Errata

1). P. 27, Fig 2-5 the outer unit normals should read

$$-\mathbf{e}_1, -\mathbf{e}_2 \text{, and } -\mathbf{e}_3$$

2). P. 28, L-1, "**x** and **t**" should read "**x** and t"

3). P. 29, eqn (2-32)

$$\frac{\partial \mathbf{u}}{\partial \mathbf{t}} \text{ should read } \frac{\partial \mathbf{u}}{\partial t}$$

The same error appears in eqn (12-170) and eqn (2-108)

4). P. 32, eqn (2-44) "*dS*" in the last integral should read "*dA*"

5) p. 49, Eqn (2-82) The last term should be $\frac{k}{\theta^2}(\nabla\theta)^2$

6) p. 50, eqn (2-86) The term

$$\mathbf{T} + \left(\frac{1}{3}\text{tr } \mathbf{T}\right)\mathbf{I} \text{ should be } \mathbf{T} - \left(\frac{1}{3}\text{tr } \mathbf{T}\right)\mathbf{I}$$

7) p. 78, Eqn (2-132) the lower case "t" on the left hand side should be bold face **"t"**

The last integral should have $\iint_A$ instead of $\int_A$

8) p.105; problem 2-24, eqn should have a minus sign prior to $\nabla \cdot \mathbf{R}$

9) p. 134, eqn (3-86)

$$"T_c" \text{ should be just } "T"$$

10) p. 245, Eqn (4-170) The square bracket term which now reads $\left[1+\varepsilon^{1/2}+O(\varepsilon)\right]$ should be

$$\left[1+\varepsilon^{1/2}Y+O(\varepsilon)\right]$$

11) p. 300, Eqn (5-27) and (5-28); The bars over the y's should be removed.

12) p. 304 The line before eqn (5-48) should begin with "the" rather than "The"

13) p. 312, L-10; $\nabla sp^{(0)}$ should read $\nabla_s p^{(0)}$

`14) p. 315, Figure 5-7 "y" that appears in two places should be "z"

15) p. 318, Equation (5-94) F' should be $\mathbf{F}'$ as in eqn (5-95)

16) p. 319, Equation (5-97) the first term on the right hand side should read $\frac{-m}{\sqrt{1+m^2}}\mathbf{e}_x$

17) p. 319, Eqn (5-99) the factor in front of the second bracketed term on the RHS should be

$$-\frac{1}{\sqrt{1+m^2}}\mathbf{e}_x$$

18)p. 356, In the second line following eqn (6-3) the "eqn" should read $\mathbf{i}_g + (\mathbf{i}_z \cdot \mathbf{i}_g)\mathbf{i}_z$

19) p. 357 L1 The "s" should be removed from the word "regardings"

20) p. 360, In the line following equation (6-18), the first t_i should be boldface, I.e. $\mathbf{t}_i$

21) p. 374, Eqn (6-79) β should replace γ everywhere in this equation

$$\left(-\beta dH - \beta\eta\frac{dH}{d\eta}\right)\frac{A}{t^{\beta d+1}} = -\frac{A^4B^4}{t^{4\beta(d+1)}}(\text{...as is...})$$

22) p. 374, Eqn (6-76) and the phrase following it should read :

$$\boxed{u_c = \frac{\varepsilon^3\sigma}{\mu} = \frac{H_0^3\sigma}{R_0^3\mu},} \qquad \text{(6-76)}$$

where H_0 and R_0 have the same significance as in the preceding example.

23) p. 380, next to last line, the equation number (3-220) should be (6-98)

24) p. 385, Fig 6-7, The vertical axis is denoted as "y" in both the middle and lower image. This should be "z" to be consistent with the text that refers to this figure.

