Mobile Robotics, Mathematics, Models, and Methods

Errata in Initial Revision

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Locations in the first column are given in several formats:

1. x,y,z means page x, para y, line z
2. x, Fig y.z means figure y.z on page x.
3. x, Eq y.z means Equation y.z on page x.
4. etc.

Generally, errors in cross references will make it more difficult to follow derivations. With a few exceptions, errors in math (both in-line and otherwise) are typically notational.

A few severe issues are noted in the comments. Look for the word severe. If your time is limited, I suggest that you use a pencil in your text to fix the severe issues and the cross reference errors. Everything else is minor.

Table 1: Typo and In-line Math Edits

Location	Present	Revised	Comment
28, 8,5	is $\Re^n.\mathcal{R}(A)$	is $\Re^n.\ \ \mathcal{R}(A)$	Add space
113,6,2	we have:	we have the matrix:	clarify quantity is a matrix
118,8,3	Let the set of solutions to the above constraint be parameterized locally by a parameter s to produce the surface $\underline{x}(s)$. Each element of the vector $\underline{x}(s)$ is a *level curve*.	Let the set of solutions to the above constraint be parameterized locally in one direction by a parameter s to produce the curve $\underline{x}(s)$. $\underline{x}(s)$ is called a *level curve*.	This discussion is confusing when applied to n dimensions.
119,1,1	We can conclude that the gradient $\partial\underline{g}/\partial\underline{x}$	We can conclude that the gradient $\partial g/\partial\underline{x}$	remove underline
1467,1,2	composite vector of unknowns $\left[\Delta\underline{x}^T\ \underline{\lambda}\Delta^T\right]^T$.	composite vector of unknowns $\left[\Delta\underline{x}^T\ \Delta\underline{\lambda}^T\right]^T$.	move delta symbol

Table 1: Typo and In-line Math Edits

Location	Present	Revised	Comment
151	Form the matrix (math font) V whose rows are two arbitrary vectors (math font, underlined) $\underline{v}_1$ and (math font, underlined) $\underline{v}_2$ in the plane.Use constrained optimization to show that the unit vector that maximizes the sum of its squared projections onto both vectors is an eigenvector of (math font) V^{TV}.	Form the matrix V whose rows are two arbitrary vectors $\underline{v}_1$ and $\underline{v}_2$ in the plane. Use constrained optimization to show that the unit vector that maximizes the sum of its squared projections onto both vectors is an eigenvector of $V^T V$.	remove format spec, take V down fromfinal superscript
176, 7,1	Consider next two frames of reference that are rotating with respect to each one another	Consider next two frames of reference that are rotating with respect to one another	remove word each
192,4,1	**4.2.2.1.1 Wheel .... Wheel Steering Control**	**4.2.2.1.1 Wheel Steering Control**	delete extra word
195,2,1	**Box 4.2 WMR Forward Kinematics: Offset Wheels**	**Box 4.2 WMR Forward and Inverse Kinematics: Offset Wheels**	add words
213,8,3	projection that occurs at line 11	projection that occurs at line 12	
217,3,8	the eigenvectors associated with the $n-1$ largest eigenvalues of C^{TC}	the eigenvectors associated with the $n-1$ largest eigenvalues of $C^T C$	move second C down from superscript
217,4,2	However, later content	However, earlier content	
242,6,1	The state vector is $\underline{x}(t) = [x(t)\ y(t)\ \theta(t)]^T$ and	The state vector is $\underline{x}(t) = [x(t)\ y(t)\ \psi(t)]^T$ and	change theta to psi
251,3,3	counteract the increasing tendency increasing tendency to roll over	counteract the increasing tendency to roll over	delete double phrase
261,3,1	using the above Jacobian	using the Jacobian	delete word
262,3,1	the parameters $\underline{p}$ may only be obtainable	the parameters $\underline{\rho}$ may only be obtainable	change letter p to rho
268, 7	4.5.7.2 Papers	see comment	move Raol and Wong up to Books

