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REVIEWS

Simulating Nearshore Environments. By P. A. MARTINEZ and J. W. HARBAUGH. Pergamon Press, 1993. 265 pp. £65 or $105.

This book is concerned with the mathematical modelling of sediment transport under the action of waves and currents and, in particular, with a numerical model developed at Stanford University with the support of a consortium of petroleum companies and computer vendors.

The first two chapters give a general outline of the way in which the model works, the assumptions on which it relies and physical features of nearshore environments such as bars, spits and deltas. Chapter three deals with wave and current mechanics. The basic equations are derived and, after a brief discussion of topics such as refraction, shoaling and radiation stress, the way in which the equations are modelled numerically is explained. Sediment transport mechanics are covered in chapter four. First of all there is a brief review of previous work in this field and then the implementation of the various equations on the model is outlined. The last three chapters are mainly concerned with applications of the model to various physical situations. The way in which the model handles grain size sorting and erosion and deposition is illustrated in chapter five. Longshore sediment transport on real beaches is considered in chapter six, and chapter seven deals with the interaction of wave-induced longshore transport with fluvial outflows from a delta.

The book is well written and the many diagrams and colour plates are useful and instructive. However, it is clearly aimed at those with lower mathematical ability than that of most JFM readers. There is little mathematics outside chapter 3 and even there the theory is kept to a basic level.

There are two other points on which JFM readers might have reservations. The first is that, as already mentioned, this book is mainly about a particular mathematical model rather than mathematical models in general. Although this limits its generality, the overall structure of this sort of mathematical model, and its advantages and weaknesses, do come across very clearly. The second is that some of the components of the present model are rather elementary. This is the result of limited computer resources – big models require a lot of computer time. However, the individual components of the model are clearly described and so it should be relatively easy to improve the modelling in particular areas if that were considered desirable.

In conclusion, this is an interesting book which will be particularly valuable to those who are new to this area. Even experts will find something to stir their imagination or their competitive instincts.

Mathematical Methods in Fluid Mechanics. By M. FEISTAUER. Longman/Wiley, 1993. 657 pp.

The above title suggest that this book is a survey of those methods which are most widely used throughout fluid mechanics. In fact, much of the book is taken up with the study of numerical methods, and some commonly used analytical techniques, such as asymptotic expansions, receive very little attention. Most of the applications discussed by the author are related to the problem of modelling flow in turbomachinery, although the theory is far more widely applicable.

The book is written in the 'theorem–proof' style, and some familiarity with real and complex analysis is assumed. Some proofs use results from functional analysis, which are summarized in an appendix. The questions addressed are those of interest to the analyst. Do solutions exist? If so, are they unique and regular? Which numerical methods are stable? There is no analysis of the stability of solutions, but reference is made to the introductory literature on that topic.

The author aims to provide a 'mathematically precise, but accessible' account of fundamental problems in fluid dynamics. Precision is certainly achieved; all assumptions and definitions are stated very carefully and clearly. The proofs are generally easy to follow, and some difficult or lengthy proofs are omitted. There is a good balance between analysis of the equations of motion and analysis of the (many) schemes which are used to compute the flow. These features do indeed make this book easier to understand than some earlier works. However, the author's stated objective is to communicate to engineers, chemists, physicists and other students of the physical sciences. I cannot help feeling that the wealth of mathematical detail will be off-putting to many such scientists.

The book begins with a derivation of the governing equations, which is followed by a chapter on inviscid irrotational incompressible flow. Most of the rest of the book is devoted to invisid compressible flow in the subsonic, transonic and supersonic regimes. The flow past a sharp trailing edge is given a detailed treatment. Viscous effects are described at the end of the book. On the whole, attention is restricted to two-dimensional or axisymmetric flows, although some of the theorems apply equally to flows which are fully three-dimensional.

The text is well written, generally speaking. There are places where the author makes assertions without giving much explanation, but a fuller explanation can be found in the cited literature. The list of references is extensive: there are over 400 citations. Interestingly, there is no reference to any work that has appeared in this journal.

An error is made in the definition of the Froude number, which is written as $Fr = U^2/L$, where U and L are typical velocity and length scales respectively. Clearly, the above quantity is not dimensionless. The correct definition is $Fr = U^2/gL$ (or more commonly $Fr = U/(gL)^{1/2}$), where g is the acceleration due to gravity.

This book is not perfect; nevertheless, I warmly recommend it to those who are involved in CFD or numerical analysis, and to other mathematicians who wish to see some practical applications of functional analysis. It will also be of benefit to anyone involved in fluid mechanics research who wishes to understand the rigorous analytical approach to the subject.

P. HYDON

SHORTER NOTICES

Histoire de l'Hydraulique. Tome 2. L'Eau Demontrée. By M. NORDON. Masson, 1992. 242 pp. ISBN 2-225-83936-0.

This is a semi-popular descriptive history in which equations and formulas are confined to the frequent footnotes and the substantial appendices to each chapter. The book commences with Léonardo da Vinci and the contributions of the Arabs, including transmission of classical knowledge to Europe. This chronological approach is modified in succeeding chapters which follow the development of some important themes, such as hydrostatics and the barometer, flow in pipes, fluid resistance, viscous effects, boundary layers and turbulence. Free-surface flows are also well represented. The concluding chapter gives an overview of chaos and the debate about its relevance to turbulence.

A Course on Nonlinear Waves. By S. S. SHEN. Kluwer Academic, 1993. 327 pp. ISBN 0-7923-2292-4. Dfl. 210 or £84.00.

Although this book contains full chapters on water waves and on flow instabilities, its main thrust is a mathematical presentation of the many recent developments in nonlinear waves over the last three decades. Discussion of the Korteweg–de Vries equation is preceded by chapters on asymptotic expansion and on hyperbolic waves. Unlike some other books of this type it quickly moves on past the inverse-scattering method to a discussion of the forced KdV equation. The Sine-Gordon equation and nonlinear Schrödinger equation are introduced with physical examples, but mathematical discussion is confined to their simpler solutions with no detail of their solution by inverse-scattering. The final topics are wave–wave interactions and X-ray crystallography. A number of mathematical programs are included in the text and appendices. One appendix includes 19 pages of explicit formulas for some very special cases of multi-soliton KdV solutions.

Entropy and Partial Differential Equations. By W. A. DAY. Longman, 1993. 108 pp. £22.

This short monograph brings together a number of results obtained by the author on the character of certain integral forms that have connections with the thermodynamical function of state called entropy. The ideas are developed for the partial differential equation that describes pure conduction of heat through non-deformable bodies in the presence of sources of thermal energy. Mathematical constraints on the dependent variable are largely motivated by the physics of such problems. For a given domain and its boundary certain integrals of the temperature function and its gradient can be recognized as components in an entropy-balance relation; the latter states that the rate of entropy supplied by the heat sources plus the rate of irreversible generation of entropy within the domain is equal to the flux of entropy across the boundary plus the rate of accumulation of entropy within the domain. Bounds for these various quantities are derived by the use of purely mathematical arguments and the monograph draws a number of useful conclusions of a thermodynamical character from these discussions.

Since the work is restricted to non-deformable bodies it is not of immediate interest to readers of JFM. However, it may be interesting to try to combine some of the author's ideas with the general topic of irreversible thermodynamics to see if similar characterizations of entropy can be derived for flowing systems within which there can be a wider range of transport phenomena.