25) p. 386 Four lines from the bottom: "6-68" should read "5-68"

26) p. 398 line following eqn (6-167b): "(6-143)" shoud read "(6-138)"

27) p. 407 unnumbered equation just before equation (6-213): should read

$$g\rho\frac{\alpha}{\beta}d^2 \quad 1.$$

28) p. 419, Problem 6-2. The last equation on p. 419 should be $r_N(t) \quad \ldots$ not $\tau_N(t) \quad \ldots$

29) p. 430 boxed equations: The left hand side of the first one should read

$$\rho\left(\frac{\partial \mathbf{u}'}{\partial t'} + \mathbf{u}' \cdot \nabla' \mathbf{u}'\right) =$$

30) pp 432-433 lines 16, 17 and 18 after boxed equations: "*R*" should be "*Re*"

Also L12 on p. 433: same change

31) p. 448, the equation preceding eqn (7-44) should read

$$J = \int_P^Q \left(\frac{\partial \psi}{\partial q_2} dq_2 + \frac{\partial \psi}{\partial q_1} dq_1\right);$$

32). P. 449, starting from eqn (7-54)

$$\frac{X''}{X} = -\frac{Y''}{Y} = \pm\lambda_m^2 \quad (7\text{-}54)$$

where λ_m is an arbitrary complex number. Hence,

$$X'' \mp \lambda_m^2 X = 0, \quad Y'' \pm \lambda_m^2 Y = 0 \quad (7\text{-}55)$$

and from this we deduce that

$$\boxed{\omega = e^{\lambda_m x} e^{i\lambda_m y}} \quad (7\text{-}56)$$

for arbitrary complex λ_m (unless, of course, $\lambda_m = 0$). Now to obtain a general solution for ψ, we must solve (7-51) with the right-hand side evaluated using (7-56). Hence,

$$\nabla^2 \psi = -e^{\lambda_m x} e^{i\lambda_m y} \gamma_m \quad (7\text{-}57)$$

where γ_m is an arbitrary constant. The solution of (7-57) is the sum of a homogeneous

solution of the form (7-56) plus a particular solution to reproduce the right-hand side. After some manipulation, we find

$$\boxed{\psi_m = \alpha_m e^{\lambda_m x} e^{i\lambda_m y} + \beta_m x e^{\lambda_m x} e^{i\lambda_m y} + \delta_m y e^{\lambda_m x} e^{i\lambda_m y}} \ . \quad (7\text{-}58)$$

Hence, the most general solution for ψ expressed in Cartesian coordinates is

$$\boxed{\psi = \sum_m \psi_m} \qquad (7\text{-}59)$$

with arbitrary complex values of λ_m.

33). p. 450, L-9 change "For $\lambda_n = 0$, on the other hand,"

to "If $\lambda_n = 0$, on the other hand,"

34). p. 451, L5 change "except for $\lambda_n = 1.$" to "except if $\lambda_n = 1.$"

35) p. 451, eqn (7-69) should read

$$r^3 \sin\theta,\ r^3 \cos\theta,\ r \ln r \sin\theta,\ r \ln r \cos\theta$$

36). p. 451, eqn (7-70) should read

$$\left(\widehat{a}_0\theta + \widehat{b}_0\right)\left[\widehat{c}_0 r^2 + \widehat{d}_0 r^2 (\ln r - 1/2)\right]$$

37). p. 451, eqn (7-71) should read

$$\begin{aligned}\psi &= \left[c_0 + d_0 \ln r + \widehat{c}_0 r^2 + \widehat{d}_0 r^2 (\ln r - 1/2)\right]\left(a_0\theta + b_0\right) \\ &\quad + \left[c_1 r + d_1 r^{-1} + \widehat{c}_1 r^3 + \widehat{d}_1 r \ln r\right]\left(a_1 \sin\theta + b_1 \cos\theta\right) \\ &\quad + \sum_{n=2}^{\infty}\left(c_n r^{\lambda_n} + d_n r^{-\lambda_n} + \widehat{c}_n r^{\lambda_n + 2} + \widehat{d}_n r^{2-\lambda_n}\right)(a_n \sin\lambda_n\theta + b_n \cos\lambda_n\theta)\end{aligned}$$

38) p. 455, Fig 7-7. The angular velocity labels should be –ωr for the upper surface and ωr for the lower surface

39). P. 456, eqn (7-95) should read

$$\begin{aligned}\sin\xi \cosh\eta &= -k\xi \\ \cos\xi \sinh\eta &= -k\eta\end{aligned}$$

40). p. 457, eqn (7-97) "ψ_1" should be just "ψ"

41) p. 462 The first term should have r^{n+3} instead of r^{r+3}

42). Eqn (7-162) remove "$\mathbf{e}_\phi$"