Table 1: Typo and In-line Math Edits

Location	Present	Revised	Comment
268, 7	Proceedings of International symposium on Reading Review, 2011	Proceedings of International Symposium on Robotics Research, 2011.	
274,3 Spot 5.1	The exponent $[\underline{x}-\underline{\mu}]^T C^{-1}[\underline{x}-\underline{\mu}]$ is called the *Mahalanobis distance* (MHD)	The exponent $[\underline{x}-\underline{\mu}]^T C^{-1}[\underline{x}-\underline{\mu}]$ is called the (squared) *Mahalanobis distance* (MHD)	add word "squared"
278,1,2	when the exponent (the squared *Mahalanobis distance*) is a constant	when the exponent (the squared *Mahalanobis distance*) is a constant	add word "squared"
290,4,2	in terms of it evolution over time;	in terms of its evolution over time;	change it to its
308, 7	It is not possible to invert this relationship to determine R from Σ_{xx}.	It is not possible to invert this relationship to determine R from Σ_{xx}. Also note that: $\hat{\underline{x}}^* = \Sigma_{xx} H^T R^{-1} \underline{z}$ In other words, the solution covariance appears in the formula for the solution itself.	Add sentence to clarify.
309	The weighted least squares solution from Equation 5.79 for $H = \begin{bmatrix} 1 & 1 \end{bmatrix}^T$ and $R = \mathrm{diag}\begin{bmatrix} \sigma_z^2 & \sigma_x^2 \end{bmatrix}$ is	The weighted least squares solution from Equation 5.79 for $H' = \begin{bmatrix} 1 & 1 \end{bmatrix}^T$ and $R' = \mathrm{diag}\begin{bmatrix} \sigma_z^2 & \sigma_x^2 \end{bmatrix}$ is	add primes to H and R
310,2,2	Now, suppose that another measurement $z_2 = 6$ was produced at the same time as the first with variance $\sigma_{z1}^2 = (1.5)^2$.	Now, suppose that another measurement $z_2 = 6$ was produced at the same time as the first with variance $\sigma_{z2}^2 = (1.5)^2$.	Change variance subscript to z2
312,11,5	By substituting Equation 5.85 into Equation 5.80, we immediately get:	We already know that the covariance of the MLE estimate is the first matrix in the solution. Therefore, from Equation 5.85 and Equation 5.84, we can immediately write:	Add sentence and reuse earlier result.

Table 1: Typo and In-line Math Edits

Location	Present	Revised	Comment
313, 11,1	Subsequent measurements have covariances of $R_3 = diag\begin{bmatrix}1 & 0.1\end{bmatrix}$ and $R_4 = diag\begin{bmatrix}0.1 & 0.1\end{bmatrix}$.	Subsequent measurements have covariances of $R_3 = diag\begin{bmatrix}1 & 0.1\end{bmatrix}$ and $R_4 = diag\begin{bmatrix}0.1 & 1\end{bmatrix}$.	Change 0.1 to 1
325,4,3	The "complement" of the linearized filter is an system dynamics model	The "complement" of the linearized filter is a system dynamics model	Change an to a
331,1,1	Let $\vec{\rho}$ be the position vector of the wheel relative to the body frame and let $\vec{\omega}$ denote the angular velocity which, is assumed	Let $\vec{\rho}$ be the position vector of the wheel relative to the body frame and let $\vec{\omega}$ denote the angular velocity, which is assumed	move comma
346,3,5	We will denote by $\bar{A}$ the proposition that event that A did not occur.	We will denote by $\bar{A}$ the proposition that event A did not occur.	delete second "that"
353, 5,2	Bayes', filter [17].	Bayes' filter [17].	remove comma
361,2,3	(Figure 5.48)	Figure 5.48	remove brackets
375, 3,3	However, there may no solution	However, there may be no solution	add word be
276,2,2	imagine placing the vehicle at the origin	imagine placing the vehicle on the hyperbola at y=0	
401,2	measure the angle	measures the angle	add s
401,3,1	Inexpensive devices have bandwidths on the order or 2 Hz	Inexpensive devices have bandwidths on the order of 2 Hz	or -> of
401,3,2	a *rebalance loop* that prevent the sensor	a *rebalance loop* that prevents the sensor	add s
403,4,1	neither constant nor entirely a real force.	neither constant nor entirely associated with a real force.	add two words
407,5,2	is fixed with a lasing medium	is filled with a lasing medium	fixed->filled
414,6,2	but the above assumes a zyx sequence.	but the above assumes a zxy sequence.	
419,3,3	Note that R_v^n and R_v^n are very different matrices	Note that $\mathfrak{R}_v^n$ and R_v^n are very different matrices	different fonts

