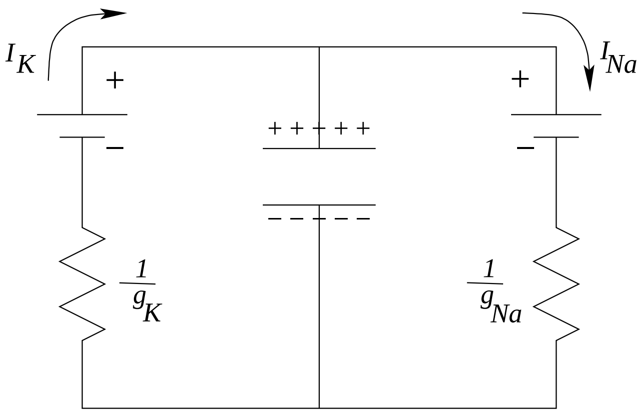
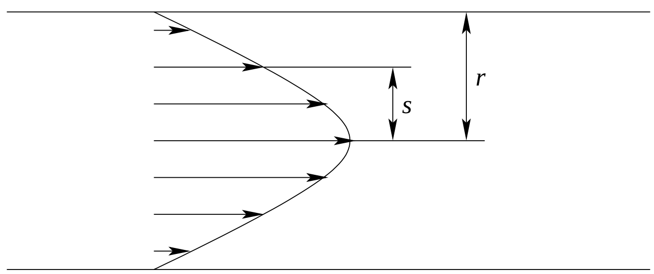
Errata of "Mathematical Modeling for Industry and Engineering" by Thomas Svobodny

1. Page 6. Figure 1.4 should be (note polarity of the batteries):



2. Page 8. Figure 1.6 should be (s and r are measured from the centerline):



3. Page 8. The equation above (1.2) should be

$$\left|\frac{dv}{ds}\right|_{s=r} = 2Ar = \left|\frac{dv'}{ds}\right|_{s=r'} = 2Br'$$

4. Page 10. The second equation should be:

$$f = k\frac{Q^2}{r^4} + Kr^a\,, \quad 1 \le a \le 2\,.$$

5. Page 10. The fourth equation should be:

$$Q^2 \sim r^{a+4}$$

6. Page 19. Note that equation below (1.14) is obtained taking into account equation (1.9). Also note that $\mathbf{r}$ in the last equation in Page 18 is a unit vector in the radial direction, i.e. $\mathbf{r}^2 = 1$.

7. Page 20. The first equation should be:

$$\frac{dx}{ds} = -A\sqrt{x^{-3} - 1}$$

   Note that the assumption of collapsing bubble ($\frac{dx}{ds} < 0$) is used to choose the negative value of the square root.

8. Page 20. The last equation should be

$$p_{max} \propto x^{-2}$$

9. Page 25. All sums should be in i: $\sum\limits_i$.

10. Page 25. The fifth and sixth equations should be:

$$0 = \frac{\partial \epsilon}{\partial \alpha} = -\sum_i P_i(Q_i - \alpha P_i - \beta)\,,$$
$$0 = \frac{\partial \epsilon}{\partial \beta} = -\sum_i (Q_i - \alpha P_i - \beta)\,.$$

11. Page 26. The fifth line from the top should be:

$$\cos x = O(1)\,, \quad \cos x = o\left(x^{-1/2}\right)$$

12. Page 44. The second line after equation (2.8) should read: " … that describes … "

13. Page 45. The last equation should be

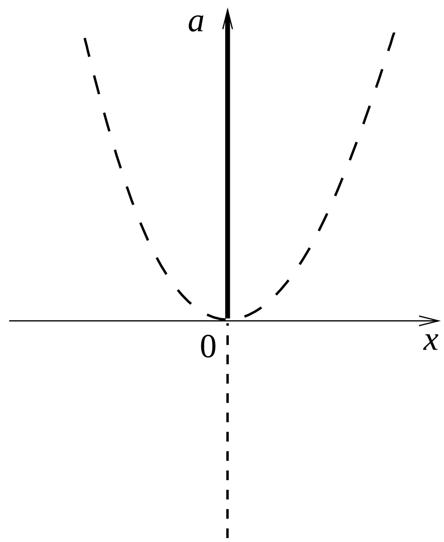
$$U_{gravitational} = \int_0^l mg\sqrt{1 - \dot{w}^2}\, ds \approx mg \int_0^l \left(1 - \frac{1}{2}\dot{w}^2 - \frac{1}{8}\dot{w}^4 - \cdots\right) ds$$

14. Page 46. The second equation from the top must be:

$$U(W) \approx \frac{\pi^2}{8l}\left(EI\left(\frac{\pi}{2l}\right)^2 - \frac{1}{2}mg\right)W^2 + \frac{\pi^4}{128l^3}\left(EI\left(\frac{\pi}{2l}\right)^2 - \frac{3}{8}mg\right)W^4$$

