Errata and Suggested Updates for

Mechanics of Fluids
Cambridge University Press
2024

Joseph M. Powers

Friday 4th July, 2025

1. p. 24: Example 2.3 is clarified by noting that the specified rotation matrix $\mathbf{Q}$ is for a clockwise rotation of $\pi/2$. The present wording is formally correct, but certainly ambiguous. So with our sign convention of counter-clockwise as positive, the rotation angle for the given matrix is $\alpha = -\pi/2$. Alternatively, we could impose a positive counter-clockwise rotation of $\alpha = +\pi/2$ by taking
$$\mathbf{Q} = \begin{pmatrix} 0 & -1 & 0 \\ 1 & 0 & .0 \\ 0 & 0 & 1 \end{pmatrix}.$$
This matrix is also a rotation with $\det \mathbf{Q} = 1$ and $\mathbf{Q}^T = \mathbf{Q}^{-1}$. This matrix maps the vector $\mathbf{v} = (1,0,0)^T$ to $\mathbf{v}' = (0,-1,0)^T$. And it maps $\mathbf{v} = (0,1,0)^T$ to $\mathbf{v}' = (1,0,0)^T$.

2. pp. 27-28: Similar to the concern for Example 2.3, the wording here requires correction. The top of the page should read "A coordinate system rotated clockwise by $\alpha = -\pi/2$ about the x_3 axis has...." Also, the words below Solution should be "...as expected for a clockwise rotation of axes of $-\pi/2$."

3. p. 38: A useful addition here would be an introduction of octahedral planes associated with a symmetric tensor.

4. p. 47: It would be useful to cite for a thorough background on Gibbs notation and especially the concept and appropriate notation for the gradient of a vector:

   Wood, B., and Whitaker, S. (2024). The development of Gibbs's dyadic and implications for the gradient of a vector field, *British Journal of the History of Mathematics*, published online 24 Nov 2024.

5. p. 69: Equation (2.368) should have instead
$$\nabla^T \cdot \mathbf{v} = \frac{1}{\sqrt{g}} \frac{\partial}{\partial x^i}(\sqrt{g} v^i) = \frac{1}{x^1}\frac{\partial}{\partial x^1}(x^1 v^1) + \frac{\partial v^2}{\partial x^2} + \frac{\partial v^3}{\partial x^3}. \qquad (2.368)$$

6. p. 110: Figure 3.9 should have $\mathbf{x}_P^o$ instead of $\mathbf{x}^o$.

7. p. 111: In the sentence just after Eq. (3.172), replace $\mathbf{I}+\Delta t\, \mathbf{L}^T$ by $\mathbf{I}+dt\, \mathbf{L}^T$.

8. p. 113: For consistency in formatting, Eq. (3.184) would benefit from additional spacing to yield

$$(\mathbf{v}^T \cdot \nabla)\ d\mathbf{x} - (d\mathbf{x}^T \cdot \nabla)\ \mathbf{v} \equiv \mathcal{L}_{\mathbf{v}}\ d\mathbf{x} \equiv [\mathbf{v}, d\mathbf{x}], \qquad (3.184)$$

9. p. 146: Should be

   Golub, G. H., and Van Loan, C. F. (2013). *Matrix Computations*, 4th ed. Baltimore: Johns Hopkins University Press.

10. p. 166: The bottom margin is too narrow, relative to other pages.

11. p. 172: First paragraph of Ch. 4.4.2, replace "yields the the work rate..." with "yields the work rate"

12. p. 175: It is more appropriate to replace Eqs. (4.170, 4.171) by the more elegant

$$\partial_o \left(\rho\left(h + \frac{1}{2}v_j v_j\right)\right) + \partial_i \left(\rho v_i \left(h + \frac{1}{2}v_j v_j\right)\right) = \frac{\partial p}{\partial t} - \partial_i q_i + \partial_i(\tau_{ij} v_j) + \rho v_i f_i, \quad (4.170)$$

$$\frac{\partial}{\partial t}\left(\rho\left(h + \frac{1}{2}\mathbf{v}^T \cdot \mathbf{v}\right)\right) + \nabla^T \cdot \left(\rho \mathbf{v}\left(h + \frac{1}{2}\mathbf{v}^T \cdot \mathbf{v}\right)\right) = \frac{\partial p}{\partial t} - \nabla^T \cdot \mathbf{q} + \nabla^T \cdot (\boldsymbol{\tau} \cdot \mathbf{v}) + \rho \mathbf{v}^T \cdot \mathbf{f}. \quad (4.171)$$

