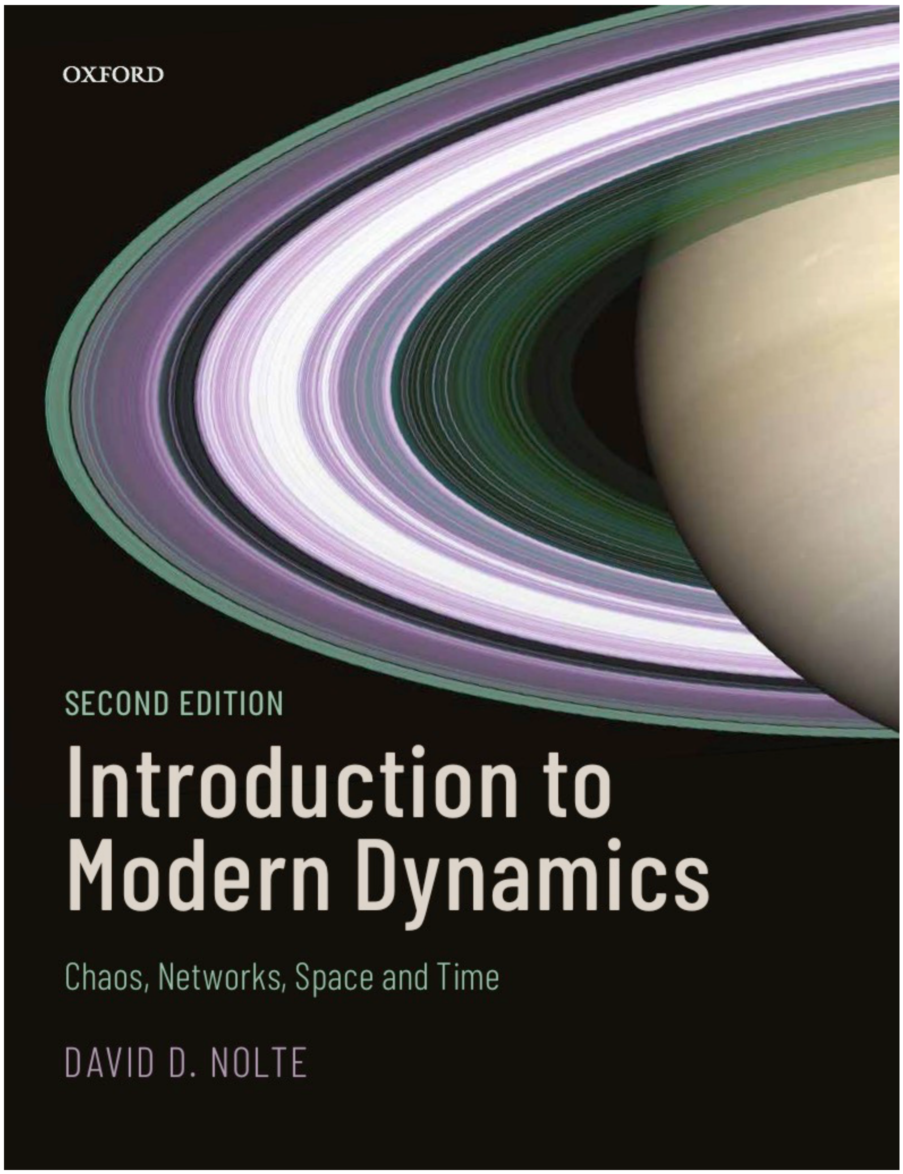
2019

Notes and Corrections to IMD2.pdf

Notes and Corrections to IMD2: Introduction to Modern Dynamics (2nd Edition)



Cover of IMD2

Chapter 1. Physics and Geometry

• pg. 27 Eq. 195 The second equation should have a minus sign in front of ω_z

$$\frac{d\hat{e}_y}{dt} = -\omega_z \hat{e}_x + \omega_x \hat{e}_z$$

• pg 34 Eq. 1.135 the last term on the second row should be yz

• pg. 34 Eq. 1.137 There should be a minus sign on the upper right term in the inertia tensor matrix.

$$I_{ab} = \begin{pmatrix} \int_V (y^2+z^2)\rho(\vec{r})dxdydz & -\int_V xy\rho(\vec{r})dxdydz & -\int_V xz\rho(\vec{r})dxdydz \\ -\int_V xy\rho(\vec{r})dxdydz & \int_V (x^2+z^2)\rho(\vec{r})dxdydz & -\int_V yz\rho(\vec{r})dxdydz \\ -\int_V xz\rho(\vec{r})dxdydz & -\int_V yz\rho(\vec{r})dxdydz & \int_V (x^2+y^2)\rho(\vec{r})dxdydz \end{pmatrix}$$

• pg. 37 Eq. 1.148 The components of the displacement should be squared

$$\sum_k a_k^2 = a^2$$

• pg. 47 Eq. 1.192 is solving for the magnitude $|\omega_\perp|$. There is a 90° phase shift between the torque and the transverse angular velocity.

Chapter 2. Lagrangian Mechanics

• pg. 59 Eq. 2.32 The second line should read

$$L = \frac{I_1}{2}\left(\dot{\phi}\sin\theta\sin\psi + \dot{\theta}\cos\psi\right)^2 + \frac{I_1}{2}\left(\dot{\phi}\sin\theta\cos\psi - \dot{\theta}\sin\psi\right)^2 + \frac{I_3}{2}\left(\dot{\phi}\cos\theta + \dot{\psi}\right)^2 - Mgd\cos\theta$$

• pg. 60

Eq. 2.33 top equation should read

$$\frac{\partial L}{\partial \theta} = \left(I_1 - I_3\right)\dot{\phi}^2 \cos\theta \sin\theta - \left(I_3 \dot{\psi}\dot{\phi} - Mgd\right)\sin\theta$$

Eq. 2.34 The top line should read

$$p_\theta = \frac{\partial L}{\partial \dot{\theta}} = I_1 \dot{\theta}$$

• pg. 61 The condition on θ for Eq. 2.42 is cosθ = 0

• pg. 65 Eq. 2.59 The potential should be V = -mgy (because y is increasing downward). The sign is correct in the Lagrangian.

