tj} - \hat{\lambda}_a\right)}{\sin\left[u\left(L_{tj}, \lambda_{tj}; \hat{L}_a, \hat{\lambda}_a\right)\right]\cos L_{tj}}\right) & L_{tj} < \hat{L}_a \end{cases}$ (11 Apr 2010)
9.2.3	308-310	To compute a position solution using Loran-C, as opposed to ELoran, pseudo-range measurements, it is necessary to estimate a separate receiver clock offset, $\delta\hat{\rho}_{rc}$, for each Loran-C chain used. Thus to obtain position information from a Loran-C chain, at least two transmitters from that chain must be received. (19 Apr 2008)
9.3	311-312	PRMG, a Russian acronym for Approach and Landing Radio Beacon Group System, is a landing aid, similar to ILS. It operates on the same UHF frequencies as RSBN and has the same user base. (25 Jan 2009)
9.3	311-312	The Microwave Landing System (MLS) is used by the US Air Force and by British Airways at Heathrow Airport in London. It was originally conceived as a replacement for ILS, but has been superseded by the development of GNSS-based landing systems. It is described in Section C.6.6 of the on-line history appendix. (25 Jan 2009)
9.4	312-316	A new book on short-range terrestrial radio navigation is: Bensky, A., *Wireless Positioning Technologies and Applications*, Norwood, MA: Artech House, January 2008. (2 Jan 2008)
9.4.4	315	Positioning using an RSS database is sometimes known as "fingerprinting". (16 Feb 2008)
9.4.4	315	A further example of a WLAN positioning using an RSS database is the German ipos system. (10 May 2008)
9.4.5	315	With a 1-GHz bandwidth, multipath components separated by 0.3 m may be resolved. (11 Apr 2010)
9.4.5	315-316	TRT is now selling products incorporating its FH-UWB positioning technology under the names Indoor Positioning System (IPS) and EUROPCOM. (12 Jan 2008)
9.4.5	315-316	A new book on UWB positioning is: Sahinoghu, Z., S. Gezici, and I. Gvenc, *Ultra Wideband Positioning Systems*, Cambridge, UK: Cambridge University Press, August 2008. (12 Jan 2008)

Section(s)	Page(s)	Update/ correction/ addition
9.5	317	In a relative navigation network, two participants must be in known locations unless the relative ranging measurements are accompanied by direction measurements. (18 October 2008)
10.1.1	322	Equation (5.89) is wrong (in the left-hand equation). It should be $\theta_{nb} = \arctan\left(\frac{f_{ib,x}^{b}}{\sqrt{{f_{ib,y}^{b}}^{2} + {f_{ib,z}^{b}}^{2}}}\right), \qquad \phi_{nb} = \arctan 2\left(-f_{ib,y}^{b}, -f_{ib,z}^{b}\right).$ (7 August 2011)
10.3	330	An odometer is sometimes known as a rotary encoder. (16 Feb 2008)
10.3	335	A further source of error in odometry is uneven road surfaces. This impacts yaw rate measurement via differential odometry much more than velocity measurement. (2 Jan 2008)
11.1.1	347	Equation (11.3) should be $\mathbf{H}_{T} = \begin{pmatrix} \frac{\partial h_{t,D}\left(\hat{L}_{b}, \hat{\lambda}_{b}\right)}{\partial L} & \frac{\partial h_{t,D}\left(\hat{L}_{b}, \hat{\lambda}_{b}\right)}{\partial \lambda} & 1 & \mathbf{0} \end{pmatrix}.$ (18 Apr 2011)
12.1.1	365-368	The open-loop and closed-loop INS correction implementations are sometimes known as feed-forward and feedback complementary filters, respectively. (25 Jan 2009)
12.1.1	366	In the line before (12.1), $\hat{\mathbf{r}}_{\beta b}^{\gamma}$ should be $\tilde{\mathbf{r}}_{\beta b}^{\gamma}$. (3 July 2011)
12.1.1	366	In the last paragraph, it is the position, velocity, and attitude *error* estimates that are zeroed after feedback. (3 July 2011)
12.1.1	367	In the last line, it should be *integration* algorithms. (3 July 2011)