13. p. 179: Although characterized as "nonrigorous," perhaps the rigor in arriving at Eq. (4.208) could be enhanced. It is not immediately obvious that the volume integral operator is equivalent to the area integral operator. So it seems as if we might be operating non-uniformly. With small effort, this could be explained better.

14. p. 220: Just before Eq. (5.155), the text should be

   "In matrix form, we can write this inequality using the method of quadratic forms, see Section 2.8:"

15. p. 220: Just after Eq. (5.155), the text should read

   "..part of the coefficient matrix has eigenvalues..."

16. p. 236: While not an error, a short new discussion of a three-dimensional extension to the stream function would be useful here. It could link nicely to Eq. (11.12) on p. 523. For background, see Aziz and Hellums.[1] The discussion would be a version of the following:

   Because $\nabla^T \cdot \mathbf{v} = 0$, it is possible to define a *vector potential*, $\boldsymbol{\psi}$, which must be constructed such that the following holds:

[1] K. Aziz and J. D. Hellums, Numerical solution of the three-dimensional equations of motion for laminar natural convection, *Physics of Fluids*, 19(2): 314-324, 1967.

$$\mathbf{v} = \nabla \times \boldsymbol{\psi}.$$

Now by the properties of vector calculus, we are ensured that the incompressibility condition will hold as

$$\nabla^T \cdot \nabla \times \boldsymbol{\psi} = 0,$$

for all $\boldsymbol{\psi}$. Next recall the definition of vorticity $\boldsymbol{\omega}$ and operate on it:

$$\begin{aligned} \boldsymbol{\omega} &= \nabla \times \mathbf{v}, \\ &= \nabla \times \nabla \times \boldsymbol{\psi}, \\ &= \nabla(\nabla^T \cdot \boldsymbol{\psi}) - \nabla^2 \boldsymbol{\psi}. \end{aligned}$$

The vector potential $\boldsymbol{\psi}$ is not uniquely determined, for example, if the curl of $\boldsymbol{\psi}$ maps to the physical velocity vector $\mathbf{v}$, so does $\boldsymbol{\psi} + \nabla\chi$, where χ is any scalar function. Let us choose to constrain $\boldsymbol{\psi}$ such that $\nabla^T \cdot \boldsymbol{\psi} = 0$. This is a common exercise in magneto-electro dynamics, and is known as choosing the gauge, see Feynman, et al. (1963, Volume 2, Chapter 18). With this choice, we get a Poisson equation for $\boldsymbol{\psi}$:

$$-\nabla^2 \boldsymbol{\psi} = \boldsymbol{\omega}.$$

Later, in Sec. 11.1.1, we shall see that in the limit of zero inertia, the incompressible Navier-Stokes equations give us Eq. (11.8), $\nabla^2 \boldsymbol{\omega} = \mathbf{0}$. Thus taking the Laplacian of our Poisson equation for $\boldsymbol{\psi}$, we get the biharmonic equation

$$\nabla^4 \boldsymbol{\psi} = \mathbf{0}.$$

This is the vector extension of the scalar Eq. (11.15), and it is valid under the mathematical constraint $\nabla^T \cdot \boldsymbol{\psi} = 0$ and the physical constraint of negligible fluid inertia.

Taking $\boldsymbol{\psi} = (\psi_x, \psi_y, \psi_z)^T$, we also see that

$$u = \frac{\partial \psi_z}{\partial y} - \frac{\partial \psi_y}{\partial z}, \qquad v = -\frac{\partial \psi_z}{\partial x} + \frac{\partial \psi_x}{\partial z}, \qquad w = -\frac{\partial \psi_x}{\partial y} + \frac{\partial \psi_y}{\partial x}.$$

17. p. 251: In Sec. 6.7.8, it would be useful to introduce the Knusden number. For an ideal gas, it is $Kn = M_o/Re\sqrt{\gamma\pi/2}$.

