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BOOK REVIEWS

Environmental Hydraulics of Open Channel Flows. By HUBERT CHANSON. Elsevier, 2004. 430 pp. ISBN 0 7506 6165 8. £44.99 or $76.95 (paperback).

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Over recent decades many civil engineering departments and organisations have added environmental to their title, so it is not surprising to find this change emulated in a book. The author has already published an introductory text on open channel flow (Chanson 2004), which covers some of the same topics. After the introductory material in part 1, the present book's orientation is shown by over one third of the book being taken up by part 2 on "Turbulent mixing and dispersion in rivers and estuaries". The dominance of this part seems appropriate given the demand on many waterways to absorb heat and other effluents. Many aspects of the topic are covered, including that of reactive contaminants.

Part 3 is a substantial introduction to unsteady flows in channels with less obvious environmental connections, appearing to cover only a little more than the author's introductory text. It does give the author a chance to discuss one of his favourite topics: tidal bores.

Interaction between flowing water and its surroundings is the topic of the final part 4. This includes a relatively brief discussion of sediment transport, a topic given more space in Chanson (2004), and a much fuller account of flow aeration. Given the author's many contributions in the latter area, and the importance of dissolved oxygen concentration to the health of any waterway, this emphasis is appropriate.

Throughout the book the author's enthusiasm for his subject shows. The preface stresses the value of field work and points the reader to the author's substantial web sites, among others. Many photographs are included, though their reproduction is with disappointingly low contrast. Brief historical notes and other remarks are set off from the main text, and plenty of diagrams help the reader. Many of the exercises refer to specific locations, using physical quantities that, I presume, are realistic. On the other hand, many topics are treated rather briefly, with some formulae simply quoted. This is balanced by extensive quoting of source references, leading to a 14 page list of references. There are some typographic errors, but the typography and style encourage reading.

Overall, the book lives up to its title. It forms a good introduction for an advanced undergraduate, or graduate student, and a guide to further information for practitioners.

REFERENCES

CHANSON, H. 2004 *The Hydraulics of Open Channel Flow: An Introduction*, 2nd Edn. Butterworth-Heinemann (Elsevier), 650pp.

D. H. PEREGRINE

Finite Elements and Fast Iterative Solvers: with Applications in Incompressible Fluid Dynamics. By H. C. Elman, D. J. Silvester & A. J. Wathen. Oxford University Press, 2005. 413 pp. ISBN 019 852867 1, £70.00 (hardback) or ISBN 019 852868-X, £35.00 (paperback)

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To describe this book in cooking parlance, you have set before you three tried and tested ingredients – finite elements, iterative solvers, and incompressible fluid dynamics. You are then invited to cook up something new and exciting and maybe even spicy. The authors realize that the readers will have very different palettes – some having digested a large quantity of only one or two of these ingredients whilst other may have been more familiar with a lighter quantity of all three. Then there are, of course, the relative novices who will have not tried any of the components and so want to know what each is about and how they can be combined. The challenge set before the authors of "Finite Elements and Fast Iterative Solvers: with Applications in Incompressible Fluid Dynamics" was to make a meal suitable for all of these palettes, and these reviewers believe they have done a pretty good job.

It is sometimes possible to get a feel for a book if you know a bit about the authors. A quick web search will tell you that these authors include a computer scientist and two mathematicians interested in numerical analysis. The next, incorrect, assumption one might make is that the mathematical bias of the authors will lead to a very theoretical text heavy on proofs and convergence analysis and light on colourful figures. There are definitely quite a few proofs, and the figures are not overly prevalent; however the authors have succeeded in writing a book from which one can learn about the practical details of finite elements (i.e. defining basis functions and elemental mappings, detailing how to accomplish elemental assembly) and also get a taste of the theory which underpins the finite element method. The authors' method of striking the balance is achieved in three ways: firstly by organizing the material so that in most cases a chapter consists of 'practical' and then 'theoretical' considerations; secondly by organizing the book so that both practical and theoretical discussions build as you progress through the chapters. Finally they have provided a Matlab library with which the reader can interact to flesh out details not explicitly mentioned in the book (or potentially deemed obvious to the authors).

The approximately four hundred page book can be divided into two major parts. After a brief introduction to the Navier–Stokes equations in Chapter 0 (note the mathematicians' numbering), the book begins with a collection of four chapters designed to lead a reader through a comprehensive overview of the mathematical, numerical and computational aspects of applying the finite element method to the Poisson, diffusion and advection–diffusion equations. The solution of these problems is also supported by discussion of the most commonly used iterative solvers such as GMRES, conjugate gradient and multigrid methods. The second half of the book, starting at Chapter 5, provides a more research-oriented discussion of the theoretical literature of the numerical solution of the Stokes and Navier–Stokes equations using the finite element method. In addition we found that the discussion of the 'theory of errors' to be well constructed and therefore useful in providing both students and practitioners with a foundation of error analysis. From a practical point of view this discussion helps the reader to appreciate what to expect (and not to expect) from finite element solutions.

The implementation details and fundamental theory are supported by a series of problems as well as computational exercises at the end of every chapter. This is then also augmented with Matlab code which must be downloaded via the Internet. As with almost all well-written Matlab code, understanding the details can be quite tricky at times. Users familiar with taking advantage of the abstraction of Matlab's functionality are not likely to have many problems. However using the library may take a little familiarization as the Matlab code is not explicitly discussed in the text.

The relative sparsity of figures and diagrams can give the impression that this is a very theoretical book and this will probably scare most undergraduate students. Nevertheless the authors' intended audience is at the level of graduate students and researchers, and we believe that the text offers a valuable contribution to all finite element researchers who would like to broadened both their fundamental and applied knowledge of the field.

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