Table 1: Typo and In-line Math Edits

Location	Present	Revised	Comment
432,5,6	three to five meter accuracy	Three to five meter accuracy	capitalize T
438,3,1	The trajectory control level considers and entire trajectory	The trajectory control level considers an entire trajectory	and->an
453,1	Provide the details of the transfer function derivation for the cascade controller shown in Figure 7.14.	Provide the details of the transfer function $T(s)$ (before assuming $K_{vi} = 0$) derivation for the cascade controller shown in Figure 7.14. Its tricky.	
469,4,6	and an entire terminal state $\underline{x}s_f = \left[x_f\ y_f\ \psi_f\ \kappa_f\right]$.	and an entire terminal state $\underline{x}(s_f) = \left[x_f\ y_f\ \psi_f\ \kappa_f\right]$.	add brackets
484,5,1	Much of the forth coming discussion	Much of the forthcoming discussion	join words
491,3,1	Of course, there are situations, such as operation in cluttered environments where	Of course, there are situations, such as operation in cluttered environments, where	add comma
503,2,3	Most sensors measure anyway.	Most sensors measure surfaces anyway.	add word "surfaces"
503,4,1	7.4.3.3.4 Sampled versus Continuum .	7.4.3.3.4 Sampled versus Continuum .	remove space
503,4,6	In such a representation computational complexity	In such a representation, computational complexity	add comma
515,1,1	Although states estimation	Although state estimation	states->state
530,7,2	similarity measures 9.	similarity measures [9].	add []
536,5,3	same color it is not possible	same color, it is not possible	add comma
539,4,4	defined by the Bessel function Figure 8.26	defined by the Bessel function (Figure 8.26)	add ()
544,5,2	In the latter case the corners can be very small	In the latter case, the corners can be very small	add comma
560,5,5	Hence, a camara that is sensitive	Hence, a camera that is sensitive	camara->camera
562,4,1	identical basic principles to those or sonar	identical basic principles to those of sonar	or->of
569,3,2	Section 1.3.10 of Chapter 5.	Section 5.1.3.10 of Chapter 5	
570,4,4	optics are also relative inexpensive	optics are also relatively inexpensive	relative->relatively

Table 1: Typo and In-line Math Edits

Location	Present	Revised	Comment
629,7,1	Conversely, the residual $z(\underline{x}) = \underline{b} - \underline{c}(\underline{x})$ can be added	Conversely, the residual $z(\underline{x}) = \underline{b} - \underline{g}(\underline{x})$ can be added	c -> g
635,4,1	Let the measurement project onto a a few states	Let the measurement project onto a few states	delete redundant word
637, 3	to locate the landmark Figure 9.48.	to locate the landmark (Figure 9.48).	add ()

643,5	Soundness ...
	Feasible ...
	Admissible ...
	Completeness ...
	If any ...
	If not ...
	Optimality ...
		Soundness ...
		   Feasible ...
		   Admissible ...
		Completeness ...
		   If any ...
		   If not ...
		Optimality ...
			Indent 2nd,3rd,4th,5th bullets

651, 3,2	set of roads and vehicles	set of roads, and vehicles	
655,5,1	to encode arbitrary gradient.	to encode arbitrary strategies.	gradient->strategies
659,1,2	described in terms of a traversal of a tree that restrict traversal is discovered during the search process	described in terms of a traversal of a tree that is discovered during the search process	delete “restrict traversal”
662,2,1	the g values nodes	the g values	
664, 2,1	The cost estimate $f(\underline{x})$is computed	The cost estimate $f(\underline{x})$ is computed	add space
666,3,6	total costs any new nodes added to OPEN	total costs of any new nodes added to OPEN	insert “of”
668,6,6	order to process child nodes is unknown means this	order to process child nodes is unknown, means this	add comma
669, 8,4	In difficult terrain the details	In difficult terrain, the details	add comma
671,4,3	(only when headed)	(only when needed)	headed->needed
679,5,5	Node costs refer to the estimated total cost	Node costs refer to the estimated total cost	estimate->estimated