18. p. 266: Just after Eq. (7.4) the phrase "...modeled as incompressible..." has an incorrect break to form a new paragraph.

19. p. 269: The terms "centripetal," "Coriolis," and "body force," should be recognized in the index.

20. p. 307: New equations should be provided for the uniform flow:

$$\phi = U_o \left(x \cos\alpha + y \sin\alpha \right), \qquad \psi = U_o \left(y \cos\alpha - x \sin\alpha \right).$$

21. p. 339: middle of second paragraph, replace "They will will have a different mathematical character" with "They will have a different mathematical character."

22. p. 390: Figure 9.27 is slightly improved by showing a small velocity magnitude increase so that $v_2 > v_1$.

23. p. 391: Eq. (9.368) is improved to more clearly show dimensionless groups when recast as

$$\begin{aligned} v_2 &= \frac{c_p p_2 T_1 \left(\sqrt{\frac{p_1^2 v_1^2 \left(2 c_p T_1 + v_1^2\right)}{c_p^2 p_2^2 T_1^2} + 1} - 1 \right)}{p_1 v_1} \\ &= v_1 \left(\frac{p_2}{p_1} \right) \frac{c_p T_1}{v_1^2} \left(\sqrt{1 + 2 \left(\frac{p_1}{p_2} \right)^2 \frac{v_1^2}{c_p T_1} \left(1 + \frac{v_1^2}{2 c_p T_1} \right)} - 1 \right). \end{aligned}$$

24. p. 437: It is possible to scale the irreversibility production rate $\dot{\mathcal{I}}$. There are many ways to do this. One way is to scale by $\rho_1^2 R^2 T_1/\mu$. This scaling induces the dimensionless irreversibility production rate to range between 0 and roughly 1.75 for the conditions of Fig. 9.51.

25. p. 441: It is appropriate to also recognize John von Neumann in addition to Taylor and Sedov for the solution of the point source blast wave. Taylor published his technical report (The formation of blast wave by a very intense explosion, British Report RC-210) on the subject of blast waves on 27 June 1941. von Neumann published equivalent results in a technical report (The point source solution, NDRC, Div. B, Report AM-9) on 30 June 1941.

26. p. 445: Equation (9.682) needs P to be replaced by p in the last sub-bracketed term.

27. p. 461: Figure 10.1 is improved by a small change. It is better to place the origin of the coordinate axes downstream somewhat, and have $p = p_o$ at such a downstream location. This is to avoid effects of the entrance length near the current location of $x = 0$.

28. p. 462: This section would be improved by either new analysis or small discussion of the Graetz problem in which advection of energy is not neglected.

29. p. 465: The text just before Equation (10.23) is better stated as "...of the form $\nabla^2 p = f(u, v, w)$. Section 6.4.4 has..."

30. p. 465: Equation (10.23) is missing a μ and should read as

$$0 = -\frac{\partial^2 p}{\partial x^2} + \mu \frac{\partial}{\partial x}\frac{\partial^2 u}{\partial y^2} = -\frac{\partial^2 p}{\partial x^2} + \mu \frac{\partial^2}{\partial y^2}\underbrace{\frac{\partial u}{\partial x}}_{=0}. \qquad (10.23)$$

31. p. 477. It might be more accurate to replace Eq. (10.112) with

$$\tau_o = \mu \frac{du}{dy}. \qquad (10.112)$$

and note that this imposes no variation with t, x, or z.

32. p. 478. Just after Eq. (10.119), the text should read

"So the only nonzero components of the stress tensor are $\tau_{xy} = \tau_{yx} = \tau_o$."

33. p. 478. It is appropriate to replace Eq. (10.120) with

$$0 = -\frac{dq_y}{dt} + \tau_o \frac{du}{dy}. \qquad (10.120)$$

34. p. 479: Eq. (10.134) should be

$$T(u) = T_o + \frac{\mu_o}{2k_o}(U^2 - u^2). \qquad (10.134)$$

35. p. 480. The phrase just before Sec. 10.2 is better stated as

"...for example, the vorticity field is given by finding $\omega_z = -du/dy$."