12.1.4	371-372	GNSS tracking loop aiding using the INS is sometimes known as ultra-tightly-coupled (UTC) integration, an alternative definition for the term. (18 October 2008)
12.2.2.1	378	Equation (12.18) is wrong (in the final subscript). It should be $\left[\delta\dot{\boldsymbol{\psi}}_{ib}^{i} \wedge\right] \approx \delta\dot{\mathbf{C}}_{b}^{i}.$ (6 February 2011)
12.2.2.1	379	Prior to (12.19), it should state "From (5.95)" (23 February 2013)
12.2.2.2	380	In equation (12.30), $\mathbf{b}_{as}$ should be $\mathbf{b}_{a}$. (2 Jan 2008)
12.2.4	384	Equation (12.53) should be $\begin{aligned} \hat{\mathbf{C}}_{b}^{n}\left(\tilde{\boldsymbol{\omega}}_{ie}^{b} - \boldsymbol{\omega}_{ie}^{b}\right) + \hat{\mathbf{C}}_{b}^{n}\left(\tilde{\boldsymbol{\omega}}_{en}^{b} - \boldsymbol{\omega}_{en}^{b}\right) &\approx \hat{\mathbf{C}}_{b}^{n}\left(\tilde{\mathbf{C}}_{n}^{b} - \mathbf{C}_{n}^{b}\right)\left(\hat{\boldsymbol{\omega}}_{ie}^{n} + \hat{\boldsymbol{\omega}}_{en}^{n}\right) + \left(\tilde{\boldsymbol{\omega}}_{ie}^{n} - \boldsymbol{\omega}_{ie}^{n}\right) + \left(\tilde{\boldsymbol{\omega}}_{en}^{n} - \boldsymbol{\omega}_{en}^{n}\right) \\ &\approx \boldsymbol{\Omega}_{in}^{n}\delta\boldsymbol{\psi}_{nb}^{n} + \left(\tilde{\boldsymbol{\omega}}_{ie}^{n} - \boldsymbol{\omega}_{ie}^{n}\right) + \left(\tilde{\boldsymbol{\omega}}_{en}^{n} - \boldsymbol{\omega}_{en}^{n}\right) \end{aligned}$ (19 February 2012)
12.2.4	385	Equation (12.56) omits the direction of the gravity term. It should be $\begin{aligned} \delta\dot{\mathbf{v}}_{eb}^{n} \approx\ & -\left(\hat{\mathbf{C}}_{b}^{n}\hat{\mathbf{f}}_{ib}^{b}\right) \wedge \delta\boldsymbol{\psi}_{nb}^{n} - \left(\boldsymbol{\Omega}_{en}^{n} + 2\boldsymbol{\Omega}_{ie}^{n}\right)\delta\mathbf{v}_{eb}^{n} + \mathbf{v}_{eb}^{n} \wedge \left(\tilde{\boldsymbol{\omega}}_{en}^{n} - \boldsymbol{\omega}_{en}^{n}\right) \\ & + 2\mathbf{v}_{eb}^{n} \wedge \left(\tilde{\boldsymbol{\omega}}_{ie}^{n} - \boldsymbol{\omega}_{ie}^{n}\right) - \frac{2g_{0}(\hat{L}_{b})}{r_{eS}^{e}(\hat{L}_{b})}\hat{\mathbf{u}}_{D}^{n}\delta h_{b} + \hat{\mathbf{C}}_{b}^{n}\mathbf{b}_{a} \end{aligned},$ where $\hat{\mathbf{u}}_{D}^{n}$ is the down unit vector of the local navigation frame. (25 Aug 2010)

Section(s)	Page(s)	Update/ correction/ addition
12.2.5	388	Equation (12.69) is wrong. It should be $n_{bad}^2 = \frac{\sigma_{bad}^2}{\tau_{bad}}, \qquad n_{bgd}^2 = \frac{\sigma_{bgd}^2}{\tau_{bgd}}$. (19 Apr 2008)
12.3.1	390-393	In the loosely-coupled measurement model, mixing latitude and longitude in radians with height in meters can cause numerical problems in the HPH^T + R matrix inversion. One solution is to change the latitude and longitude units to mrad. (11 April 2010)
12.3.1	390	In equation (12.79), $\hat{\boldsymbol{\omega}}_b^b$ should be $\hat{\boldsymbol{\omega}}_{ib}^b$. (31 Jan 2009)
12.3.1	390, 392	In equations (12.80) and (12.90), $\hat{\boldsymbol{\Omega}}_{en}^n$ should be omitted. (31 Jan 2009) Also, the Position of **T** in Equation (12.90) is wrong. It should be $\begin{aligned} \mathbf{H}_{r1}^n &\approx \hat{\mathbf{T}}_r^p \left[\left(\hat{\mathbf{C}}_b^n \mathbf{l}_{ba}^b \right) \wedge \right] \\ \mathbf{H}_{v1}^n &\approx \left[\left\{ \hat{\mathbf{C}}_b^n \left(\hat{\boldsymbol{\omega}}_{ib}^b \wedge \mathbf{l}_{ba}^b \right) - \hat{\boldsymbol{\Omega}}_{ie}^n \hat{\mathbf{C}}_b^n \mathbf{l}_{ba}^b \right\} \wedge \right] \\ \mathbf{H}_{v5}^n &\approx \hat{\mathbf{C}}_b^n \left[\mathbf{l}_{ba}^b \wedge \right] \end{aligned}$. (6 February 2011)
