Erratum for the book

Spectral Methods

Algorithms, Analysis and Applications

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[Updated on December 28, 2015 with corrections in shaded text]

1 Chapter 1

1. Page 16, Line 12: Change $h = \frac{2\pi}{N}$ to $h = \frac{2\pi}{N+1}$.

2 Chapter 2

1. Page 28 in (2.25), replace $D_{N/2-1}(x - x_j)$ by $\mathcal{D}_{N/2-1}(x - x_j)$.
2. Page 29 in Table 2.1, replace $2\tilde{u}_{N/2-1}$ by $\tilde{u}_{N/2-1}$, and replace $\tilde{u}_{N/2}$ by $2\tilde{u}_{N/2}$.
3. Page 36, four lines below (2.53), change "$e^{\mathrm{i}(p-k)x_j} = 1$" to "$\frac{1}{2N}\sum_{j=0}^{2N-1} e^{\mathrm{i}(p-k)x_j} = 1$"

3 Chapter 3

1. Page 69, remove "**3.1.8.1**" before "**A Short Summary of this Section**".
2. Page 83, Line 7: change "$G_{N-1}^{\alpha,\beta+1}$" and "$\widetilde{G}_{N-1}^{\alpha,\beta+1}$" to "$G_{N-2}^{\alpha+1,\beta+1}$" and "$\widetilde{G}_{N-2}^{\alpha+1,\beta+1}$", respectively.
3. Page 86, "π" is missing in (3.147), which should be
$$\frac{2j+1}{2N+3}\pi \le \theta_j \le \frac{2j+2}{2N+3}\pi, \quad 0 \le j \le N.$$
4. Page 94, remove the factor 2^n in the denominator of the terms in the sum of (3.169).
5. Page 104, a comma is missing in the last line of (3.203).
6. Page 106, $T(x)$ should be $T_n(x)$ in (3.212a).
7. Page 118, Theorem 3.35 above (3.257), add the condition on l: "$0 \le l < N+1$"
8. Page 120, the line above (3.267), change "$0 \le l \le m$" to "$1 \le l \le m$", and two lines below (3.267), remove "$,\beta$"

9. Page 130, the proof in lines 2-6 should be changed to

$$\begin{aligned}
\|I_N^c u\|_\omega^2 &= \frac{\pi}{N+1}\sum_{j=0}^{N}\hat{u}^2(\theta_j) \le \frac{\pi}{N+1}\sum_{j=0}^{N}\Big\{\max_{\theta\in K_j}|\hat{u}(\theta)|\Big\}^2 \\
&\le \sum_{j=0}^{N}\Big(\|\hat{u}\|_{L^2(K_j)} + \frac{\pi}{N+1}\|\partial_\theta\hat{u}\|_{L^2(K_j)}\Big)^2 \\
&= \sum_{j=0}^{N}\|\hat{u}\|_{L^2(K_j)}^2 + \frac{2\pi}{N+1}\sum_{j=0}^{N}\|\hat{u}\|_{L^2(K_j)}\|\partial_\theta\hat{u}\|_{L^2(K_j)} + \frac{\pi^2}{(N+1)^2}\sum_{j=0}^{N}\|\partial_\theta\hat{u}\|_{L^2(K_j)}^2 \\
&\le \|\hat{u}\|_{L^2(0,\pi)}^2 + \frac{2\pi}{N+1}\Big(\sum_{j=0}^{N}\|\hat{u}\|_{L^2(K_j)}^2\Big)^{\frac{1}{2}}\Big(\sum_{j=0}^{N}\|\partial_\theta\hat{u}\|_{L^2(K_j)}^2\Big)^{\frac{1}{2}} + \frac{\pi^2}{(N+1)^2}\|\partial_\theta\hat{u}\|_{L^2(0,\pi)}^2 \\
&\le \|\hat{u}\|_{L^2(0,\pi)}^2 + \frac{2\pi}{N+1}\|\hat{u}\|_{L^2(0,\pi)}\|\partial_\theta\hat{u}\|_{L^2(0,\pi)} + \frac{\pi^2}{(N+1)^2}\|\partial_\theta\hat{u}\|_{L^2(0,\pi)}^2 \\
&= (\|\hat{u}\|_{L^2(0,\pi)} + \frac{\pi}{N+1}\|\partial_\theta\hat{u}\|_{L^2(0,\pi)})^2.
\end{aligned}$$

   This implies

$$\|I_N^c u\|_\omega \le \|\hat{u}\|_{L^2(0,\pi)} + \frac{\pi}{N+1}\|\partial_\theta\hat{u}\|_{L^2(0,\pi)}.$$

   Finally, the inverse change of variable $\theta \to x$ leads to (3.297).