Table 2: Math and Algorithm Edits

Location	Present	Revised	Comment
40	$\frac{\partial}{\partial \underline{p}}\underline{f}(\underline{x},\underline{p}) = \underline{f}_{\underline{x}} \cdot \frac{\partial \underline{x}}{\partial \underline{p}} + \underline{f}$	$\frac{\partial}{\partial \underline{p}}\underline{f}(\underline{x},\underline{p}) = \underline{f}_{\underline{x}} \cdot \frac{\partial \underline{x}}{\partial \underline{p}} + \underline{f}_{\underline{p}}$	Add $\underline{p}$ subscript
77,Eq 2.72	$\begin{bmatrix} 1 & -\delta\psi & \delta\theta & 0 \\ \delta\psi & 1 & -\delta\phi & 0 \\ -\delta\theta & \delta\phi & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$	$\begin{bmatrix} 0 & -\delta\psi & \delta\theta & 0 \\ \delta\psi & 0 & -\delta\phi & 0 \\ -\delta\theta & \delta\phi & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$	severe error, replace diagonal with zeros
95, Eq 2.96	$T_{R2}^{R1} = T_B^R T_P^B (T_T^B)^{-1} (T_B^R)^{-1}$	$T_{R2}^{R1} = T_B^R T_P^{B1} (T_T^B)^{-1} (T_B^R)^{-1}$	replace superscript B with B1
97,Eq 2.97	$\left[\begin{array}{c:c:c} c\psi_k^i & -s\psi_k^i & c\psi_j^i a_k^j - s\psi_j^i b_k^j + a_j^i \\ s\psi_k^i & c\psi_k^i & s\psi_j^i a_k^j + c\psi_j^i b_k^j + b_j^i \\ 0 & 0 & 1 \end{array}\right]$	$\left[\begin{array}{c:c:c} c\psi_k^i & -s\psi_k^i & c\psi_j^i a_k^j - s\psi_j^i b_k^j + a_j^i \\ s\psi_k^i & c\psi_k^i & s\psi_j^i a_k^j + c\psi_j^i b_k^j + b_j^i \\ 0 & 0 & 1 \end{array}\right]$	move column separators right
124, Eq 3.7	*subject to:* $\underline{c}'\mathrm{mp}(\underline{x}) = \underline{0}$	*subject to:* $\underline{c}(\underline{x}) = \underline{0}$	remove letters mp
127, Eq 3.12	$f(\underline{x}) = \frac{1}{2}\underline{x}^T Q_{xx}\underline{x} + \underline{b}^T\underline{x} + \underline{c}$	$f(\underline{x}) = \frac{1}{2}\underline{x}^T Q_{xx}\underline{x} + \underline{b}^T\underline{x} + c$	no underline on c
163, Eq 3.119	$k_p = \frac{\tau}{\Delta t}$	$k_p = \frac{\Delta t}{\tau}$	reciprocal
199, Eq 4.62	${}^{s1}\underline{r}_{c1} = d\begin{bmatrix} -s\gamma_1 & -c\gamma_1 \end{bmatrix}^T$ ${}^{s3}\underline{r}_{c3} = d\begin{bmatrix} -s\gamma_3 & -c\gamma_3 \end{bmatrix}^T$ ${}^{s2}\underline{r}_{c2} = d\begin{bmatrix} s\gamma_2 & c\gamma_2 \end{bmatrix}^T$ ${}^{s4}\underline{r}_{c4} = d\begin{bmatrix} s\gamma_4 & c\gamma_4 \end{bmatrix}^T$	${}^{s1}\underline{r}_{c1} = d\begin{bmatrix} -s\gamma_1 & c\gamma_1 \end{bmatrix}^T$ ${}^{s3}\underline{r}_{c3} = d\begin{bmatrix} -s\gamma_3 & c\gamma_3 \end{bmatrix}^T$ ${}^{s2}\underline{r}_{c2} = d\begin{bmatrix} s\gamma_2 & -c\gamma_2 \end{bmatrix}^T$ ${}^{s4}\underline{r}_{c4} = d\begin{bmatrix} s\gamma_4 & -c\gamma_4 \end{bmatrix}^T$	severe error, change sign of all y coordinates
208,1	$\underline{\rho}_i^T = \dots = \begin{bmatrix} 0 & 0 & (c\gamma x_i^v + s\gamma y_i^v) \end{bmatrix}$	$\underline{\rho}_i^T = \dots = -\begin{bmatrix} 0 & 0 & (c\gamma x_i^v + s\gamma y_i^v) \end{bmatrix}$	severe error, add minus sign to 3rd expression only
210, Eq 4.94	$\underline{c}_{\underline{x}} = \begin{bmatrix} -s\psi & c\psi & -L \\ -s\psi\gamma & c\psi\gamma & Lc\gamma \end{bmatrix}$	$\underline{c}_{\underline{\dot{x}}} = \begin{bmatrix} -s\psi & c\psi & -L \\ -s\psi\gamma & c\psi\gamma & Lc\gamma \end{bmatrix}$	change subscript to $\underline{\dot{x}}$