43) p. 474 L2 after eqn (7-186), remove the footnote number 18

44) p. 478, L4 in the second paragraph; (2-117) should be (2-112)

45) p. 478, The equation (7-202); replace $\lambda\hat{p} - p$ with $\hat{p}_{tot} - p_{tot}$

46). P. 480, eqn (7-206) "∇f_0" should be "$\nabla_s f_0$";

Also in eqns (7-210), (7-227), and (7-230) "$\nabla^2 f_0$" should be "$\nabla_s^2 f_0$"

47) p. 480, Line just before eqn (7-207); (2-117) should be (2-112)

48). P. 480 the equation between (7-210) and (7-211) should be

$$\frac{(2\gamma/a)}{p_c} = \frac{2}{Ca}$$

49) p. 481, L1. (7-206) should be (7-211)

50) p. 481, eqn (7-215); The second term on the RHS should read $\hat{B}_n r^{n+1}$

51) p. 482; delete the phrase "(the streamlines are closer together)"

52) p. 484, The symbol π that appears in eqn (7-227), in the line following this eqn, in eqn (7-230) and two lines after eqn (7-230) should all be changed to Π

53) p. 486, eqn (7-236), change equation to read

$$\frac{\partial \gamma}{\partial T} = -\beta < 0,$$

54) p. 488, eqn (7-243), change equation to read

$$T_\infty(z) = T_\infty(0) + \alpha r \eta$$

55) p. 488, eqn (7-244), change equation to read

$$\frac{\partial \gamma}{\partial \eta} = \frac{\partial \gamma}{\partial T}\frac{\partial T}{\partial \eta} = -\alpha\beta a$$

56) p. 491, In figure 7-18, the label "-1 mm^3" should be just "1 mm^3"

57). P. 518, problem 7-15, title should read "Flows" (not "Fows")

58) p. 526, two lines before eqns (8-2), the reference to (6-6a) should be (7-6a)

59). P. 527, eqn (8-5). Change numerator to ∂^n instead of ∂^{n-1}

39) p. 532, the equation (8-30b) should read $S = \frac{1}{3}M_{kk}$

40) p. 532, equation (8-31) should read $\mathbf{\Gamma} = \mathbf{E} + \frac{1}{2}\boldsymbol{\varepsilon}\cdot\boldsymbol{\omega}$ or $\Gamma_{ij} = E_{ij} + \frac{1}{2}\varepsilon_{ijk}\omega_k$

41) p. 532, equation (8-32) should read $\boldsymbol{\Gamma}\cdot\mathbf{x}=\mathbf{E}\cdot\mathbf{x}+\frac{1}{2}\boldsymbol{\omega}\wedge\mathbf{x}$

42) p. 533 , L5 after equation (8-37); " …rotating sphere in the." Should read "…rotating sphere in the preceding section (A-2)."

42) p. 533, equation (8-36) should read $\mathbf{u}_{\infty}=\mathbf{E}\cdot\mathbf{x}+\frac{1}{2}\boldsymbol{\omega}\wedge\mathbf{x}$

43) p. 539, equation (8-65) should have just "*p*" instead of " p' "

xx) p. 540, eqn (8-70), Should be $\frac{3c_3}{5}$ not $\frac{2c_3}{5}$ on left hand side.

44) p. 551, equation (8-123), the last term of the first equation should be $\frac{(\boldsymbol{\alpha}\cdot\mathbf{x})\mathbf{x}}{r^3}$ not $\frac{(\boldsymbol{\alpha}+\mathbf{x})\mathbf{x}}{r^3}$

45) p. 557, L-1 after equation (8-163); insert right after "vectors"

"(in these two equations we use the ' symbol to denote dimensional variables, which should not be confused with the designation of $\mathbf{u}'$ elsewhere in this section as the perturbation velocity defined by eqn (8-146))"

46) p. 561, Figure 8-7; The label $\boldsymbol{\xi}-\xi\mathbf{e}_1$ should be $\mathbf{x}-\xi\mathbf{e}_1$.