10. The above modification also applies to line 7-10 on Page 132.

11. Page 137, above Theorem 3.44, change "Chap. 5" to "Chap. 6"

12. Page 138, the last line, change "$\sum_{n=k}^{N}$" to "$\sum_{n=0}^{N-k}$"

4 Chapter 4

1. Page 141, the line below (4.3), change "necessary" to "sufficient"

2. Page 146, replace a_-b+ by a_-b_+.

3. Page 151, Line 4, replace O(N^2) by $O(N^2)$.

4. Page 169, in the proof of Theorem 4.3, add "and with integration by parts" after "Under the assumption (4.3)"; and remove $H^2(I)\cap$ in the definition of X in the line below (4.85).

5 Chapter 6

1. Page 202: Last line: replace (6.3) by (6.4).

2. Page 212, above (6.37), "$\phi_k(x) = \gamma_k J_{n+3}^{-2,-1}(x)$" should be "$\phi_k(x) = \gamma_k J_{k+3}^{-2,-1}(x)$".

3. Page 223, the part of the proof below (6.68) should be changed to: *....., while for* $m = 1$, *we verify from the Cauchy-Schwarz inequality that*

$$\|\partial_x \tilde{u}\| \le c\big(\|\partial_x u\| + |u(-1) - u(1)|\big) \le c\Big(\|\partial_x u\| + \Big|\int_{-1}^{1} \partial_x u\, dx\Big|\Big) \le c\|\partial_x u\|.$$

This ends the proof of Theorem 3.4.

4. Page 236, Problem 6.4, change "(6.18)" to "(6.32)"

6 Chapter 7

1. Page 241, Formula (7.15): change "if $\alpha > 0$" in the second line, to "if $-1 < \alpha < 0$".
2. Page 246, Eqn. (7.36): change "$\forall p \cdot q \in \widehat{P}_{2N+\delta}$" to "$\forall p \in \widehat{P}_K,\ \forall q \in \widehat{P}_L,\ K + L \le 2N + \delta$".
3. Page 258, Eqn. (7.82): change "$\forall p \cdot q \in \widehat{P}_{2N+1}$" to "$\forall p \in \widehat{P}_K,\ \forall q \in \widehat{P}_L,\ K + L \le 2N + 1$".
4. Page 268, right below Eqn. (7.119): change

$$-\frac{1}{4}\big((ue^{x/2}) - \Pi_N^{1,0}(ue^{x/2}), v_N\big)_\omega \quad \text{to} \quad -\frac{1}{4}\big((ue^{x/2}) - \Pi_N^{1,0}(ue^{x/2}), w_N\big)_\omega$$

and add the missing parentheses in the term

$$-\frac{1}{2}\int_0^{+\infty} \big[\big((ue^{x/2}) - \Pi_N^{1,0}(ue^{x/2})\big) w_N\big]' e^{-x} dx$$

7 Chapter 8

1. Page 302, above and in (8.12), change "$(EA)^{-1}$ (resp. $(EA)^{-T}$)" to "$(AE)^{-1}$ (resp. $(AE)^{-T}$)"
2. Page 303, lines 7-8, change "$(EA)^{-1}$ " to "$(AE)^{-1}$", and change "$(EA)^{-T}$" to "$(AE)^{-T}$"
3. Page 304, change E^{TBE} and E^{TAE} to $E^T BE$ and $E^T AE$, respectively, in (8.20) and (8.21).

8 Chapter 9

1. Page 371, change $T(u) = -\mathrm{i}u$ in (9.21) to $T(u) = -\mathrm{i}ku$.
2. Page 394, replace the superscript n by k in the last line.
3. Page 395, replace ψ^{k+1} by ϕ^{k+1} in (9.118)-(9.119).
4. Page 396, $2p_N^k - p_N^{k-1}$ should be p_N^k in (9.121) corresponding to (9.102).
5. Page 396, the first "Poisson equation" should be "Poisson-type equation" in the last line.