Table 2: Math and Algorithm Edits

Location	Present	Revised	Comment
224, Eq 4.111	$\underline{c}(\underline{x}) = {}^{v}\begin{bmatrix} v_z \\ \omega_x \\ \omega_y \end{bmatrix}_{w}^{v} = \underline{0}$	$\underline{c}(\underline{x}) = {}^{v}\begin{bmatrix} v_z \\ \omega_x \\ \omega_y \end{bmatrix}_{v}^{w} = \underline{0}$	switch right super and subscript, leave left alone
227,7	$\frac{\tau}{\Delta t}(y_{k+1} - y_k) + y_{k+1} = \dots$	$\frac{\tau}{\Delta t}(y_{k+1} - y_k) + y_k = \dots$	change k+1 to k
227,8	$\dots = y_k + \frac{\Delta t}{\tau}(u_{k+1} - y_{k+1})$	$y_{k+1} = y_k + \frac{\Delta t}{\tau}(u_{k+1} - y_k)$	change k+1 to k
242, Eq 4.152	$\begin{bmatrix} c\theta(t) & -s\theta(t) & 0 \\ s\theta(t) & c\theta(t) & 0 \\ 0 & 0 & 1 \end{bmatrix}$	$\begin{bmatrix} c\psi(t) & -s\psi(t) & 0 \\ s\psi(t) & c\psi(t) & 0 \\ 0 & 0 & 1 \end{bmatrix}$	change theta to psi everywhere
242, 7,1	$\begin{bmatrix} 0 & 0 & -[s\theta(t)V_x(t) + c\theta(t)V_y(t)] \\ 0 & 0 & [c\theta(t)V_x(t) - s\theta(t)V_y(t)] \\ 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} 0 & 0 & -[s\psi(t)V_x(t) + c\psi(t)V_y(t)] \\ 0 & 0 & [c\psi(t)V_x(t) - s\psi(t)V_y(t)] \\ 0 & 0 & 0 \end{bmatrix}$	change theta to psi everywhere (including inline 2 lines above)
242, 8,1	$\begin{bmatrix} c\theta(t) & -s\theta(t) & 0 \\ s\theta(t) & c\theta(t) & 0 \\ 0 & 0 & 1 \end{bmatrix}$	$\begin{bmatrix} c\psi(t) & -s\psi(t) & 0 \\ s\psi(t) & c\psi(t) & 0 \\ 0 & 0 & 1 \end{bmatrix}$	change theta to psi everywhere
243, Eq 4.154	$\begin{bmatrix} c\theta(t) & -s\theta(t) & -\Delta y(t, \tau) \\ s\theta(t) & c\theta(t) & \Delta x(t, \tau) \\ 0 & 0 & 1 \end{bmatrix}$	$\begin{bmatrix} c\psi(t) & -s\psi(t) & -\Delta y(t, \tau) \\ s\psi(t) & c\psi(t) & \Delta x(t, \tau) \\ 0 & 0 & 1 \end{bmatrix}$	change theta to psi everywhere
243, Eq 4.155	$\begin{bmatrix} c\theta(t) & -s\theta(t) & -\Delta y(t, \tau) \\ s\theta(t) & c\theta(t) & \Delta x(t, \tau) \\ 0 & 0 & 1 \end{bmatrix}$	$\begin{bmatrix} c\psi(t) & -s\psi(t) & -\Delta y(t, \tau) \\ s\psi(t) & c\psi(t) & \Delta x(t, \tau) \\ 0 & 0 & 1 \end{bmatrix}$	change theta to psi everywhere (just like line above)
263,7	$\begin{bmatrix} V(t)\cos\theta(t) \\ V(t)\sin\theta(t) \\ \omega(t) \end{bmatrix}, \begin{bmatrix} c\theta & 0 \\ s\theta & 0 \\ 0 & 1 \end{bmatrix}$	$\begin{bmatrix} V(t)\cos\psi(t) \\ V(t)\sin\psi(t) \\ \omega(t) \end{bmatrix}, \begin{bmatrix} c\psi & 0 \\ s\psi & 0 \\ 0 & 1 \end{bmatrix}$	change theta to psi everywhere