15. Page 47. **EXERCISE 7** should read
   " … This potential exemplifies the form … "

16. Page 47. Figure 2.15 should be:



17. Page 48. The second equation from the top should be

$$S = 2\pi ab \left[\sqrt{1 - e^2} + \frac{\arcsin(e)}{e} \right] ,$$

18. Page 48. The last equation obviously should be

$$E_s = \gamma S = \gamma 4 \pi r_0^2 \left(1 + \frac{2}{45} e^4 + \cdots \right) ,$$

19. Page 49. The top equation should be

$$E_e = Q^2/(2C) = \frac{Q^2}{8\pi\epsilon_0 r_0} \left(1 - \frac{1}{45} e^4 + \cdots \right) .$$

20. Page 50. Should be:

$$r = c_1 = \cosh \left(\frac{x - c_2}{c_1} \right)$$

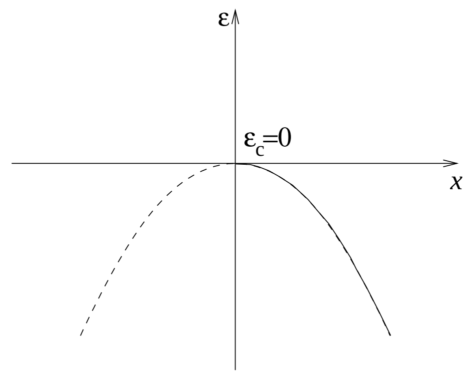
21. Page 52. Before **EXERCISE 12** should read:

$$V(x) = \epsilon x + b x^3$$

22. Page 52. **EXERCISE 12** should read:
"The graphs in Figure 2.19 are drawn for $b > 0$. Draw the analogous graphs for $b < 0$. ... "

23. Page 52. The third line after Figure 2.19 should refer to Figure 2.20. Since there is no bifurcation in that figure this line should call it the equilibrium rather than bifurcation diagram.

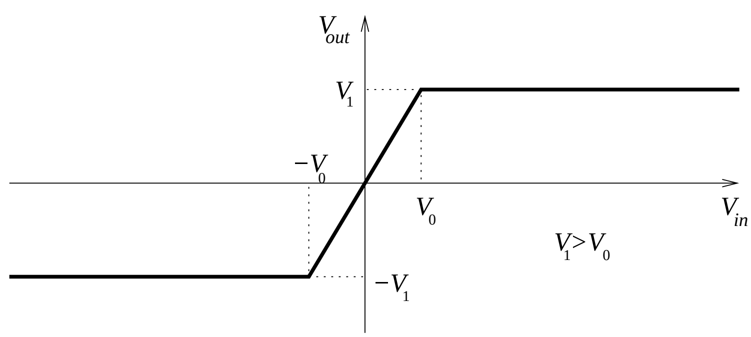
24. Page 53. In order to correspond exactly to Figure 2.19 the equilibrium diagram in Figure 2.20 should be



and the critical value ε_c should be zero.

25. Page 53. Exercise 14 (ii) should read: "Show that $\epsilon_c = \frac{4}{3}a\sqrt{a/(6c)}$.

26. Page 61. Figure 2.26 should be:



27. Page 86. Below **EXERCISE 11** should read:
"As an example, if $e = 1$, $d = 0$, then $a = 0$, $b = 1$, $c = -2$, and we get

$$\Pi_2 = \rho\mu^{-2}F_D\,.$$

This number is independent of Π_1. ... "

28. Page 103. Equation before equation (4.3) should be

$$N(kT_c) = N_0 2^k$$

29. Page 104. The second equation should be:

$$\rho = r\Delta t + o(\Delta t)\,,$$

30. Page 104. The third equation should be:

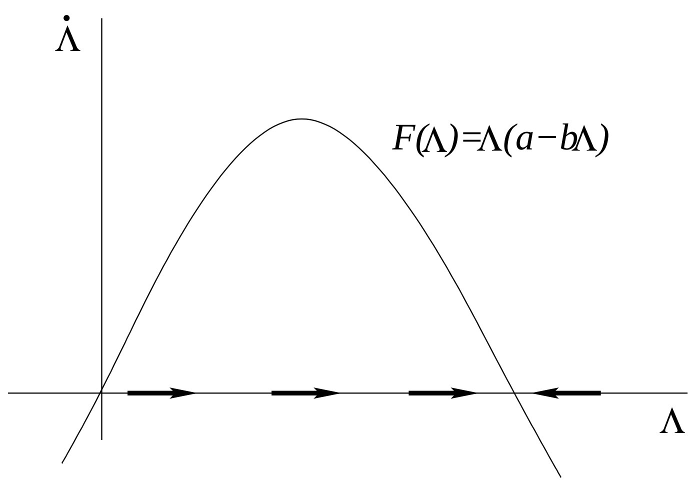
$$\begin{aligned} N(t+\Delta t) &= (1 - r\Delta t)N(t) + 2r\Delta t(N(t) + o(\Delta t) \\ &= N(t) + r\Delta t N(t) + o(\Delta t)\,. \end{aligned}$$