36. p. 491. A new header is probably needed just before Eq. (10.215) saying

Finite Pr, Ec

37. p. 521: Section 11.1.1 would be enhanced by a short discussion of fundamental solutions to the biharmonic equation. For example, in two-dimensional flows

    (a) $\psi(x, y) = xv(x, y) - yu(x, y) + w(x, y)$ where u, v, and w are each harmonic functions and u and v are harmonic conjugates of each other.

    (b) $\psi(r) = c_1 + c_2 \ln r + c_3 r^2 \ln r + c_4 r^2$ satisfies $\nabla^4 \psi = 0$.

38. pp. 523-525: Example 11.1. It would be useful to show $\nabla^4 \psi = 0$.

39. pp. 526-528: Example 11.2. It would be useful to show $\nabla^4 \psi = 0$.

40. pp. 529-533: Example 11.3. While not an error, it would be useful for a future edition to consider a transformation for Stokes flow over a sphere: $\eta = \cos \phi$. See Leal (2007).

41. p. 557: Here it would be useful to add text and analysis to give an approximation of the local Nusselt number for laminar flow over a flat plate. It should be

$$Nu_x = 0.332 Re_x^{1/2} Pr^{1/3}.$$

See Incropera and DeWitt (1981, p. 326), Schetz (1993, p. 88), White (2006, p. 239).

42. p. 561: Equation (11.281) has two small errors. The mass equation should have y instead of $\tilde{y}$, and there is too much white space between the equal sign and the 0. So, we should find instead

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0, \qquad u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} = \nu \frac{\partial^2 u}{\partial y^2}. \qquad (11.281)$$

43. p. 575: More details would be useful in showing how to find the compressible boundary layer profile. A version of this problem for a slightly more general relation between μ and T is given in von Kármán and Tsien, Boundary layers in compressible fluids, *Journal of the Aeronautical Sciences*, 5(6): 227-232. Direct solution of Eq. (11.381) and boundary conditions is not obvious. Note at $\eta = 0$, the no-slip condition gives $f(0) = 0$. This results in $d^2f/d\eta^2|_{\eta=0} \to -\infty$. Some related discussion is found in Mills and Abedin, Computing laminar boundary layers with the von Mises equation, *Aeronautical Journal*, 78(766): 476-479. 1974.

    This singular behavior may be concisely recognized and captured by including new text just following Eq. (11.381):

    "Let us take

$$\frac{df}{d\eta} = g.$$

    Then Eq. (11.381) becomes

$$\begin{aligned} -\frac{\eta}{2} g &= \frac{d}{d\eta}(fg), \\ -\frac{1}{2}\eta g &= f\frac{dg}{d\eta} + g\frac{df}{d\eta}, \\ -\frac{1}{2}\eta g &= f\frac{dg}{d\eta} + g^2, \\ \frac{dg}{d\eta} &= -\frac{-g^2}{f} - \frac{1}{2}\frac{\eta g}{f}. \end{aligned}$$

    This, along with $df/d\eta = g$, define a non-autonomous system of differential equations that must satisfy $f(0) = 0$, $f(\infty) = 1$. Now the plate surface is at $y = 0$, which we assign to the stream function with $\psi = 0$, and so $\eta = 0$. Because at the plate surface we have $u = 0$, and thus $f = 0$, we see