Table 2: Math and Algorithm Edits

Location	Present	Revised	Comment
264,1	$\begin{bmatrix} c\theta & c\theta \\ s\theta & s\theta \\ 1/W & -1/W \end{bmatrix}$	$\begin{bmatrix} c\psi & c\psi \\ s\psi & s\psi \\ 1/W & -1/W \end{bmatrix}$	change theta to psi everywhere
264,2	$\begin{bmatrix} (v_r + v_l)c\theta \\ (v_r + v_l)s\theta \\ (v_r - v_l)/W \end{bmatrix}$	$\begin{bmatrix} (v_r + v_l)c\psi \\ (v_r + v_l)s\psi \\ (v_r - v_l)/W \end{bmatrix}$	change theta to psi everywhere
265, Eq 4.221	$\delta\underline{x}(t) = F\delta\underline{x}(t) + G\delta\underline{u}(t)$	$\delta\dot{\underline{x}}(t) = F\delta\underline{x}(t) + G\delta\underline{u}(t)$	missing dot (time derivative)
274, 1	$p(x) = \frac{1}{\sqrt{2\pi\sigma}}\exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$	$p(x) = \frac{1}{\sqrt{2\pi}\sigma}\exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$	sigma is not inside square root
298,10	$\sigma_k^2 = \left(\frac{k-1}{k}\right)\sigma_k^2 = \left(1-\frac{1}{k}\right)\sigma_k^2$	$\sigma_k^2 = \left(\frac{k-1}{k}\right)\sigma_{k-1}^2 = \left(1-\frac{1}{k}\right)\sigma_{k-1}^2$	change k subscript to k-1
302,3,3	$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} x_i \\ y_i \end{bmatrix} + \begin{bmatrix} c_i & -l_i s_i \\ s_i & l_i c_i \end{bmatrix}$	$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} x_i \\ y_i \end{bmatrix} + \begin{bmatrix} -l_i s_i \\ l_i c_i \end{bmatrix}$	delete first col of 2nd matrix
304,7	$Exp[\Phi(t, t_0)\delta\underline{x}(t_0)\delta\underline{x}(t_0)\Phi(t, t_0)^T]$	$Exp[\Phi(t, t_0)\delta\underline{x}(t_0)\delta\underline{x}(t_0)^T\Phi(t, t_0)^T]$	add transpose
311,1,2	The measurements relationship is: $\begin{bmatrix} \underline{\mathrm{z}} \\ \underline{x} \end{bmatrix} = \begin{bmatrix} \mathrm{H} \\ I \end{bmatrix}\underline{\mathrm{x}}'$	The measurement relationship is: $\begin{bmatrix} \underline{\mathrm{z}} \\ \underline{x} \end{bmatrix} = \begin{bmatrix} \mathrm{H} \\ I \end{bmatrix}\underline{\mathrm{x}}'$	Remove s at end of word “measurements”. Add second equality.
311, Eq 5.84	$\underline{\mathrm{x}}' = (H^T R^{-1} H)^{-1} H^T R^{-1} \underline{z}$	$x' = (H'^T R'^{-1} H')^{-1} H'^T R'^{-1} \underline{z}$	Add primes to H and R
328, Eq 5.111	$\begin{bmatrix} \ldots & \ldots & \partial\dot{x}/\partial\theta & \ldots & \ldots \\ \ldots & \ldots & \partial\dot{y}/\partial\theta & \ldots & \ldots \\ \ldots & \ldots & \partial\dot{\theta}/\partial\theta & \ldots & \ldots \\ \ldots & \ldots & \partial\dot{v}/\partial\theta & \ldots & \ldots \\ \ldots & \ldots & \partial\dot{\omega}/\partial\theta & \ldots & \ldots \end{bmatrix}$	$\begin{bmatrix} \ldots & \ldots & \partial\dot{x}/\partial\psi & \ldots & \ldots \\ \ldots & \ldots & \partial\dot{y}/\partial\psi & \ldots & \ldots \\ \ldots & \ldots & \partial\dot{\psi}/\partial\psi & \ldots & \ldots \\ \ldots & \ldots & \partial\dot{v}/\partial\psi & \ldots & \ldots \\ \ldots & \ldots & \partial\dot{\omega}/\partial\psi & \ldots & \ldots \end{bmatrix}$	Change theta to psi everywhere (3rd col) and thetadot to psidot everywhere (3rd row).