47) p. 562, The term in square brackets in equation (8-181) should read

$$\left[\frac{\delta_{ij}}{r}+\frac{(x_i-\xi\delta_{i1})(x_j-\xi\delta_{j1})}{r^3}\right]$$

48). P. 563, equation (8-188) *l* = 1, 2 should be *l* = 2, 3

49). P. 563, L-3 from bottom "parallel and perpendicular" should be "perpendicular and parallel"

50) p. 574, line before equation (8-233); $\mathbf{u}_1$ should be $\mathbf{T}_1$

51) p. 594, 1st sentence in section 1; (2-114) should be (2-110).

xx) p. 596, eqn (9-6) the last term should read $\frac{\nu}{\kappa}$ instead of $\frac{\upsilon}{\kappa}$

xx) P. 598, middle of thepage, the definition $Sc\equiv\frac{\upsilon}{D}$ should read $Sc\equiv\frac{\nu}{D}$

Similarly υ should be replaced by ν in eqns (3-114),(3-253),(3-256),(3-260),(3-262),(3-263), (3-266),(3-268) and p. 175,L-6 ($t_c = \ell_c^2/\nu$); p. 177, L4 and L6 after eqn (3-256) (ℓ_c^2/ν and R^2/ν);

p. 178, L-14(R^2/ν); p. 179, L-2 before eqn (3-266) and L-6 ($\omega R^2/\nu$); p. 183, L6 (R^2/ν);

problem (3-9); part (a) L3 (d^2/ν), part (b) L2 (d^2/ν), part (c) L1 ($d^2\omega/\nu$)

xx) p. 602, eqn (9-24); first term in the square brackets on the RHS should read

$$\left(1-\frac{3}{2r}+\frac{1}{2r^3}\right)\eta\frac{\partial\theta}{\partial r}$$

12) p. 617, Eqn (9-75) There is a major term missing on the RHS which should read

$$E^4\psi = Re\left\{\frac{1}{r^2}\left[\frac{\partial\psi}{\partial r}\frac{\partial}{\partial\eta}\left(E^2\psi\right)-\frac{\partial\psi}{\partial\eta}\frac{\partial}{\partial r}\left(E^2\psi\right)\right]+\frac{2}{r^2}E^2\psi\left(\frac{\partial\psi}{\partial r}\frac{\eta}{1-\eta^2}+\frac{1}{r}\frac{\partial\psi}{\partial\eta}\right)\right\}$$

52) p. 624, eqn (9-108); should have a vertical bar on the second Ψ, i.e. $\Psi\big|_{\rho\quad 1}$

54) p. 625, the first line of equation (9-116) should read, " $C_n = D_n = 0, \quad \text{all } n \geq 2$ "

xx) p. 630, eqns (9-148) and (9-150); remove the negative sign

xx) p. 630, eqn (9-152); last term should read

$$\frac{1}{2}\int_\sigma \theta_0^2 \mathbf{u}\cdot\mathbf{n}_\sigma dS$$

55) p. 640, figure 9-8; the vertical axis should be labeled "*Nu*"; the horizontal axis should be labeled "*Pe*" and the four values corresponding to the ticks on the axis should be 0.0001, 0.001, 0.01, 0.1, respectively, from left to right.

56)p. 640, L7 above eqn (9-192); (9-161) should be (9-191).

13) p. 699, next to last line Eq. (9-3) should be Eq. (9-203)

57) p. 705, L1 following eqn (10-23); $u_\theta = u$ should be $u_\theta \equiv u$.

58) p. 705, L1 following eqn (10-26); ν (nu) should be *v* (vee) (as in eqn (10-26)

59) p. 705, eqn (10-28); should be $\frac{\partial u}{\partial x}+\frac{\partial V}{\partial Y}=0$

xx) p. 707, eqn (10-39) $\frac{du_e}{\partial x}$ should be $\frac{du_e}{dx}$; the same error appears in eqns (10-40) and (10-89)

60) p. 713, L5 of first paragraph; Has a v in the definition of Re, it should be "nu"; ν

61) p. 755, reference 19 should refer to reference 17 rather than reference 16

62) p.730, L3; "approached" should be "approach"

63) p. 739, equation (10-195); should read $\omega\big|_{r=S} = 2\kappa u_s$, and the line after this equation should say, "that is, the vorticity at the bubble surface is equal to twice the product of the tangential velocity at the bubble surface, and the local"