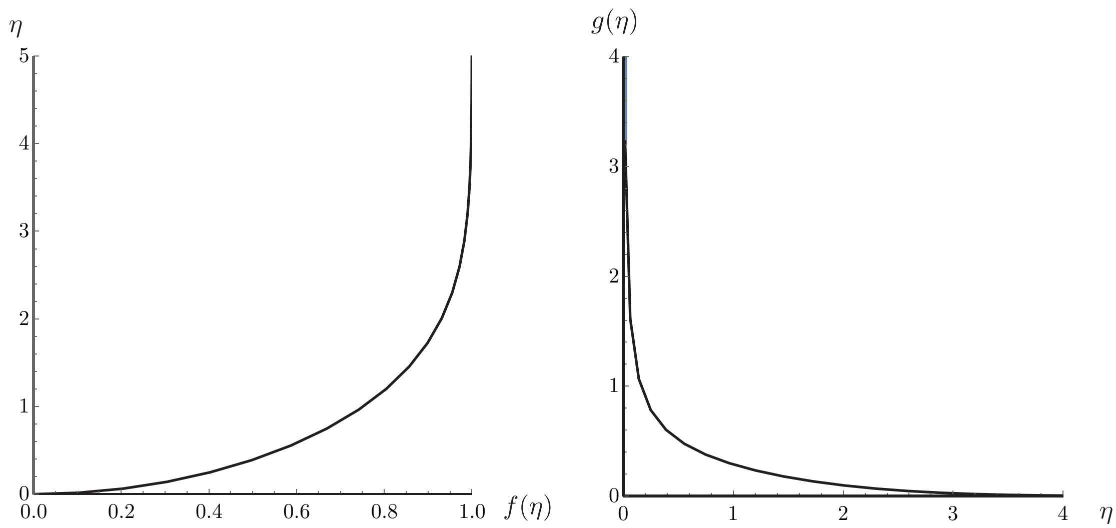

Figure 1: Compressible boundary layer velocity profile $f(\eta)$ along with $g(\eta)$.

that $dg/d\eta$ is singular at the plate surface. Let us address the singularity by defining a new independent variable s such that

$$\frac{d\eta}{ds} = f, \qquad \eta(s = 0) = 0.$$

Using the chain rule our system becomes

$$\begin{aligned} \frac{dg}{ds} &= -g^2 - \frac{1}{2}\eta g, \\ \frac{df}{ds} &= fg, \\ \frac{d\eta}{ds} &= f. \end{aligned}$$

These equations are not singular. We must have $\eta(s = 0) = 0$, $f(s = 0) = 0$, $f(s \to \infty) = 1$. To solve this numerically, we need to seed the initial value of f with a very small positive number so as to move η away from its equilibrium for $f = 0$. Here we choose $f(0) = 1/1000$. And we take the maximum value of s to be $s_{max} = 1000$. Then a numerical solution is generated. Knowing now $f(s)$ and $\eta(s)$, we parametrically plot $f(\eta)$ and $g(\eta)$ in Fig. 1. We see $g(\eta) = df/d\eta$ is singular at $\eta = 0$. And it is obvious that $dg/d\eta|_{\eta=0} \to -\infty$."

44. p. 577: Consider adding the following problem and solution.

Consider the solution of a doublet for the Stokes equations, $\nabla^T \cdot \mathbf{v} = 0$,

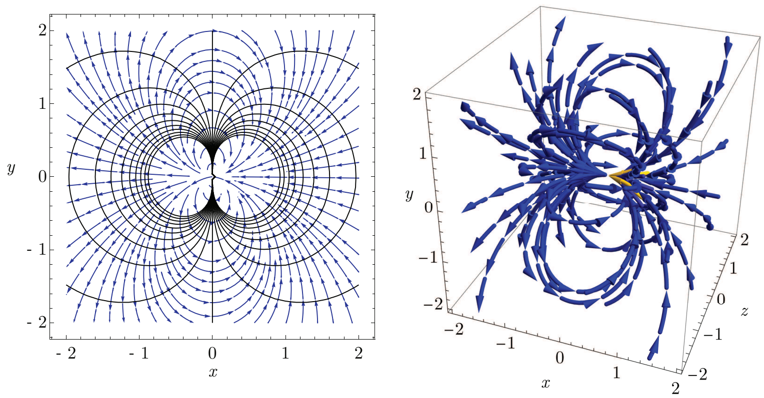

Figure 2: Doublet in Stokes flow; velocity vector field and contours of velocity potential; $c = 1$, $z = 0$, $\boldsymbol{\alpha} = (1, 0, 0)^T$.