31. Page 107. The last line should refer to the top plot in Figure 4.7.

32. Page 109. The second line should refer to the middle plot in Figure 4.7.

33. Page 109. **Exercise 9** should refer to the bottom plot in Figure 4.7.

34. Page 111. Figure 4.8 should be:



35. Page 111. The third line from the bottom should refer to Figure 4.9.

36. Page 112. The vertical axis in Figure 4.9 should be labeled with Λ.

37. Page 112. The last equation should be:

$$\Lambda(t) = \frac{\Lambda_0 a e^{at}}{a - b\Lambda_0\,(1 - e^{at})}\,.$$

38. Page 113. The second line after the second equation should read: "Since $\Lambda = 0$ is not … "

39. Page 113. Labels of the horizontal and vertical axes in Figure 4.10 should be Λ and $F(\Lambda)$, respectively.

40. Page 113. The inline equation in the last line should be $\Lambda = \frac{a}{2b}$.

41. Page 114. The first equation should be

$$c = k\Lambda\,.$$

42. Page 114. The second equation should be

$$\begin{aligned}\dot{\Lambda} &= a\Lambda - b\Lambda^2 - k\Lambda \\ &= (a-k)\Lambda - b\Lambda^2\,,\end{aligned}$$

43. Page 114. The second and third lines after the second equation should contain $\Lambda = \frac{a-k}{b}$ and $\Lambda_\infty = \frac{a}{2b}$, respectively.

44. Page 114. The third equation should be

$$c_\infty = k\Lambda_\infty = \frac{a^2}{4b}\,,$$

45. Page 118. The fourth line from the top should refer to Figure 4.11.

46. Page 118. The dotted horizontal line in Figure 4.12 should correspond to the value of $n = \frac{1}{v_m}$.

47. Page 119. **EXERCISE 16**. The formula should be

$$n^{\frac{1}{\alpha-\omega}} \left|(\alpha-\omega) - \frac{\omega\beta\gamma}{\delta}n\right|^{\left(\frac{1}{\omega-\alpha}-\frac{1}{\omega}\right)} = Ke^t\,,$$

argue that n will approach an equilibrium only if

$$\alpha > \omega\,.$$

48. Page 144, **Exercise 2** (i) should have $\mathbf{F}=-\nabla U$.

49. Pages 148, 149, 153. Figures 5.5, 5.6 and 5.8 should have label x along the horizontal axes and $\dot{x}$ along the vertical ones.

50. Page 154. The sixth line from the bottom should refer to Figure 5.9.

51. Page 159. The second from the top trajectory in Figure 5.11 must have arrow pointing from left to right.

52. Page 164. To be consistent with the further discussion the top two lines and equation (5.32) should read:
We could hook it up to a geared motor that supplies a constant torque $ml\tau$:

$$ml^2\ddot{\theta} + mgl\sin\theta = ml\tau\,. \qquad (5.32)$$

53. Page 164. Figure 5.12 should have the label θ along the horizontal axis. The leftmost tick mark label should be $-\pi$, not π.

54. Page 166. The top equation should be

$$F_d \propto -|v|v\,.$$

This is to emphasize that the drag force always acts against the direction of motion.

55. Page 166. Equation (5.33) must be

$$\dot{E} = -\lambda v^2|v|\,. \qquad (5.33)$$

56. Page 175, Figure 5.17 (a). The vertical axis should be labelled as $|A|$, not A.

57. Page 175, Figure 5.17 (b). The vertical axis should be labelled as θ, not ϕ.

58. Page 175, Figure 5.18. The vertical axis should be labelled as y, not x.

59. Page 176. The last line should read "The profile ... ".

60. Page 179, Figure 5.20 (a). The vertical axis should be labelled as $|A|$, not A.

61. Page 179, Figure 5.20 (b). The vertical axis should be labelled as δ, not ϕ.

62. Page 186. The third line from the top should read " ... , this results ... ".

63. Page 186. The ninth line from the bottom should read " ... are used ... ".

64. Page 191, Figure 5.26. The middle label on the horizontal axis should be $\omega_0^2 = 1$.

65. Page 192. The second equation from the top should be

$$\left(\frac{\omega - 1}{2\lambda}\right)^2 + \left(\frac{3}{8}\frac{\beta A^2}{2\lambda}\right)^2 - \frac{3}{4}\frac{\beta A^2(\omega - 1)}{(2\lambda)^2} + 1 = \left(\frac{C}{2\lambda A}\right)^2$$