64) p. 743, the two lines prior to eqn (10-220) should read, "First, if we substitute for V_0 into the right hand side of eqn (10-214), we obtain a nonhomogeneous form of the continuity equation for (u_1, V_1), namely,"

65) p. 745, last line; should read $1 = -2k_1 \int_0^\infty e^{-t^2} dt = -2k_1 \left(\sqrt{\pi}/2\right)$

66) p. 747, eqn (10-248); should read $\rho \dfrac{D\mathbf{u}'}{Dt'} = \nabla' \cdot \mathbf{T}'$

67) p.747, L+1 after eqn (10-248); ….fluid. The dashes in (10-248) signify that the variables are dimensional

68) p.747, eqn (10-249); $\rho \dfrac{D}{Dt'}(\mathbf{u}' \cdot \mathbf{u}') = \nabla' \cdot (\mathbf{u}' \cdot \mathbf{T}') - \nabla'\mathbf{u}' : \mathbf{T}'$

eqn (10-250); $\dfrac{\rho}{2} \nabla' \cdot \left[(\mathbf{u}' \cdot \mathbf{u}')\mathbf{u}'\right] = \nabla' \cdot (\mathbf{u}' \cdot \mathbf{T}') - \nabla'\mathbf{u}' : \mathbf{T}'$

eqn (10-251); $\int_{V'} \nabla' \cdot \left[\dfrac{\rho}{2}(\mathbf{u}' \cdot \mathbf{u}')\mathbf{u}'\right] dV' = \int_{V'} \nabla' \cdot (\mathbf{u}' \cdot \mathbf{T}') dV' - \int_{V'} \nabla'\mathbf{u}' : \mathbf{T}' dV'$

eqn (10-252); $\int_{A'} \dfrac{\rho}{2}(\mathbf{u}' \cdot \mathbf{u}')\mathbf{u}' \cdot \mathbf{n} dA' \equiv \int_{A_{particle}} \dfrac{\rho}{2}(\mathbf{u}' \cdot \mathbf{u}')\mathbf{u}' \cdot \mathbf{n} dA' - \int_{A_\infty} \dfrac{\rho}{2} U_\infty^3 \cos\theta \sin\theta R^2 d\theta d\phi$

eqn (10-253); $\int_{A'} \mathbf{n} \cdot (\mathbf{u}' \cdot \mathbf{T}') dA' = \int_{A'} \mathbf{u}' \cdot (\mathbf{n} \cdot \mathbf{T}') dA' = \mathbf{U}_\infty \cdot \int_{A_\infty} \mathbf{T}' \cdot \mathbf{n} dA' - \int_{A_{particle}} \mathbf{u}' \cdot (\mathbf{n} \cdot \mathbf{T}') dA'$

eqn (10-254); $\mathbf{U}_\infty \cdot \int_{A_\infty} \mathbf{T}' \cdot \mathbf{n} dA' = \mathbf{U}_\infty \cdot \int_{A_{particle}} \mathbf{T}' \cdot \mathbf{n} dA' = \mathbf{U}_\infty \cdot \mathbf{F}_{drag}$

69) p.748, eqn (10-255); $U_\infty F_{drag} = 2\pi\mu U_\infty^2 a \int_1^\infty \int_0^\pi r^2 (\nabla\mathbf{u} : \mathbf{T}) \sin\theta d\theta dr$

70) p. 879, note 3, L2; $C\exp(mz + \partial t)$ should be $C\exp(kz + \sigma t)$; also $\exp(mz)$ should be $\exp(kz)$, and in the next line $\sin mz$ (or $\cos mz$) should be $\sin kz$ (or $\cos kz$)

71) p. 814, eqn (12-62a); The ρ should be ρ_1

72) p. 815, eqn (12-73); the subscript $z = 0$ should be $z' = 0$

73) p. 819, L5 after eqn (12-85d); change “than explicitly” to “than being explicitly”

74) p. 832, L2 after eqn (12-127); The *u* and v should exchange places in this equation.