$\nabla p = \mu \nabla^T \cdot \nabla \mathbf{v}$. Show the solution

$$\mathbf{v} = c\left(\frac{\boldsymbol{\alpha}}{r^3} - \frac{3(\boldsymbol{\alpha}^T \cdot \mathbf{x})\mathbf{x}}{r^5}\right) = c\left(\mathbf{I} - \frac{3\mathbf{x}\mathbf{x}}{r^2}\right) \cdot \frac{\boldsymbol{\alpha}}{r^3}, \qquad p = p_0,$$

satisfies the Stokes equations, and plot the streamlines in the plane $z = 0$ for $c = 1$ and $\boldsymbol{\alpha} = (1, 0, 0)^T$. In general $\boldsymbol{\alpha}$ is any constant unit vector, $\mathbf{x} = (x, y, z)^T$, and $r = \sqrt{x^2 + y^2 + z^2}$.

Solution

The velocity field here expands to

$$\mathbf{v} = c\begin{pmatrix} \frac{-2x^2+y^2+z^2}{(x^2+y^2+z^2)^{5/2}} \\ \frac{3xy}{(x^2+y^2+z^2)^{5/2}} \\ \frac{3xz}{(x^2+y^2+z^2)^{5/2}} \end{pmatrix}.$$

It is easily verified by direct substitution that

$$\nabla^T \cdot \mathbf{v} = 0, \qquad \nabla p = \mathbf{0}, \qquad \nabla^T \cdot \nabla \mathbf{v} = \mathbf{0},$$

so the Stokes equations are satisfied. One can also show a velocity potential exists

$$\phi = c\frac{\boldsymbol{\alpha}^T \cdot \mathbf{x}}{r^3}.$$

The velocity vector field and velocity potential contours are given in Fig. 2 for $c = 1$ and $z = 0$.

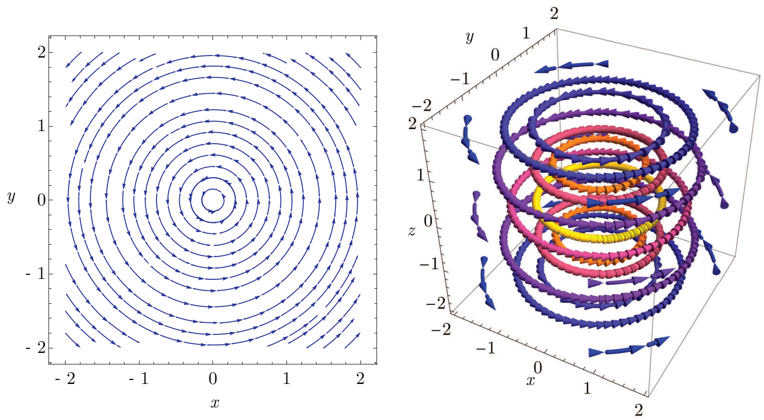

Figure 3: Rotlet in Stokes flow; velocity vector field; $c = 1$, $z = 0$, $\boldsymbol{\alpha} = (0, 0, 1)^T$.

45. p. 577: Consider adding the following problem and solution.

    Consider the solution of a rotlet for the Stokes equations, $\nabla^T \cdot \mathbf{v} = 0$, $\nabla p = \mu \nabla^T \cdot \nabla \mathbf{v}$. Show the solution

    $$\mathbf{v} = c \left(\frac{\boldsymbol{\alpha} \times \mathbf{x}}{r^3} \right), \qquad p = p_0,$$

    satisfies the Stokes equations, and plot the streamlines in the plane $z = 0$ for $c = 1$ and $\boldsymbol{\alpha} = (0, 0, 1)^T$. In general $\boldsymbol{\alpha}$ is any constant unit vector, $\mathbf{x} = (x, y, z)^T$, and $r = \sqrt{x^2 + y^2 + z^2}$.

    Solution

    The velocity field here expands to

    $$\mathbf{v} = c \begin{pmatrix} \frac{-y}{(x^2+y^2+z^2)^{3/2}} \\ \frac{x}{(x^2+y^2+z^2)^{3/2}} \\ 0 \end{pmatrix}.$$

    It is easily verified by direct substitution that

    $$\nabla^T \cdot \mathbf{v} = 0, \qquad \nabla p = \mathbf{0}, \qquad \nabla^T \cdot \nabla \mathbf{v} = \mathbf{0},$$

    so the Stokes equations are satisfied. The velocity vector field is given in Fig. 3.

