Known Typographical Errors in the First Edition, First Printing of Perturbation Methods in the Computer Age by D. C. Wilcox

These are all of the known typographical errors as of May 11, 2008.

1. Page 16, Problem 1.10: Replace the asymptotic sequence with the following.

$$\phi_n(x) = \frac{2 + \cos(x^n)}{x^n}, \qquad x \to \infty$$

2. Page 24, Equation (2.29): Replace the equation with the following.

$$f(t) \sim t^\alpha \left[a_0 + \sum_{n=1}^{\infty} a_n t^{\beta_n} \right] \quad \text{as} \quad t \to 0$$

3. Page 24, Equation (2.30): Replace the equation with the following.

$$a_0 \neq 0, \quad \alpha > -1 \quad \text{and} \quad \beta_n > 0$$

4. Page 40, from just below Equation (2.99) through Equation (2.102): Replace the paragraph and equations with the following.

   Unlike Laplace's Method, there is no need for $\psi(c)$ to be the maximum value of $\psi(t)$. However, as we will see below, we will use contour integration and the contour we select depends upon the sign of $\psi^{(n)}(c)$. Noting note from the Riemann-Lebesgue Lemma that the difference between the integral from 0 to ϵ and the integral from 0 to ∞ is $O(1/x)$, i.e., that

$$\int_0^\epsilon e^{ix(\cdots)}\, d\xi \sim \int_0^\infty e^{ix(\cdots)}\, d\xi + O\left(\frac{1}{x}\right)$$

   we can approximate that

$$\int_{-\epsilon}^{\epsilon} e^{ix\psi^{(n)}(c)\xi^n/n!}\, d\xi \sim \begin{cases} 2\displaystyle\int_0^\infty e^{ix\psi^{(n)}(c)\xi^n/n!}\, d\xi, & n \text{ even} \\ 2Re\left\{\displaystyle\int_0^\infty e^{ix\psi^{(n)}(c)\xi^n/n!}\, d\xi\right\}, & n \text{ odd} \end{cases}$$

5. Page 41, Caption of Figure 2.7: Replace "even n" with "$\psi^{(n)}(c) < 0$".

6. Page 42, Paragraph above Equation (2.109): Replace "for $x \to \infty$, the asymptotic" with "for $x \to \infty$ with an even value for n, the asymptotic".

7. Page 42, Equation (2.109): Replace "n even" with "$\psi^{(n)}(c) < 0$".

8. Page 42, Just below Equation (2.109): Replace "For odd values of n, we must use" with "When n is odd, we take the real value on the right-hand side of Equation (2.109). For $\psi^{(n)}(c) > 0$, we must use"

9. Page 42, Equation (2.110): Replace the equation with

$$I(x) \sim \frac{2\Gamma\left(\frac{1}{n}\right)}{n} e^{ix\psi(c)+i\frac{\pi}{2n}} \left[\frac{n!}{x\left|\psi^{(n)}(c)\right|}\right]^{\frac{1}{n}} f(c), \quad \psi^{(n)}(c) > 0$$

10. Page 42, Just below Equation (2.110): Add "As with $\psi^{(n)}(c) < 0$, when n is odd, we take the real value on the right-hand side of Equation (2.110)."

11. Page 42, Caption of Figure 2.8: Replace "odd n" with "$\psi^{(n)}(c) > 0$".

12. Page 73, Problems 2.15 and 2.16: Replace "Use Laplace's Method" with "Use Watson's Lemma and/or Laplace's Method".

13. Page 81, just below Equation (3.19): Replace "Substituting into Equation (3.18)" with "Substituting into Equation (3.17)".

14. Page 89, Equation (3.63): The summation should begin at $n = 1$, not $n = 0$. The correct equation is

$$x \sim e^{i2m\pi/3} + \sum_{n=1}^{\infty} a_{n,m}\epsilon^n$$

15. Page 134, Equation (3.260) through the first sentence in the last paragraph: Replace all equations and text with the following.

   This is a useful result that enables us to compute the skin friction from our defect-layer solution, a point we will return to later. For our present purpose, Equation (3.258) enables us to determine ω_t. That is, since

$$u_\tau = \frac{U_e}{\left(B + \frac{u_0}{\kappa}\right) + \frac{1}{\kappa}\ell n Re_{\delta^*}} \tag{3.260}$$

   we can differentiating with respect to x to obtain

$$\begin{aligned} \frac{du_\tau}{dx} &= \frac{dU_e/dx}{\left(B + \frac{u_0}{\kappa}\right) + \frac{1}{\kappa}\ell n Re_{\delta^*}} - \frac{U_e dRe_{\delta^*}/dx}{\kappa Re_{\delta^*}\left[\left(B + \frac{u_0}{\kappa}\right) + \frac{1}{\kappa}\ell n Re_{\delta^*}\right]^2} \\ &= \frac{u_\tau}{U_e}\frac{dU_e}{dx} - \frac{u_\tau^2}{\kappa U_e Re_{\delta^*}}\frac{dRe_{\delta^*}}{dx} \end{aligned} \tag{3.261}$$