12.4.2	400	For tightly coupled integration of GNSS attitude, the measurement noise is not correlated between antennas; only the range biases are correlated in this way. . (2 October 2010)
13.1.1	409	In equation (13.3), $\hat{\boldsymbol{\Omega}}_{en}^n$ should be omitted. (31 Jan 2009)
13.1.1	410	Equation (13.4) is wrong (in the velocity term). It should be $\mathbf{x}^\gamma = \begin{pmatrix} \delta\boldsymbol{\psi}_{\gamma b}^\gamma \\ \delta\mathbf{v}_{\beta b}^\gamma \\ \mathbf{b}_a \\ \mathbf{b}_g \\ \vdots \end{pmatrix} \quad \{\beta, \gamma\} \in \{i,i\}, \{e,e\}, \{e,n\}$. (6 February 2011)
13.1.2	411	Equation (13.7) is wrong (final subscript). It should be $\mathbf{I}_3 + \left[\delta\mathbf{z}_{A,k}^{\gamma-} \wedge \right] = \hat{\mathbf{C}}_r^\gamma \hat{\mathbf{C}}_b^r \hat{\mathbf{C}}_\gamma^b \quad \gamma \in i, e, n$. (6 February 2011)
13.3	416	Equation (13.28) is wrong (initial superscript). It should be $\mathbf{H}_{ZV,k}^i = \begin{pmatrix} \mathbf{0}_3 & -\mathbf{I}_3 & \boldsymbol{\Omega}_{ie}^i & \mathbf{0}_3 & \mathbf{0}_3 & \mathbf{0} \end{pmatrix}$. (6 February 2011)
14.1.4	426-429	In federated integration architectures, there is an option to implement separate inertial or dead-reckoning navigation equations for each local filter, provided the raw IMU or DR sensor measurements are available.
14.1.6	431	Equation (14.10) is wrong (in the final subscript). It should be $\mathbf{H}_i^\gamma = \left. \begin{pmatrix} -\frac{\partial \mathbf{m}}{\partial \mathbf{x}_{Nav}^\gamma} & \mathbf{0} & \frac{\partial \mathbf{m}}{\partial \mathbf{x}_{Sensor-i}} & \mathbf{0} \end{pmatrix} \right\|_{\mathbf{x}^\gamma = \hat{\mathbf{x}}^\gamma}$. (6 February 2011)
14.1.7	432	Equation (14.14) is wrong (in the final subscript). It should be $\mathbf{H}_i^\gamma = \left. \begin{pmatrix} -\frac{\partial \mathbf{m}}{\partial \mathbf{x}_{\mathrm{Re}f}^\gamma} & \mathbf{0} & \frac{\partial \mathbf{m}}{\partial \mathbf{x}_{Sensor-i}} & \mathbf{0} \end{pmatrix} \right\|_{\mathbf{x}^\gamma = \hat{\mathbf{x}}^\gamma}$. (6 February 2011)

Section(s)	Page(s)	Update/ correction/ addition
14.3.1.1	438	Equation (14.33) is wrong (in the first row). It should be $\hat{\theta}_{nbA} = \arctan\left[\frac{\left(\tilde{f}_{ib,x}^{b} - \hat{b}_{a,x}\right)}{\sqrt{\left(\tilde{f}_{ib,y}^{b} - \hat{b}_{a,y}\right)^{2} + \left(\tilde{f}_{ib,z}^{b} - \hat{b}_{a,z}\right)^{2}}}\right]$ $\hat{\phi}_{nbA} = \arctan 2\left[-\left(\tilde{f}_{ib,y}^{b} - \hat{b}_{a,y}\right), -\left(\tilde{f}_{ib,z}^{b} - \hat{b}_{a,z}\right)\right]$. (7 August 2011)
14.3.3	442	Equation (14.47) is wrong (in the third row). It should be $\delta\mathbf{z}_{O,k}^{-} = \begin{pmatrix} \tilde{v}_{erO}\left(1 - \hat{s}_{or}\right) - \hat{v}_{er} \\ \tilde{\psi}_{nbO}\left(1 - \hat{s}_{or}\right) - \frac{\hat{v}_{er}}{T_{r}}\hat{s}_{\Delta or} - \hat{\psi}_{nb} \\ -\hat{v}_{x} \end{pmatrix}_{k}$. (6 February 2011)
15.4.1	462-463	In the solution separation RAIM method, the correct solution is not necessarily furthest away from the others.
A.4	477	Equation (A.33) should be $\mathrm{adj}\mathbf{A} = \begin{pmatrix} \alpha_{11} & -\alpha_{21} & \cdots & (-1)^{m+1}\alpha_{n1} \\ -\alpha_{12} & \alpha_{22} & \cdots & (-1)^{m+2}\alpha_{n2} \\ \vdots & \vdots & \ddots & \vdots \\ (-1)^{n+1}\alpha_{1m} & (-1)^{n+2}\alpha_{2m} & \cdots & \alpha_{nm} \end{pmatrix}$. (16 Aug 2009) $\left\|\mathbf{A}\right\| = \sum_{i=1}^{n} (-1)^{r+i} A_{ri}\alpha_{ri}$