J. Fluid Mech. (1994), vol. 269, pp. 373–375

REVIEWS

Turbulence in Open-Channel Flows. By I. NEZU and H. NAKAGAWA. Balkema, 1993. 286 pp. $85 or £55.

This is one of the series of monographs issued by the International Association for Hydraulic Research. The authors are well known for their work on open-channel flows at Kyoto University: however the book is not a compendium of research papers, but a balanced account of the subject. Although a good deal of the quantitative information is applicable only to open-channel flows, the book is a useful introduction to turbulence in general and could be read with profit by students and research workers in most branches of fluid mechanics.

Part 1 of the book is called 'Statistical structures of turbulence'. A short introduction reminds one that the first satisfactory turbulence measurements in open-channel flows were not made until the 1960s, with the advent of the hot-film anemometer. Chapter 2 introduces the equations of motion and standard material like the law of the wall for smooth and rough surfaces. Wavenumber spectra are introduced rather abruptly, which may deter non-mathematical readers. Chapter 3 is a useful summary of turbulence measurement techniques, concentrating on the hot-film and laser-Doppler anemometers. Chapter 4 treats two-dimensional open-channel flows in detail, with plenty of experimental data. Chapters 2 and 4 also contain some empirical correlations for turbulence quantities, which may be useful to engineers but which are misleadingly referred to as 'laws'. Chapter 5 discusses three-dimensional flows. Secondary flows of Prandtl's first kind (generated in curved channels) are omitted, on the slightly curious argument that secondary flows of the second kind (generated by Reynolds-stress gradients) require a more accurate turbulence model. Chapter 6 is a general discussion of turbulence modelling, to which Professor Wolfgang Rodi of Karlsruhe contributed.

Part 2 is called 'Coherent structures in open-channel flows', and chapter 7 is a short introduction. Chapter 8 treats 'bursting', with particular reference to the inner layer on rough or smooth surfaces. Conditional-sampling techniques are discussed in detail, and there are many well-chosen flow-visualization photographs and line drawings of eddy structure. Unfortunately S. K. Robinson's review of coherent motions in the turbulent boundary layer (*Ann. Rev. Fluid Mech.* vol. 23, 1992, pp. 601–639) was evidently too late to be referenced. Chapters 9 and 10 deal specifically with structures in open-channel flows, with particular reference to 'boils' – regions of horizontal divergence that occur when a large upward-moving eddy meets the free surface. Again the line drawings and photographs are very helpful. Chapter 11 introduces numerical simulations. Apparently the first simulation of a free-surface flow (at zero Froude number) was that of Handler *et al.*, now published in *AIAA J.* vol. 31, 1993, pp. 1998–2007, which was again too late to make the book. The final chapter deals with sediment transport by coherent structures. The authors comment that our state of knowledge of sediment physics is relatively primitive in spite of an enormous amount of research, and they attribute this to a lack of data on turbulence in open-channel flows.

This is apparently the first full-length book to deal with the important subject of turbulent open-channel flows. It is well written and well produced, and in particular it makes excellent use of graphics. It will be found useful both by practising hydraulic engineers and by students.

P. BRADSHAW

Kalman Filter Method in the Analysis of Vibrations Due to Water Waves. By P. WILDE and A. KOZAKIEWICZ. World Scientific, 1993. 173 pp.

The fluid-dynamical part of this book consists of an experimental determination of the way in which a cylinder, immersed in a water tank, responds to the influence of water waves. For example, in one experiment a cylinder of length 40 cm and diameter 6 cm was suspended horizontally at various distances from the bottom in water of depth 60 cm, and the quantities estimated included the coefficients of added mass and of added moment of inertia. In another experiment, a heavy weight was attached to the top of a light flexible vertical column, and the lower part of the column immersed in water; the aim was to determine the loads on the cylinder in response to the waves, with particular attention to the irregular transverse forces due to vortex shedding.

Only a small proportion of the book deals directly with fluid dynamics: the overwhelming part of it consists of the mathematical theory required to analyse random functions in which the randomness can be related, by integration or differentiation, to a Brownian motion process regarded as a mathematical construction. A fundamental aspect of the model used is that not only are the exact values of the physical quantities, e.g. pressure, subject to irregular variation, but so also is the observation process; hence random variables occur not only in the equations of motion but also in the equations relating physical quantities to what is observed. The Kalman filter referred to in the title of the book is one estimation method, having certain optimality properties within the framework of the model, for obtaining the underlying quantities from the observations.

I found the book of interest, and learned something from it. The authors convincingly establish the appropriateness of their statistical techniques to the problem in hand. But I feel that the book is open to criticism regarding the ordering of its material. The description of the experimental work occurs late, after the development of much of the statistical theory, almost seeming to appear as an afterthought; within the experimental sections, the point of the experiment was not always stated clearly, and I had to work quite hard in some cases to determine what result of general significance was being deduced from the graphs of response as a function of time; and the definition of the Kalman filter is given on page 160 in a book of 165 pages! The book falls rather uneasily between (i) an exposition of a statistical method, with the experiments on cylinders as examples, and (ii) an account of some work done in wave theory, with the mathematical method as subsidiary, and suited for appendices. Apart from these reservations about the structure of the book, I feel that it covers worthwhile material.

C. J. CHAPMAN

Plasma Physics: an Introduction Course. Edited by R. DENDY. Cambridge University Press, 1993. 513 pp. £60.

This book is a collection of 18 separate articles written by different authors which has been developed from lectures presented in recent years at the Culham Summer School in Plasma Physics. The aim of the book is to provide an introduction to the theoretical and experimental study of plasmas and their applications. The lectures at the Culham Summer School have traditionally been of a high standard and the lecture notes compiled in this book are no exception. The subjects of this book are divided into four parts. Firstly, the fundamentals of plasma physics are covered by the first four chapters, introducing the concepts of plasma particle dynamics, plasma kinetic theory, waves in plasmas, and magnetohydrodynamics. Secondly, more advanced concepts and techniques of plasma physics are treated in three chapters, discussing turbulence in fluids and fusion plasmas, nonlinear phenomena and chaos in fluid flows, and computational plasma physics. Thirdly, some specific areas of applications of plasma physics are examined in six chapters, including tokamak experiments, space plasma physics (basic processes in the solar system and microprocesses), solar plasmas, gravitational plasmas, laser-produced plasmas, and industrial plasmas. Finally, the last five chapters address the physics of fusion plasmas, covering the topics of transport in magnetically confined plasmas, radio-frequency plasma heating, boundary plasmas, how to build a tokamak, and historical survey of nuclear fusion research. A list of references is given at the end of each chapter. Most reference lists are comprehensive and up-to-date. An extensive index for the entire book is given at the end. Despite the fact that the 18 chapters have been written by many different authors, the editor has succeeded in putting together a very useful book. Most chapters are clearly written and well illustrated. I recommend this book to any student and researcher interested in understanding the basics of plasma physics and its various applications.

A. C.-L. CHIAN