• pg. 72 Eq. 2.98 The gravitation potential energy should be un-italic as

$$V(r) = -\frac{GMm}{r}$$

• pg. 77 Eq. 2.112 The v_ϕ is a linear velocity equal to $r\dot{\phi}$.

Chapter 3. Hamiltonian Mechanics

• pg. 88 Example 3.2: The Lagrangian is missing a square on the $\dot{\phi}$.

• pg. 98 Example 3.5: The Hamiltonian is expressed in terms of the conjugate momentum as

$$H = \frac{J^2}{2I}$$

When re-expressing the energy in terms of J and ω, the energy is

$$E = \frac{1}{2}\omega J$$

Note that applying Hamilton's equations to the first expression yields the correct angular frequency ω, but not for the second. Hamilton's equations, because of the partial derivatives, must be applied to the correct form of the Hamiltonian that emerges from the Legendre transform of the Lagrangian. The second equation is useful for solving adiabatic invariance problems, but not for using Hamilton's equations.

• pg. 101 Top equation is missing a 2 and should be

$$J = \frac{2}{\pi} \int_0^{\phi_{max}} L\, d\phi$$

because the integral is over only one-quarter of the orbit.

Chapter 4. Nonlinear Dynamics and Chaos

• pg. 128 Eq. 4.46 should be

$$\dot{u} = \mu\omega_0 u\left[1 - \frac{\beta^2}{2}\left(u^2 + v^2\right)\right]$$
$$\dot{v} = \mu\omega_0 v\left[1 - \frac{\beta^2}{2}\left(u^2 + v^2\right)\right]$$

• pg. 130 Example 4.4: The limits of integration for the integral over dr is from r_0 to r_1. The limit of integration over time is from t = 0 to t = T = 2π.

• pg. 136 - 137 The Feigenbaum number δ is given by the inverse of the ratio of intervals

$$\delta = \lim_{n\to\infty} \frac{S_{n+1} - S_n}{S_{n+2} - S_{n+1}}$$

• pg. 150 HW Problem 4.3d: There should be a “dot” over the “y” for the second equation.

• pg. 153 HW 4.24. The equations should be

$$\dot{x} = y$$
$$\dot{y} = b\sin z - \mu y\left(x^2 - a\right) - x$$
$$\dot{z} = 1$$

• pg. 153 HW 4.28. The equations should be

$$\dot{x} = \alpha\left(y - x - h(x)\right)$$
$$\dot{y} = x - y + z$$
$$\dot{z} = -\beta y$$

Chapter 5. Hamiltonian Chaos

• pg. 154 The figure is NOT the human protein interactome! It is a Hamiltonian tapestry.

• pg. 157 In Eq. 5.4 the argument I should be $\mathcal{J}$.

• pg. 167 In Fig. 5.10, the parameter C = 0.01 is the parameter K of Eq. 5.21. Also, in Fig. 5.11, the parameter ε is also the parameter K. The threshold for the dissolution of the last open orbit is K = 0.97.

Chapter 6. Coupled Oscillators and Synchronization

Chapter 7. Network Dynamics

• pg. 217 Eq. 7.33. The sum is over all links, so there are not self-connections. Thus:

A population of N phase oscillators can be coupled globally described by the flow

$$\frac{d\phi_k}{dt} = \omega_k + g\frac{1}{N-1}\sum_{j\neq k}^{N}\sin\left(\phi_j - \phi_k\right) \qquad (7.33)$$

in which the coupling constant g is the same for all pairs of oscillators.

• pg. 228 Fig. 7.14. The equation should be $S = 1 - \exp\left(-\langle k\rangle S\right)$.

• pg. 237 Eq. 7.71 The minus in front of the "mu" should be plus on the second line

$$\frac{dr}{dt} = \mu i - \nu r$$

Chapter 8. Evolutionary Dynamics

• pg. 244 The equations should read

$$\dot{x} = x\left(3 - x - 2y\right)$$
$$\dot{y} = y\left(2 - x - y\right)$$

Chapter 9. Neurodynamics and Neural Networks

Chapter 10. Economic Dynamics

Chapter 11. Metric Spaces and Geodesic Motion

Chapter 12. Relativistic Dynamics

• pg. 389 These Lorentz transformations suffered catastrophic failure during the typesetting and proofing process at the publisher. The correct Lorentz transformations are

Lorentz Transformations (12.3)

$$\begin{aligned} t' &= \gamma\left(t - \frac{v}{c^2}x\right) & t &= \gamma\left(t' + \frac{v}{c^2}x'\right) \\ x' &= \gamma\left(x - vt\right) & x &= \gamma\left(x' + vt'\right) \\ y' &= y & y &= y' \\ z' &= z & z &= z' \end{aligned}$$

• pg. 421 For Eq. 12.119 there is a missing equals sign. The equations should read

$$\begin{aligned} u^0 + u^1 &= c\exp\left(\frac{g\tau}{c}\right) \\ u^0 - u^1 &= c\exp\left(-\frac{g\tau}{c}\right) \end{aligned} \qquad (12.119)$$

Chapter 13. The General Theory of Relativity and Gravitation

Appendix.