46. p. 577: Consider adding the following problem and solution.

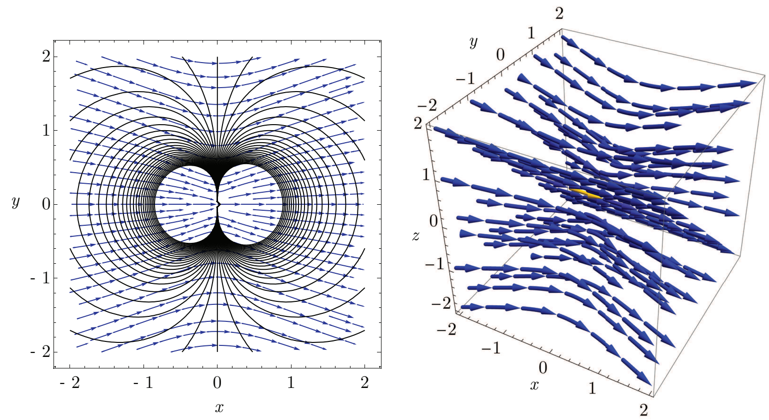

Figure 4: Stokeslet in Stokes flow; velocity vector field and pressure field; $c = 1$, $\mu = 1$, $z = 0$, $p_0 = 0$.

Consider the solution of a Stokeslet for the Stokes equations, $\nabla^T \cdot \mathbf{v} = 0$, $\nabla p = \mu \nabla^T \cdot \nabla \mathbf{v}$. Show the solution

$$\mathbf{v} = c\left(\frac{(\boldsymbol{\alpha}^T \cdot \mathbf{x})\mathbf{x}}{r^3} + \frac{\boldsymbol{\alpha}}{r}\right) = c\left(\frac{\mathbf{xx}}{r^2} + \mathbf{I}\right) \cdot \frac{\boldsymbol{\alpha}}{r}, \qquad p = 2c\mu\frac{\boldsymbol{\alpha}^T \cdot \mathbf{x}}{r^3} + p_0,$$

satisfies the Stokes equations, and plot the streamlines in the plane $z = 0$ for $c = 1$ and $\boldsymbol{\alpha} = (1, 0, 0)^T$. In general $\boldsymbol{\alpha}$ is any constant unit vector, $\mathbf{x} = (x, y, z)^T$, and $r = \sqrt{x^2 + y^2 + z^2}$.

Solution

The velocity and pressure fields here expand to

$$\mathbf{v} = c\begin{pmatrix} \frac{2x^2+y^2+z^2}{(x^2+y^2+z^2)^{3/2}} \\ \frac{xy}{(x^2+y^2+z^2)^{3/2}} \\ \frac{xz}{(x^2+y^2+z^2)^{3/2}} \end{pmatrix}, \qquad p = \frac{2c\mu x}{(x^2+y^2+z^2)^{3/2}}.$$

It is easily verified by direct substitution that

$$\nabla^T \cdot \mathbf{v} = 0, \qquad -\nabla p + \mu \nabla^T \cdot \nabla \mathbf{v} = \mathbf{0},$$

so the Stokes equations are satisfied. The velocity vector and pressure field is given for $c = 1$, $\mu = 1$, $z = 0$ in Fig. 4. With the stress tensor as

$$\mathbf{T} = -p\mathbf{I} + \nabla \mathbf{v},$$

direct calculation verifies

$$\nabla^T \cdot \mathbf{T} = \mathbf{0}.$$

Direct calculation also verifies that

$$\nabla^2 p = 0.$$

Thus, the pressure field is harmonic.

47. p. 581: Just before Eq. 12.3, the sentence should read "Note this is completely...."

48. p. 615: Just before Eq. (13.7), replace "so the the projected vector" with "so the projected vector"

49. p. 626: Just before Eq. (13.70), we should find "...the trigonometric identity $\sin \pi z \cos 2\pi z = (-\sin \pi z + \sin 3\pi z)/2$ and..."