Table 2: Math and Algorithm Edits

Location	Present	Revised	Comment
328, Eq 5.112	$\begin{bmatrix} \dots \\ \dots \\ \psi_{k+1} \\ v_k \\ \omega_k \end{bmatrix}$	$\begin{bmatrix} \dots \\ \dots \\ \psi_{k+1} \\ v_{k+1} \\ \omega_{k+1} \end{bmatrix}$	Change subscripts of last two elements to k+1.
376, Eq 6.8	$\begin{bmatrix} \delta x \\ \delta y \\ \delta\theta \end{bmatrix}$	$\begin{bmatrix} \delta x \\ \delta y \\ \delta\psi \end{bmatrix}$	change theta to psi
380, 2	Writing total differentials: $\dots + \dots + F_{\theta_1}\delta\psi_1 + F_{\theta_2}\delta\psi_2 = 0$ $\dots + \dots + G_{\theta_1}\delta\psi_1 + G_{\theta_2}\delta\psi_2 = 0$	Writing total differentials: $\dots + \dots + F_{\psi_1}\delta\psi_1 + F_{\psi_2}\delta\psi_2 = 0$ $\dots + \dots + G_{\psi_1}\delta\psi_1 + G_{\psi_2}\delta\psi_2 = 0$	change theta to psi
391,6	$\begin{bmatrix} \sigma_{xx}(0) & \sigma_{xy}(0) & \sigma_{x\theta}(0) \\ \sigma_{xy}(0) & \sigma_{yy}(0) & \sigma_{y\theta}(0) \\ \sigma_{x\theta}(0) & \sigma_{y\theta}(0) & \sigma_{\theta\theta}(0) \end{bmatrix}$	$\begin{bmatrix} \sigma_{xx}(0) & \sigma_{xy}(0) & \sigma_{x\psi}(0) \\ \sigma_{xy}(0) & \sigma_{yy}(0) & \sigma_{y\psi}(0) \\ \sigma_{x\psi}(0) & \sigma_{y\psi}(0) & \sigma_{\psi\psi}(0) \end{bmatrix}$	change theta to psi
594,4	$\underline{\rho}_S^W = \underline{\rho}_O^W * \underline{\rho}_S^W$	$\underline{\rho}_S^W = \underline{\rho}_O^W * \underline{\rho}_S^O$	severe, superscript W -> O
601,4	$\underline{\rho} = argmin$ $\left[f(\underline{\rho}) = \frac{1}{2}\underline{r}^T(\underline{\rho}, \underline{Z})\underline{r}(\underline{\rho}, \underline{Z})\right]$	$\underline{\rho}^* = argmin$ $\left[f(\underline{\rho}) = \frac{1}{2}\underline{r}^T(\underline{\rho}, \underline{Z})\underline{r}(\underline{\rho}, \underline{Z})\right]$	change $\underline{\rho}$ to $\underline{\rho}^*$
601,5	$\underline{\rho} = argmax$ $[f(\underline{\rho}) = \underline{z}_{obs}^T \underline{z}_{pred}(\underline{\rho}, \underline{Z})]$	$\underline{\rho}^* = argmax$ $[f(\underline{\rho}) = \underline{z}_{obs}^T \underline{z}_{pred}(\underline{\rho}, \underline{Z})]$	change $\underline{\rho}$ to $\underline{\rho}^*$
608,2	$\underline{\rho} = argmin$ $\left[f(\underline{\rho}) = \frac{1}{2}\underline{r}^T(\underline{\rho}, \underline{Z})\underline{r}(\underline{\rho}, \underline{Z})\right]$	$\underline{\rho}^* = argmin$ $\left[f(\underline{\rho}) = \frac{1}{2}\underline{r}^T(\underline{\rho}, \underline{X})\underline{r}(\underline{\rho}, \underline{X})\right]$	change $\underline{\rho}$ to $\underline{\rho}^*$ and $\underline{Z}$ to $\underline{X}$
629, Eq 9.43	$\underline{c}(\underline{x}) = \underline{b}$	$\underline{g}(\underline{x}) = \underline{b}$	c -> g

Table 2: Math and Algorithm Edits

Location	Present	Revised	Comment
662, algorithm expandNodeDijkstra, line 05	**else if** $(gnew < x\texttt{.g})$	**else if** $(gnew < x_{next}\texttt{.g})$	x -> xnext, severe bug
665, algorithm expandNodeAstar, line 05	**if**$(x_{next} \in O$ && $fnew < x\texttt{.f})$	**if**$(x_{next} \in O$ && $fnew < x_{next}\texttt{.f})$	x -> xnext, severe bug
665, algorithm expandNodeAstar, line 08	**else** **if**$(x_{next} \in C$ && $fnew < x\texttt{.f})$	**else** **if**$(x_{next} \in C$ && $fnew < x_{next}\texttt{.f})$	x -> xnext, severe bug

