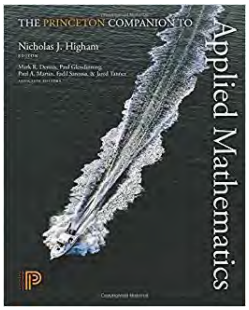
The Princeton Companion to Applied Mathematics

by Nichloas J. Higham (editor), Princeton University Press, 2015,
£77, US$ 99.50, ISBN: 978-0691150390

Review by David I Graham



The first question that comes to mind when reviewing a book like this is "Why?" A Google search for "Applied Mathematics" finds 382 million pages related to the subject, many of which will be very detailed and with access to animations and relevant computer code as well as links to related work. The editors are, of course, well aware of this and try to answer the question themselves. In the Preface they claim that the distinguishing feature of the book is that it is "self-contained, structured reference work giving a consistent treatment of the subject".

The book is in eight parts and runs to almost 1000 pages. There is certainly a serious attempt to be self-contained, with the first part containing the longest articles in the book, defining basic language and terms from coordinate systems through calculus up to operators and stability. The second part then briefly reminds the reader of essential concepts from asymptotics to wave phenomena. These are arranged in alphabetical order, occasionally meaning that there is no natural flow from one contribution to the next. The structure becomes more free-form as we get further into the book. This is inevitable given the great variety in topics covered. With over 160 authors contributing to the articles, consistency was always going to be difficult to achieve and there is considerable variation in the later parts, especially in the level of detail and follow-up information. One contribution in Part V has a reference list of one item, namely a book written by the contributor himself. Conversely, the exemplary contribution on financial mathematics in Part V provides not only an excellent reference list but also a discussion of what to look for in each of the references. Overall, the reference lists seem to be generally good. In terms of self-containedness, some of the contributions in the later parts require prior knowledge not fully detailed in the introductory parts, though more detailed investigations utilising the reference lists should mean an interested reader would be able to fill the gaps.

Returning to the material covered, Part IV is really the heart of the book. It describes in considerable detail (over 400 pages), forty "Areas of Applied Mathematics" including straightforward choices such as various flavours of mechanics, differential equations and numerical methods but also less obvious areas such as algebraic geometry. There is a very readable contribution on "Symmetry in Applied Mathematics", which starts from the symmetries of plane figures and goes as far as symmetry breaking, with much discussion related to the various symmetries seen in Taylor–Couette fluid flow between co-rotating cylinders. The author confesses that the article "barely scratches the surface". A typical example for this part is the ten page contribution on "Fluid Dynamics", which rattles along at great pace, covering everything from 2-dimensional streamlines through flight aerodynamics up to flow instability — enough material to fill a decent course module. Similarly, the nineteen page contribution on "Numerical Linear Algebra and Matrix Analysis" is a comprehensive collection of the main results relating to matrix computations and notes some useful 'must have' references. I have to confess that some of the other contributions are rather dry for my taste, though the articles generally represent excellent starting points for further investigation — which is one of the great strengths of the book as a resource.

Parts V ("Modelling"), VI ("Example Problems") and VII ("Application Areas") together give us 64 different examples, averaging at around five pages in length. Several of these — including a contribution on "Sport" that strangely covers only sailing, rowing and swim-

ming — are related to fluid dynamics, meaning that there is some repetition between articles. The article on "A Symmetric Framework with Many Applications" outlines a nice example of a unifying viewpoint for minimisation problems of various kinds. As a computational applied mathematician, I welcomed the contributions in Part VII related to historical developments in programming languages (and the confusion to which different conventions can lead) and the future in terms of high-performance computing.

A particularly interesting feature of the book is the last Part (VIII), which offers some "Final Perspectives". I found many of these contributions to be extremely thoughtful and useful, including advice on how to read Mathematics articles or to write articles or even general interest books. As an author of reasonably large fortran codes myself, I found the sections on "Reproducible Research" and "Experimental Mathematics" to be especially thought-provoking.

My final thoughts are that this book is an excellent resource for any mathematics departmental library. The articles cover a vast array of different application of mathematics and are generally well-written with useful reference lists. In particular, the book represents an excellent launch point for individuals such as project students looking for an area of Applied Mathematics to investigate in greater depth.

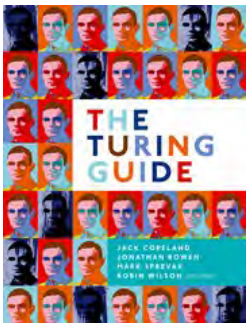
David Graham

David is a Senior Lecturer in Applied Mathematics at the University of Plymouth. His main research interests are in developing and using numerical methods for fluid dynamics. David is a keen footballer and, in decreasing order of competence he also plays guitar, banjo, ukulele and bouzouki.

The Turing Guide

by Jack Copeland, Jonathan Bowen, Mark Sprevak and Robin Wilson,
Oxford University Press, 2017, £19.99, US$ 29.95, ISBN: 978-0198747833

Review by David Glass



For several decades after his tragic and untimely death in 1954 at the age of just 41, very little was known about Alan Turing's important work at Bletchley Park during the second world war. However, as the full scale of his achievements in codebreaking and the relevance of the wartime effort to the history of computing became clearer, Turing's reputation has increased dramatically. By providing a very wide-ranging and yet accessible account of Turing's life and work, *The Turing Guide* is an excellent contribution to this development and the growing literature on Turing.

The book consists of forty-two chapters divided into eight sections, with the first section providing biographical material. The first chapter provides a brief sketch of Turing's life, with a helpful timeline of key events, while in the second chapter, entitled 'The man with the terrible trousers', Turing's nephew, Sir John Dermot Turing, provides a unique family perspective. The third chapter is a compilation of extracts from papers and reminiscences of the late Peter Hilton, who worked with Turing for the last 12 years of Turing's life. According to Hilton, Turing was