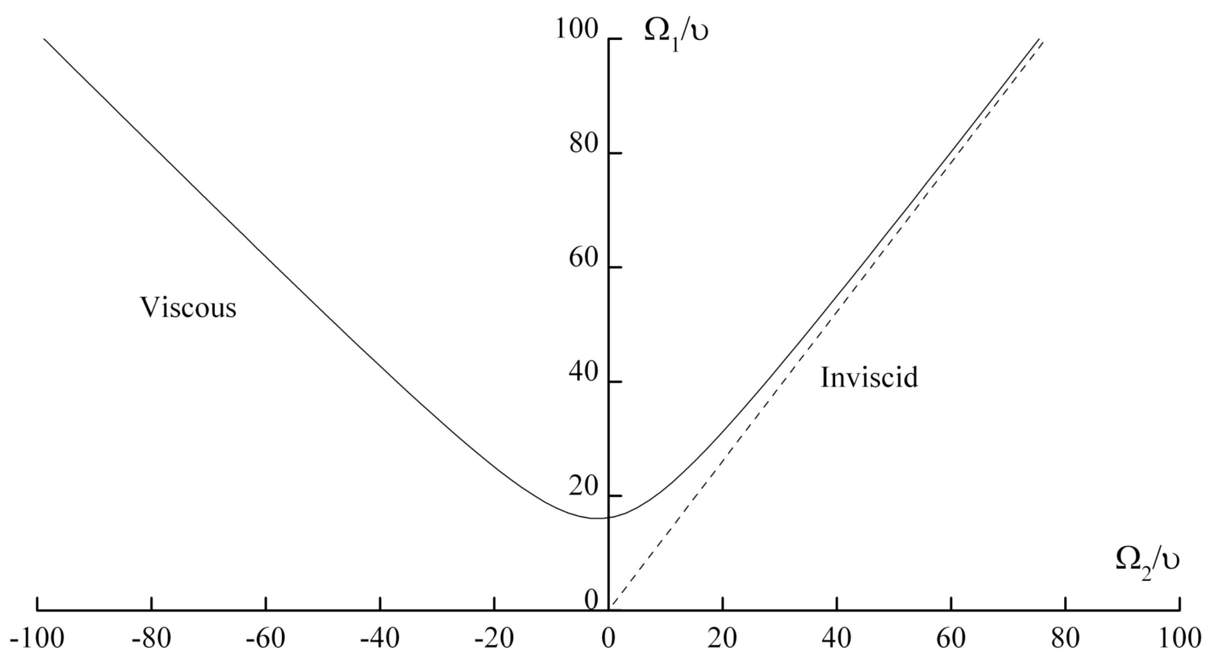
75) p. 835, Line just before eqn (12-129); “Rayleigh stated …” should read “For the case when , n Rayleigh’s condition for stability takes the form”

76) p. 837, The definition for *T* following eqn (12-147) should read

$$T \equiv -\frac{4C'\Omega_1}{\nu^2}d^4 = \frac{4(\Omega_1 R_1^2 - \Omega_2 R_2^2)}{R_2^2 - R_1^2}\frac{\Omega_1}{\nu^2}(R_2 - R_1)^4$$

77) p. 840, first line; delete “for this thin-gap approximation”

78) fig 12-3; There was a plotting error in this figure. The corrected is attached.



79) p. 846, last of eqns (12-178); remove the + sign from the right hand side

80) p.847, eqn (12-187) and eqn (12-188) and also in the eqn following (12-187); ∇_1^2 should be ∇_2^2

81) p. 848; ∇_1^2 should be ∇_2^2 in all of the equations on this page, and also in the line preceding eqn (12-190).

82) p. 849; ∇_1^2 should be ∇_2^2 in the eqn between eqns (12-195) and (12-196), and also in eqn (12-197)

83) p. 855, eqn (12-219b); The minus sign should be removed.

84) pp. 859-860, eqns (12-241) and (12-242); change β' to $\hat{\beta}$

85) p. 860, eqn (12-252); remove the + sign

86) p. 876, L-3 prior to eqn (12-318); change "equation in the." to "equation in the previous section."

zz) p. 898, appendix L1 should read

$$\nabla \wedge \mathbf{A} \to \varepsilon_{ijk} \frac{\partial A_k}{\partial x_j}$$