Geometric Algebra for Physicists

Errata

Note that line numbers here do not include the lines between equations and text.

Notation

p.xiii, para 2, rigourously is $\mapsto$ rigorously in.

Chapter 1

p.1, paragraph 1, properties to should be properties *from*.

p.18, exercise 1.2, should read (corrections in italics) Demonstrate that the following define vector spaces:

1. the set of all polynomials of degree *less than or equal to* n;
2. all solutions of a given linear *homogeneous* ordinary differential equation;
3. the set of all $n \times m$ matrices.

p.18, exercise 1.7, the left-hand side of the equation should read

$$\frac{n(n-1)\cdots(n-m+1)}{1\cdot 2\cdots m} = \frac{n!}{(n-m)!m!}.$$

Chapter 2

p.21, at the end of the figure caption, portait $\mapsto$ portrait.

p.32, line 2. A factor of b is missing in the second line of equation 2.50, which should read

$$\begin{aligned} a(b\wedge c) &= (a\cdot b)c - (a\cdot c)b - \tfrac{1}{2}(bac - cab) \\ &= 2(a\cdot b)c - 2(a\cdot c)b + \tfrac{1}{2}(bc - cb)a. \end{aligned}$$

p.33, line 11, generalises $\mapsto$ generalised.

p.46, line 8, $R = \exp(-B/2)$ should read $R = \exp(-B\theta/2)$.

p.48, equation (2.133), the rightmost member of the equalities should be Rc, not cR.

p.51, section 2.8, line 3. $\delta_{ij} \mapsto 2\delta_{ij}$.

Chapter 3

p.60, 4th line from the bottom, (3.15) should read (3.17).

Chapter 4

p.85, last line of the second paragraph, doe $\mapsto$ does.

p.87, line 1 should read: The sum runs over every permutation $k_1, \ldots, k_r$ of $1, \ldots, r$, and $(-1)^\epsilon$ is $+1$ or -1 as the permutation $k_1, \ldots, k_r$ is even or odd respectively.

p.89, equation (4.24), the binomial coefficient is written the wrong way up.

p.90, equation (4.25) should read

$$\dim\bigl(\mathcal{G}_n\bigr) = \sum_{r=0}^{n} \dim\bigl(\mathcal{G}_n^r\bigr) = \sum_{r=0}^{n} \binom{n}{r} = (1+1)^n = 2^n.$$

p.95, equation (4.60), the first term in the equation should read $B(e_1 e_2 \cdots e_r)$ not $B(e_1 e_2 \cdots r_r)$.

p.102, equation (4.108), the right-hand side is intended to be a pure scalar, so the equation should read

$$A_{i\cdots jk} = \langle (\mathsf{e}_k \wedge \mathsf{e}_j \cdots \wedge \mathsf{e}_i) A \rangle.$$

p.110, equation (4.156). There is a factor of I^{-1} missing from the right-hand side of the first line.

p.124, exercise 4.2. The equation should read

$$e_i = a_i - \sum_{j=1}^{i-1} \frac{a_i \cdot e_j}{e_j^2} e_j.$$

Chapter 5

p.126, second paragraph, it it not essential should read it *is* not essential.

p.140, section 5.3.1. An error has arisen due to a change of convention midway through writing. The derivation was supposed to be for objects receding in opposite directions. As such, the sign of α_2 in equation (5.72) is wrong and the equation should read

$$v_2 = \mathrm{e}^{-\alpha_2 \gamma_1 \gamma_0 / 2} \gamma_0 \mathrm{e}^{\alpha_2 \gamma_1 \gamma_0 / 2} = \mathrm{e}^{-\alpha_2 \gamma_1 \gamma_0} \gamma_0.$$

Following on, equation (5.74) should read

$$\tanh(\alpha_1 + \alpha_2) = \frac{\tanh(\alpha_1) + \tanh(\alpha_2)}{1 + \tanh(\alpha_1)\tanh(\alpha_2)},$$

and equation (5.75) should read

$$u' = \frac{u_1 + u_2}{1 + u_1 u_2 / c^2}.$$

p.149, the caption for figure 5.7 should read *Relativistic visualization of a sphere.*

p.153, equation (5.146), the w should be an ω.

p.157, text after equation (5.173) should read *anticommutes.*

Chapter 6

p.168, equation (6.4), the indices on the final δ should be the other way round, δ_i^j.

p.176, line 6-7 should read by replacing each J_i term with $1/h_i\,\partial_i\phi$.

p.177, line 2 should read the magnitudes are $h_\rho = 1$, $h_\phi = \rho$ and $h_z = 1$.

p.188, equation (6.116), equation (6.117) and in the text below (6.117), dX^k should read ΔX^k.

p.196, in the text above equation (6.165), '$f(x)$ on the real axis' and $|Z|$ should read $|z|$.

p.197, equation (6.171) should read

$$\oint_{\partial V} dS\,\psi = \int \nabla\psi\, dX = 0.$$

p.199, equation (6.184) should read

$$n_+ \cdot \nabla\psi = -n_+ \wedge \nabla\psi = I\,(n_+ I) \cdot \nabla\psi = -I n_+ \cdot \nabla\psi.$$

p.204, equation (6.194) should read

$$\mathsf{P}(A_r(x), x) = \begin{cases} A_r(x) \cdot I(x)\, I^{-1}(x) = A_r \cdot I\, I^{-1}, & r \le n \\ 0 & r > n \end{cases}.$$

p.212, equation (6.257) should read

$$\mathsf{R}(\mathsf{e}_i \wedge \mathsf{e}_j) \times A = [D_i, D_j]A.$$

p.224 line 4, the sentence should read Linear materials have the property that $\mathcal{T}$ and $\mathcal{E}$ are linearly related by a rank-4 tensor.

p.224 line 19, the notes text should read 'and in a series of papers by Garret Sobczyk'.

