

The Princeton Companion to Applied Mathematics

Edited by Nicholas J. Higham

PRINCETON UNIVERSITY PRESS 2015, 1016 PAGES
PRICE (HARDBACK) £69.95 ISBN 978-0-691-15039-0

This collection of almost 200 authoritative, but accessible, articles on applied mathematics (spread over a thousand or so pages) is arranged thematically with the following themes:

- Part I Introduction to Applied Mathematics
- Part II Concepts
- Part III Equations, Laws, and Functions of Applied Mathematics
- Part IV Areas of Applied Mathematics
- Part V Modeling
- Part VI Example Problems
- Part VII Application Areas
- Part VIII Final Perspectives

In the Preface the editor, Professor Higham (Richardson Professor of Applied Mathematics, University of Manchester), writes ‘*The Companion* differs from an encyclopedia in that it is not an exhaustive treatment of the subject, and it differs from a handbook in that it does not cover all relevant methods and techniques.’ It does however provide a flavour of a wide range of applied mathematics including such aspects as how to read and write it in addition to descriptions of the mathematics itself.

The target audience is stated to be mathematicians at undergraduate level or above; students, researchers, and professionals in other subjects who use mathematics; and mathematically interested lay readers. In other words the background knowledge required to understand the articles varies considerably from article to article! There are some articles easily understandable to sixth-form students (for example, Part VI.2 Bubbles, by Andrea Prosperetti; Part VI.6 The Flight of a Golf Ball, by Douglas N. Arnold) and some where a mathematically interested lay reader might struggle without suitable background knowledge (for example, Part IV.13 Numerical Solution of Partial Differential Equations, by Endre Süli; Part IV.29 Magnetohydrodynamics by David W. Hughes).

I was pleased to see there are plenty of diagrams throughout the book; most of these are monochrome, but there is a centrally placed collection of 23 colour plates.

I can’t claim to have read all the articles in *The Companion* (yet!), but here are a few that I stopped to read as I flicked through the pages (I’ll list one from each theme).

Part I.6 The History of Applied Mathematics, by June Barrow-Green and Reinhard Siegmund-Schultze. This is probably the longest article in the book (about 25 pages), but is easy

to read and accessible to all.

Part II.21 Invariants and Conservation Laws, by Mark R. Dennis. I like this because it explained Noether’s theorem in a way I could understand!

Part III.17 The Lambert W Function, by Robert M. Corless and David J. Jeffrey. This implicit elementary function seems strange when one first comes across it, but the authors clarify it nicely here.

Part IV.7 Special Functions, by Nico M. Temme. This covers a raft of interesting functions used by applied mathematicians, physicists, engineers and statisticians. It includes Bernoulli numbers, Euler numbers, Stirling numbers, the Gamma function, the Gauss Hypergeometric function, Bessel functions, Legendre functions and others.

Part V.5 Mathematical Physiology, by Anita T. Layton. An application far from my area of expertise, but with a surprisingly familiar set of equations!

Part VI.5 Insect Flight, by Z. Jane Wang. I was attracted by a couple of the section titles; namely: ‘How Do Insects Fly?’ and ‘How Do Insects Turn?’

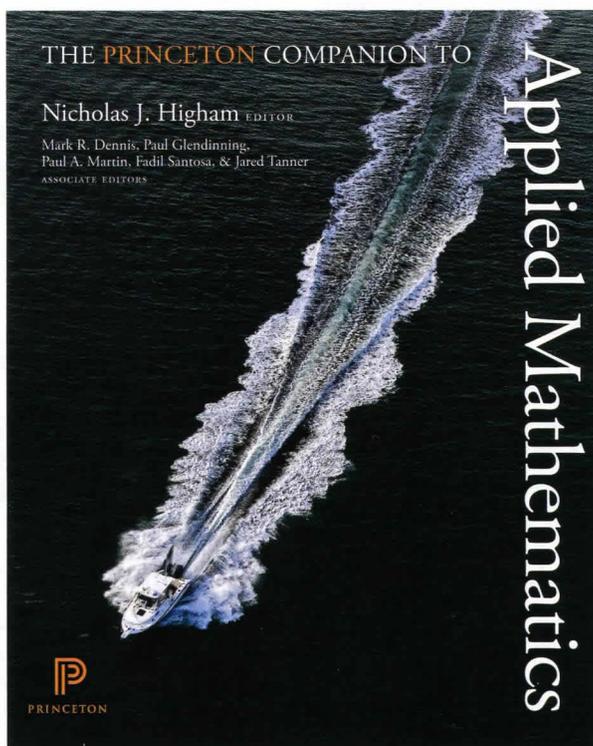
Part VII.10 Compressed Sensing, by Yonina C. Eldar. A relatively young topic I think I should know more about.

Part VIII.3 How to Write a General Interest Mathematics Book, by Ian Stewart. Who could possibly resist such an article from Ian Stewart?!

The readers of this magazine are likely to be interested in many of the articles in *The Companion*. There are too many individual topics to list here, but a pdf file of the Contents may be downloaded from: <http://press.princeton.edu/titles/10592.html>. Files containing the Preface and a list of the contributors may also be downloaded from the same site.

Safe to say there is something for everyone in *The Princeton Companion to Applied Mathematics*.

Alan Stevens CMath FIMA



IMA Website Book Reviews

Book reviews published here are also put on the IMA website, <http://tinyurl.com/IMArevs>. Some reviews will be posted directly onto the website and noted here. These reviews will be available on the IMA website from December:

Professor Stewart’s Casebook of Mathematical Mysteries by Ian Stewart (Profile Books Ltd 2014, ISBN 978-1-846-68347-3). Reviewed by **Francis McGonigal CMath MIMA**.

Advanced General Relativity: Gravity Waves, Spinning Particles, and Black Holes by Claude Barrabès and Peter A Hogan (OUP 2013, ISBN 978-0-199-68069-6). Reviewed by **John Bartlett CMath MIMA**.