Table 3: Cross Reference Edits

Location	Present	Revised	Comment
41,1,2	Figure 2.7	Figure 2.8	
139,4,2	section Figure 3.2.1.4	section 3.2.1.5	Figure -> Section 3.2.1.4->3.2.1.5
167,1	Solve Equation 3.104	Solve Equation 3.105	4 -> 5
170,6,1	Substituting this into Equation 3.139 above	Substituting this into Equation 3.140 above	
180, 1, (Box 4.1)	Equation 4.11, Equation 4.12, and Equation 4.13.	Equation 4.12, Equation 4.13, and Equation 4.14.	
201,4	Rewrite Equation 4.40	Rewrite Equation 4.39	
209, 6,1	Equation 4.91	Equation 3.91	
210,10,1	Algorithm 4.2	Algorithm 4.1	
224,3	Based on Equation 4.74	Based on Equation 2.74	4 -> 2
225, 3	constraint from Figure 4.6	constraint from Figure 4.17	6 -> 17
228,12,1	Equation 4.114	Equation 4.116	
230,2,2	The transform of our first-order system (Equation 4.113)	The transform of our first-order system (Equation 4.114)	
258,1	Section 2.2.3 of Chapter 3	Section 3.2.2.3 of Chapter 3	clarify reference
258, 5	the functional in Equation 3.122 in Chapter 3	the functional in Equation 3.133 in Chapter 3	
264, 2, 1	Equation 4.214	Equation 4.216	

Table 3: Cross Reference Edits

Location	Present	Revised	Comment
265,6,2	Jacobian of the left-hand side of Equation 4.221	Jacobian of the left-hand side of Equation 4.222	
296,8,3	Equation 5.58	Equation 5.57	
297,4,3	Equation 5.61	Equation 5.60	
305,3,2	Equation 5.71	Equation 5.69	
305,5,1	Equation 5.69	Equation 5.68	
306,2,2	Equation 4.138	Equation 4.150	
309,3,2	Equation 5.80	Equation 5.79	
311,7,1	The result of Equation 5.87	The result of Equation 5.86	
342,10,2	It can be derived by returning to Equation 5.83 and including the above	It can be derived by returning to Equation 5.84 and including the above	
350,6,4	the computation of the denominator in Equation 5.142 requires that	the computation of the denominator in Equation 5.143 requires that	
361,5,1	Recall Equation 5.151 and Equation 5.152	Recall Equation 5.150 and Equation 5.151	
389	Section 4.5.6 of Chapter 4	Section 4.5.6.6 of Chapter 4	more precise xref
415,2,3	based on Equation 2.76 in Chapter 2	based on Equation 2.81 in Chapter 2	
415,3,1	Equivalently, based on Equation 2.132 in Chapter 2	Equivalently, based on Equation 2.133 in Chapter 2	
424,7	first two lines of Equation 6.57	first two lines of Equation 6.58	
427,3,5	Figure 6.28 illustrates the equivalent	Figure 6.32 illustrates the equivalent	
596,1,1	then we can use Equation 2.55	then we can use Equation 2.56	
596,3,1	For the camera, we can use Equation 2.81	For the camera, we can use Equation 2.82	
615,6,3	Figure 5.38	Figure 5.36	
629,4,1	This is of the form of equation Equation 9.37.	This is of the form of Equation 9.37.	delete redundant word
638,1,3	varies along the line of the laser (Figure 9.48).	varies along the line of the laser (Figure 9.49).	

Table 4: Figure Edits

Location	Present	Revised	Comment
65, Fig 2.22	as drawn	see comment	x,y axes should not be partially erased
416, Fig 6.30	${}^{i}\underline{\Omega}_{n}^{i} = \Omega\begin{bmatrix}0 & 0 & 1\end{bmatrix}^T$ ${}^{n}\underline{\Omega}_{n}^{i} = \Omega\begin{bmatrix}c\lambda & 0 & -s\lambda\end{bmatrix}^T$	${}^{i}\underline{\Omega}_{e}^{i} = \Omega\begin{bmatrix}0 & 0 & 1\end{bmatrix}^T$ ${}^{e}\underline{\Omega}_{e}^{i} = \Omega\begin{bmatrix}c\lambda & 0 & -s\lambda\end{bmatrix}^T$	change n sub/sup script to e
428, Fig 6.33 caption	two antenna	two antennae	
503,Fig 7.44	as drawn	see comment	increase contrast in left image
598, Fig 9.16	as drawn	see comment	increase contrast in right figure to see highlighted fork holes
618, Fig 9.35 caption	Line are approximately 1 pixel wide	Lines are approximately 1 pixel wide	line -> lines
621, Fig 9.39	as drawn	see comment	increase contrast to see feature traces
663, Fig 10.19	as drawn	see comment	increase contrast to see left image