Chapter 7

p.229, line 2, introduce $\mapsto$ introduced.

p.229, final line, inuniting should be two words.

p.238, line 11 just after equation (7.60), should to be $\mapsto$ should be.

p.249, eq. 7.114, argument of the cosine function should be $(\omega\tau - \phi)$.

p.253, second line of first paragraph of section 7.4.1, as opposed plane-polarised $\mapsto$ as opposed to plane-polarised.

p.263, line 7, Huygen's $\mapsto$ Huygens'

p.264, figure caption, difraction $\mapsto$ diffraction.

Chapter 8

p.271, the second last sentence should read 'since the vector of observables $\boldsymbol{s} = s_k\boldsymbol{\sigma}_k$ was formed by rotating the $\boldsymbol{\sigma}_3$ vector'.

p.272, final line, a range problems $\mapsto$ a range of problems.

p.283, line above section 8.3.1, of the mark $\mapsto$ off the mark.

p.298, equation (8.193), the final term on the right-hand side should have a factor of γ_0 at the end.

Chapter 9

p.315, in the paragraph after equation (9.24) the second to last sentence should read: The presence of multiple time coordinates can complicate the evolution equations *in* the relativistic theory.

p.338, example 9.6 should read

The β_μ operators that act on states in the two-particle relativistic algebra are defined by:

$$\beta_\mu(\psi) = \tfrac{1}{2}\big(\gamma^1_\mu\psi\gamma^1_0 + \gamma^2_\mu\psi\gamma^2_0\big).$$

Verify that these operators generate the *Duffin–Kemmer* ring

$$\beta_\mu\beta_\nu\beta_\rho + \beta_\rho\beta_\nu\beta_\mu = \eta_{\nu\rho}\beta_\mu + \eta_{\nu\mu}\beta_\rho.$$

Chapter 10

p.368, equation (10.136) should read

$$B = (P^*\wedge L^*)^* = (IP)\cdot L = I\langle PL\rangle_3.$$

p.379, equation (10.181), the result should equal $\sin^2(\theta/2)$.

p.384, paragraph 2, the second sentence should read: The group of *conformal* rotors, denoted $\text{spin}^+(2,4)$, is therefore a four-fold covering of the restricted conformal group.

p.387, equation (10.210) should read

$$\psi_r = (r\cdot r\,\epsilon - r^1\eta\gamma_0^1 J - \bar{\epsilon})\langle I\boldsymbol{\sigma}_2\tilde{\kappa}\omega\rangle_q,$$

p.390, line 4, discussed is $\mapsto$ discussed *in*.

Chapter 11

p.395, final line, avariety should be two words.

p.405, The claim preceding (11.62) only holds in Lorentzian spaces. In spaces with 2 or more basis vectors of both signatures, further discrete elements are required to encode all rotors.

p.407, equation (11.76), the second R_1 should be an R_2.

p.414, just before equation (11.119), satsisfy is spelt wrong.

p.418, problem 11.5, in the final equation $\varepsilon^2(a)$ should read $\varepsilon^2(b)$

Chapter 12

p.427, line 5, the sentence should end with a question mark.

p.427, in the paragraph below equation (12.43), the density in concentrated should read: the density is concentrated.

Chapter 13

p.469, equation (13.141) should read

$$g_\mu = \mathsf{h}^{-1}(e_\mu), \qquad g^\mu = \bar{\mathsf{h}}(e^\mu).$$

p.471, equation (13.148) should read

$$D_\mu\psi = \partial_\mu\psi + \tfrac{1}{2}\Omega_\mu\psi.$$

p.471, just above equation (13.152), in should be replaced by is.

p.476, just after equation (13.185), 'see that' is written twice.

p.490, the final line of equation (13.286) should read $g^\mu\wedge g^\nu\wedge(\mathsf{R}_{\mu\nu}\times\mathcal{A})$.

p.494, equation (13.319) should read

$$\mathcal{G}(\partial_a)\cdot(a\mathcal{D}\mathcal{K}) = 0,$$

p.494, equation (13.320) should read

$$\mathcal{D}\cdot\big(\mathcal{G}(\mathcal{K})\big) = \dot{\mathcal{D}}\cdot\dot{\mathcal{G}}(\mathcal{K}) - \partial_a\cdot\mathcal{G}(a\cdot\mathcal{D}\mathcal{K}) = 0$$

Chapter 14

p.517, final paragraph of section 14.3.3 is missing a full stop at the end of the final sentence.

p.523, before equation (14.125), the text should read 'For this we set' instad of 'For this for we set'.

p.563, final line should read ... Schwarzschild background to the Kerr case.

Index

p.576, Huygen's $\mapsto$ Huygens'

p.578, symmetric fuunction $\mapsto$ symmetric function.