Erratum

Errare humanum est

A few errors and typos have been identified in the book *Multicomponent Transport Algorithms* and are listed here.

Cover page

- On the cover page, the formula in the picture for the shear viscosity η should be like formula (6.2.13)

$$\eta = \frac{\left(\sum_k X_k^2/H_{kk}\right)^2}{\sum_{k,l} X_k X_l H_{kl}/(H_{kk}H_{ll})},$$

  that is, there is a missing square exponent at the numerator.

Chapter 2

- On page 12, line 7, 'Kapper' should be 'Kaper'.

- On page 25, in Equation (2.1.55), on page 27, in Equation (2.1.69), and on page 40, in Equations (2.2.31) and (2.2.32), n should be $\overline{n}$, the mixture number density $\overline{n} = \sum_{k\in\mathcal{S}} n_k$.

- On page 97, second line after Equation (2.9.10), 'Kapper' should be 'Kaper'.

Chapter 5

- Between Chapters 5 and Chapter 6, the indices of all approximated matrices $D^{[i]}$ are shifted by one unit. The matrices $D^{[i]}$, $i \geq 0$, of Chapter 5 are denoted $D^{[i+1]}$, $i \geq 0$, in Chapter 6.

- On page 300, at the end of the paragraph, after Equation (5.4.33), the second statement $\widehat{x}_i^k = \sqrt{Y_k}\mathcal{X}^{1/2}x_i^k$ should be $\widehat{y}_i^k = \sqrt{Y_k}\mathcal{X}^{1/2}y_i^k$.

Chapter 6

- On page 333, Equation (6.1.11) should be replaced by the relations

$$\mu_{kl}^2 = \mu_k\mu_l, \qquad \mu_{kl}^* = \frac{\mu_{kl}}{\sqrt{\epsilon_{kl}\sigma_{kl}^3}}, \qquad \delta_{kl}^* = \frac{1}{2}(\mu_{kl}^*)^2, \qquad k,l \in \mathcal{S}. \tag{6.1.11}$$

- On page 337, the cost of m steps of the standard iterative method for the Schur complement of a diagonal matrix is

$$C_{m,\text{Schur}} = m(\mathfrak{s}^2-1)n^2 + \mathcal{O}(n). \tag{6.1.22}$$

  Indeed, the product of the matrix G^{11} by a $(\mathfrak{s}-1)n$ vector costs $(\mathfrak{s}-1)^2n^2$ operations and the subsequent products by the rectangular matrices G^{12} and G^{21} arising from $G^{12}\big(G^{22}\big)^{-1}G^{21}$ only cost $2(\mathfrak{s}-1)n^2$. The total operational cost for one step is therefore $(\mathfrak{s}-1)^2n^2 + 2(\mathfrak{s}-1)n^2 = (\mathfrak{s}^2-1)n^2$ up to $\mathcal{O}(n)$ terms arising from the product by the diagonal matrix $(G^{22})^{-1}$. This cost is naturally equivalent to the cost $\mathfrak{s}^2n^2$ of a matrix-vector product for the matrix G of size $\mathfrak{s}n$ decreased by n^2 taking into account the zeros of the right lower block of size n.

- On page 343, Equation (6.2.13) should be

$$\eta^{[1]} = \frac{\Big(\sum_{k\in\mathcal{S}} X_k^2/H_{kk}^{0000}\Big)^2}{\sum_{k,l\in\mathcal{S}} X_kX_lH_{kl}^{0000}/(H_{kk}^{0000}H_{ll}^{0000})}, \tag{6.2.13}$$

  since the coefficients of the matrix H are denoted by H_{kl}^{0000}, $k,l \in \mathcal{S}$.

Appendix C

- On page 404, on line 5, there is a factor 2 missing in front of $[\![\gamma^2 - \gamma\gamma' \cos\chi]\!]_{kl}$ and the proper relation between collision integrals thus reads

$$2[\![\gamma^2 - \gamma\gamma' \cos\chi]\!]_{kl} = [\![\gamma^2 + \gamma'^2 - 2\gamma\gamma' \cos\chi]\!]_{kl}.$$

References

- In the reference list, for reference [BP79], 'positive' should be 'nonnegative'.

Notes

These extra notes are intented to supplement the text and to answer various readers' questions.

Chapter 2

- In the reactive case situation, we have only written the production rates for binary collisions. The situation of multiple collisions is explicitly considered in particular in Reference [EG98a] and also in Reference [Gio99].

Chapter 6

- A library of FORTRAN routines for the evaluation of multicomponent transport coefficients is available at the authors web site [EGLIB].

- The impact of multicomponent transport on the structure of Bunsen laminar flames has been investigated in [EG98b].

- The situation of partially ionized mixtures has been investigated in [Gio10].

[EG98a] A. Ern and V. Giovangigli, The Kinetic Equilibrium Regime, Physica-A, **260**, (1998), pp. 49–72.

[EG98b] A. Ern and V. Giovangigli, Thermal Diffusion Effects in Hydrogen-Air and Methane-Air Flames, Comb. Theory Mod., **2**, (1998), pp. 349–372.

[EGLIB] A. Ern and V. Giovangigli, http://www.cmap.polytechnique.fr/www.eglib.

[Gio99] V. Giovangigli, Multicomponent Flow Modeling, Birkhäuser Boston, MESST Series, 1999.

[Gio10] V. Giovangigli, Multicomponent Transport Algorithms for Partially Ionized Plasmas, J. Comp. Phys. **229**, (2010), pp. 4117–4142.