66. Page 192. The third equation from the top should be

$$X^2 - \frac{3}{4}\frac{\beta A^2}{2\lambda}X + \left(\frac{3}{8}\frac{\beta A^2}{2\lambda}\right)^2 = \left(\frac{C}{2\lambda A}\right)^2 - 1$$

67. Page 192. The fourth equation from the top should be

$$X = \frac{3}{64}\frac{\beta C^2}{\lambda^3}\left(\frac{2\lambda A}{C}\right)^2 \pm \sqrt{\left(\frac{C}{2\lambda A}\right)^2 - 1}\,, \quad \text{or}$$

$$\omega - 1 = \frac{3}{8}\beta A^2 \pm 2\lambda\sqrt{\left(\frac{C}{2\lambda A}\right)^2 - 1}\,.$$

68. Page 192. The fifth equation from the top should be

$$\omega - 1 = \pm 2\lambda\sqrt{\left(\frac{C}{2\lambda A}\right)^2 - 1}\,.$$

69. Page 192. The third line below the last equation should read " ... tilted toward the ω^2-axis ... ".

70. Page 193, Figure 5.27. The horizontal and vertical axes should be labelled as ω^2 and A, respectively.

71. Page 299. Equation (8.1) should be

$$l\ddot{\theta} = -g\sin\theta + \Upsilon/(ml)\,, \tag{8.1}$$

72. Page 300. The top two equations should be

$$\begin{aligned} l_1\ddot{\theta}_1 + g\sin\theta_1 &= \Upsilon_{21}/(m_1 l_1)\,, \\ l_2\ddot{\theta}_2 + g\sin\theta_2 &= \Upsilon_{12}/(m_2 l_2)\,, \end{aligned}$$

73. Page 301. The top equation should be

$$\Omega_j = k/(m_j l_j)$$

74. Page 301. The second line in the equation for the potential energy should be

$$= m_1 g l_1 (1 - \cos\theta_1) + m_2 g l_2 (1 - \cos\theta_2) + \frac{k}{2}(\theta_2 - \theta_1)^2$$

75. Page 301. The second line in the equation for the kinetic energy should be

$$= \frac{1}{2} m_1 l_1^2 \dot{\theta}_1^2 + \frac{1}{2} m_2 l_2^2 \dot{\theta}_2^2 \,.$$

76. Page 311. Equations (8.14) and (8.15) should be

$$\begin{aligned} (-m\omega^2 + 2k)C_1 - kC_2 &= 0\,, \\ -kC_1 + (-m\omega^2 + k)C_2 &= 0\,. \end{aligned}$$

77. Page 309. The last equation in the bottom of the page should be

$$T = \frac{1}{2} m \dot{y}_1^2 + \frac{1}{2} m \dot{y}_2^2 \,.$$

78. Page 311. The characteristic equation should be:

$$\text{determinant } = \omega^4 - 3\omega_0^2 \omega^2 + \omega_0^4 \,,$$

79. Page 346. As $\bar{d} > 0$ and numbering is started from the leading car the definition should be $\bar{d} = x_{n-1}(0) - x_n$ and then

$$\begin{aligned} d_n(t) = x_{n-1}(t) - x_n(t) &= \bar{d} + \int_0^t [u_{n-1}(s) - u_n(s)]\, ds \\ &= \bar{d} + \frac{1}{\lambda} \int_0^t \dot{u}_n(s+\tau)\, ds \\ &= \bar{d} + \frac{1}{\lambda}\, u_n(s+\tau)\big|_0^t \\ &= \bar{d} + \frac{1}{\lambda} u_n(t+\tau) - \frac{1}{\lambda} u_n(t)\,. \end{aligned}$$

80. Page 347. The equation above (9.3) should be

$$d_2(t') = \bar{d} - 0 - \bar{U}/\lambda \,.$$

81. Page 351. The first equation should be

$$x_p = e^{i(\omega t + p\phi)} \,.$$

82. Page 352. The second equation from the top should be

$$c_n = \frac{\lambda_n}{T_n} = \frac{(N/n)d}{2\pi/\left(2\omega_0 \sin\frac{n\pi}{N}\right)}, \quad n = 1, \dots, \frac{N}{2}$$

83. Page 355. In all equations on this page the complex exponential function $e^i \omega t$ should be replaced with $\cos \omega t$.

84. Page 356. The third line should be "In other words, $A_N \approx e^{-\gamma} C \dots$ "