50. p. 628: Equation (13.86) needs a small improvement. One should remove the dependence on t to yield

$$\psi(x, z) = \pm\sqrt{b(r-1)} \sin \pi z \sin ax, \qquad (13.86)$$

51. p. 628: Equation (13.87) is in error. It should be

$$T(x, z) = \pm\sqrt{b(r-1)} \sin \pi z \cos ax - (r-1) \sin 2\pi z, \qquad (13.87)$$

This renders it consistent with the correct Eq. (13.67).

52. p. 628: Equation (13.89) is in error. It should be

$$T(x, z) = 2\sqrt{6}(\sin \pi z)\left(\cos \frac{\pi x}{\sqrt{2}}\right) - 9 \sin 2\pi z. \qquad (13.89)$$

This renders it consistent with the correct Eq. (13.67) and Fig. 13.6.

53. p. 648: Section 14.1.2, "Connection to the Mean Free Path Scale" should be briefly augmented so that it receives additional support from an uncited recent article,

Gallis, M. A., Torczynski, J. R., Krygier, M. C., Bitter, N. P., and Plimpton, S. J. (2021). Turbulence at the edge of continuum, *Physical Review Fluids*, **6**, 013401.

This article quantitatively and decisively connects predictions of a standard sub-continuum fluid model to those of a continuum fluid model in the turbulent regime and demonstrates a point made qualitatively in the text: that in the limit of high Mach and Reynolds numbers, the Kolmogorov microscale length approaches the mean free path length.

54. p. 660: May want to note that the initial conditions, Eqs. (14.84, 14.86), are such that $\rho(x, y, z, 0)T(x, y, z, 0) = \rho_o T_o$, as $p_o = \rho_o R T_o$. The initial pressure distribution is such that $\nabla p = -\rho g$. In the limit as $(T_o - T_1)/T_o \rightarrow$

0, Taylor series expansion of Eq. (14.86) reveals the initial pressure distribution is approximatd by

$$p(x, y, z, 0) \sim p_o - \rho_o g z \left(1 + \frac{T_o - T_1}{2T_o}\frac{z}{h}\right).$$

This is identical to Eq. (12.130). It provides a correction for the incompressible hydrostatic limit.

55. p. 675: Add the citation

    Gebhart, B., Jaluria, Y., Mahajan, R. L., and Sammakia, B. (1988). *Buoyancy-Induced Flows and Transport*. New York: Hemisphere.

56. p. 676: Should be

    Golub, G. H., and Van Loan, C. F. (2013). *Matrix Computations*, 4th ed. Baltimore: Johns Hopkins University Press.

57. p. 676: Add the citation

    Hirschel, E. H., Cousteix, J., and Kordulla, W. (2014). *Three-Dimensional Attached Viscous Flow: Basic Principles and Theoretical Foundations*, Berlin: Springer.

58. p. 678: Add the citation

    Ladyzhenskaia, O. (1969). *The Mathematical Theory of Viscous Incompressible Flow*, 2nd ed. New York: Gordon and Breach.

59. p. 679: Add the citation

    O'Neill, M. E., and Chorlton, F. (1986). *Ideal and Incompressible Fluid Dynamics*, New York: John Wiley.

60. p. 679: Add the citation

    O'Neill, M. E., and Chorlton, F. (1989). *Viscous and Compressible Fluid Dynamics*, New York: John Wiley.

61. p. 679: Add the citation

    Oswatitsch, K. (1956). *Gas Dynamics*, New York: Academic Press.

62. p. 680: One can now recognize

    Panton, R. L. (2024). *Incompressible Flow*, 5th ed. Hoboken, New Jersey: John Wiley.

    Many interior citations in the book likely require a page number modification if the citation is to the 2024 edition.

63. p. 681: Rearrange the citation Samelson and Wiggins (2006) so that it precedes Saminy, et al. (2004)

64. p. 699: Add the citation

    Schobeiri, M. T. (2022). *Advanced Fluid Mechanics and Heat Transfer for Engineers and Scientists*. Cham, Switzerland: Springer.

SOLUTION MANUAL

1. p. 65: It could be useful to adjust the solution of Problem 4.4 to be fully 3D. This affects the mean stress $T_m = (1/3)T_{ii}$. This would also require adjusting the actual problem statement to emphasize the 3D feature.