   Substituting Equation (3.261) into the definition of ω_t [see Equation (3.252)] and using the fact that $u_\tau^2 = \frac{1}{2}U_e^2 c_f$, we find

$$\begin{aligned} \omega_t &= \frac{\delta^*}{c_f U_e}\frac{dU_e}{dx} - \frac{\delta^*}{c_f u_\tau}\frac{\frac{1}{2}U_e^2 c_f}{\kappa U_e^2 \delta^*/\nu}\frac{d}{dx}\left(\frac{U_e\delta^*}{\nu}\right) \\ &= \frac{\delta^*}{c_f U_e}\frac{dU_e}{dx} - \frac{1}{2\kappa u_\tau}\frac{d}{dx}\left(U_e\delta^*\right) \\ &= \frac{\delta^*}{c_f U_e}\left[1 - \frac{1}{\kappa}\frac{c_f}{2}\frac{U_e}{u_\tau}\right]\frac{dU_e}{dx} - \frac{1}{2\kappa}\frac{U_e}{u_\tau}\frac{d\delta^*}{dx} \\ &= \frac{\delta^*}{c_f U_e}\left[1 - \frac{1}{\kappa}\frac{u_\tau}{U_e}\right]\frac{dU_e}{dx} - \frac{1}{2\kappa}\frac{U_e}{u_\tau}\frac{d\delta^*}{dx} \end{aligned} \tag{3.262}$$

We can compute $d\delta^*/dx$ and dU_e/dx from the definitions of α_t and β_t given in Equation (3.252), i.e.,

$$\frac{d\delta^*}{dx} = \frac{c_f\,\alpha_t}{2} \quad \text{and} \quad \frac{dU_e}{dx} = -\frac{1}{\rho\,U_e}\frac{dP}{dx} = -\frac{\tau_w}{\rho\,U_e\delta^*}\beta_t \tag{3.263}$$

Combining Equations (3.262) and (3.263), we have

$$\begin{aligned}
\omega_t &= \frac{\delta^*}{c_f U_e}\left[1 - \frac{1}{\kappa}\frac{u_\tau}{U_e}\right]\left(-\frac{\tau_w}{\rho\,U_e\delta^*}\right)\beta_t - \frac{1}{2\kappa}\frac{U_e}{u_\tau}\left(\frac{c_f\,\alpha_t}{2}\right) \\
&= -\frac{\tau_w}{\underbrace{\rho\,U_e^2 c_f}_{=2\tau_w}}\left[1 - \frac{1}{\kappa}\frac{u_\tau}{U_e}\right]\beta_t - \frac{1}{4\kappa}\underbrace{c_f\,\frac{U_e}{u_\tau}}_{=2u_\tau/U_e}\,\alpha_t \\
&= -\frac{1}{2}\beta_t\left[1 - \frac{1}{\kappa}\frac{u_\tau}{U_e}\right] - \frac{1}{2\kappa}\frac{u_\tau}{U_e}\alpha_t
\end{aligned} \tag{3.264}$$

Therefore, regrouping terms, we conclude that

$$\omega_t = -\frac{1}{2}\beta_t + \frac{1}{2\kappa}\left(\beta_t - \alpha_t\right)\frac{u_\tau}{U_e} \tag{3.265}$$

Finally, since we seek a solution valid in the limit $u_\tau/U_e \to 0$, we have

$$\omega_t = -\frac{1}{2}\beta_t + O\left(\frac{u_\tau}{U_e}\right) \tag{3.266}$$

NOTE: Equations (3.263) through (3.270) must be changed to (3.267) through (3.274) for consistency.

16. Page 135, Equation (3.269): Replace "β_t" with "$2\beta_t$".

17. Page 149, Paragraph just above Equation (4.19), line 4: Replace "damping coefficient is c" with "damping coefficient is $2c$".

18. Page 149, Figure 4.3: In the figure, replace dashpot strength "c" with "$2c$". Also, the spring and dashpot should be connected to the mass in parallel rather than in series.

19. Page 171, First paragraph: Replace "substitution into either Equation (4.139) or Equations (4.140) yields" with "substitution of Equations (4.141) and (4.142) into the first of Equations (4.140) yields".

20. Page 173, Equation (4.157) and (4.158): Replace "$d\alpha/dt$" and "$d\beta/dt$" with "$d\alpha/d\tau$" and "$d\beta/d\tau$", respectively.

21. Page 173, Equations (4.159): The equation for $\beta(\tau)$ is missing a factor of τ. The correct equation is

$$\alpha(\tau) = \alpha_0 \quad \text{and} \quad \beta(\tau) = \frac{3}{8}\alpha_0^2\tau \tag{4.159}$$

22. Page 190, Problem 4.6: In the differential equation, replace "d^2y/dy^2" with "d^2y/dt^2".

23. Page 191, Problem 4.9: In the differential equation, replace "d^2y/dy^2" with "d^2y/dt^2".

24. Page 192, Problem 4.15: In the differential equation, replace "d^2y/dy^2" with "d^2y/dt^2".