On the Theory

2. Probability Theory and Random Variables

- p. 54, Eqs (2.220) and (2.221) should read

$$\underline{x}''_n := \underline{x}_{n-1} - 2\underline{x}_n + \underline{x}_{n+1} = \sum_{p=1}^{P} a_p \underline{x}''_{n-p} + \underline{e}_n\,,$$

  and

$$\underline{x}_{n+1} = -(\underline{x}_{n-1} - 2\underline{x}_n) + \sum_{p=1}^{P} a_p \underline{x}''_{n-p} + \underline{e}_n$$

4. Estimation

- p. 84: after the text after Eq. (4.37) add:
  "Care has to be taken when naming the weighted sum of the squared residuals being a Mahalanobis distance, since the inverse of $\Sigma_{\widehat{v}\widehat{v}}$ does not exist. However, the weight matrix W_{ll} is what is called a *generalized inverse* of $\Sigma_{\widehat{v}\widehat{v}}$. Therefore we need a definition of a generalized Mahalanobis distance if the covariance matrix is singular. Then we would define $\Omega = \widehat{\boldsymbol{v}}^{\mathsf{T}} \Sigma^{-}_{\widehat{v}\widehat{v}} \widehat{v}$ with the generalized inverse $W_{ll} = \Sigma^{-}_{\widehat{v}\widehat{v}}$.
  A generalized inverse A^{-} of a general matrix A fulfills $AA^{-}A = A^{-}$. Therefore a generalized Mahalanobis distance can be defined as $\underline{d}^2 = (\underline{\boldsymbol{x}} - \boldsymbol{\mu}_x)^{\mathsf{T}} \Sigma^{-}_{xx} (\underline{\boldsymbol{x}} - \boldsymbol{\mu}_x)$, which can be shown to be χ^2-distributed with $\mathrm{rk}\Sigma_{xx}$ degrees of freedom if $\underline{\boldsymbol{x}} \sim \mathcal{N}(\boldsymbol{\mu}_x, \Sigma_{xx})$."
- p. 92: before (4.94) add the reference: Förstner (1979).
- p. 93, 138, 139, and 151 in Eqs. (4.105), (4.350), (4.351), (4.345) (4.346), and (4.389) it must read ... = argmin... instead of ... = argmax....
- p. 119, second paragraph. It should read: 'Let us therefore assume that I reference values, collected in the vector $\boldsymbol{y}_r$, for ...'
- p. 132, Fig. 4.11, line three of the heading: The text should read: '... with all points and a statistical test is applied to identify outliers, a ...'

5. Homogeneous Representations of Points, Lines and Planes

- p. 212, 3rd line before Eq. (5.52): It should read: '..., and we will generally not distinguish between them.'
- p. 215, Definition 5.3.9: It must start with "The projective space $\mathbb{P}^n(\mathbb{R})$ contains all n-dimensional points χ with homogeneous real-valued coordinates $\mathbf{x} \in \mathbb{R}^{n+1} \setminus \mathbf{0}$, ..."

6. Transformations

- p. 253, after (6.23): The text should read: '...we have the parameters c and f which cause the typical effects ...'.

7. Geometric Operations

- p. 322: Add a section on directly estimating conics and quadrics.

7.4.4 Minimal Solutions for Conics and Quadrics

Given are $I = 5$ points $\chi_i(\mathbf{x}_i)$. They are assumed to lie on a conic. From the vector representation of conics and quadrics (7.117), p. 316 we directly obtain the unknown parameters a_{ij} of the conic $a_{11}u_i^2 + 2a_{12}u_iv_i + 2a_{13}u_iw_i + a_{22}v_i^2 + 2a_{23}v_iw_i + a_{33}w_i^2 = 0$ from the nullspace of the 5×6-matrix

$$\underset{5\times 6}{A} = \begin{bmatrix} u_1^2,\ 2u_1v_1,\ v_1^2,\ 2u_1w_1,\ v_1^2,\ 2v_1w_1,\ w_1^2 \\ \cdots \\ u_i^2,\ 2u_iv_i,\ v_i^2,\ 2u_iw_i,\ v_i^2,\ 2v_iw_i,\ w_i^2 \\ \cdots \\ u_5^2,\ 2u_5v_5,\ v_5^2,\ 2u_5w_5,\ v_5^2,\ 2v_5w_1,\ w_5^2 \end{bmatrix},$$

see Sect. 4.8.2.5, p. 182, (5.434), there with a different notation for coordinates and parameters. The nullspace efficiently can be calculated using the QR decomposition, see (A.116), p. 778. The solution generalizes to a direct algebraic solution for $I > 5$ points. The direct determination of quadrics can be achieved analogously. Then 9 or more points $\mathcal{X}_i$ are necessary.
Conditioning of the given coordinates is only necessary if more than the minimum number of points is used, see Sect. 6.9, p. 286.

10. Reasoning with Uncertain Geometric Entities

- p. 432, Eqs. (10.330), (10.333) it must read

$$\sigma_\alpha = 0.52°$$

- p. 432, the second last paragraph: it must read " The estimated variance factor $\widehat{\sigma}_0^2 = 1.1219^2$, ..."

13. Geometry and Orientation of the Image Pair

- p. 557, the last sentence of the proof needs to be deleted.

14. Geometry and Orientation of the Image Triplet

- p. 632, Table 14.4, last row, second column: It sould read

$$\mathsf{S}^{s\mathsf{T}}(\mathbf{x}''')\, \mathsf{T}_\diamond(\mathbf{x}')\, \mathsf{S}^{(s)\mathsf{T}}(\mathbf{x}'') = \mathit{0}$$

- p. 640, Fig. 14.4: The point in the left image with projection centre O' should be χ', not χ'''.

15. Bundle Adjustment

p. 648, eq. (15.13) should read

$$p(\boldsymbol{k}_i, \boldsymbol{p}_t | \boldsymbol{l}_{it}) \propto p(\boldsymbol{l}_{it} | \boldsymbol{k}_i, \boldsymbol{p}_t)\, p(\boldsymbol{k}_i)\, p(\boldsymbol{p}_t)\, .$$

Appendix

- p. 772, Eq. (A.49) must read

$$R\boldsymbol{x} \times R\boldsymbol{y} = R(\boldsymbol{x} \times \boldsymbol{y}) \qquad \text{and} \qquad S(R\boldsymbol{x})R = RS(\boldsymbol{x})\, ,$$

- p. 781, text before (A.139) must read: "Taking the decomposition of the not necessarily symmetric matrix A,"
- p. 781, after Eq. (A.144) add: "The relations (A.140) to (A.144) also hold for matrices which cannot be decomposed as (A.139)."

References

Förstner, W. (1979). Ein Verfahren zur Schätzung von Varianz- und Kovarianzkomponenten. *Allgemeine Vermessungs–Nachrichten 11–12*, 446–453. 1