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BOOK REVIEW

Handbook of Mathematical Fluid Dynamics, Vol. 3. By S. Friedlander & D. Serre. North-Holland, 2004. 674 pp. ISBN 0 444 51556 9. $175.

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This is the third in a series of three volumes concentrating on the mathematical challenges arising from fluid dynamics (reviews of the first two volumes can be found in *J. Fluid Mech.*, vol. 480, p. 335 and vol. 513, p. 373). It includes six invited review articles ranging from 65 to more than 200 pages in length.

The first article, "From Particles to Fluids", by Raffaele Esposito and Mario Pulvirenti, reviews the efforts to derive the equations of hydrodynamics from the mechanics of particles. Specifically, the article discusses the derivation of the Boltzmann equation from Hamilton's equations, and the derivation of the Euler and Navier–Stokes equations from either the Boltzmann equation or directly from particle systems. For the Navier–Stokes equations, this is accomplished only for the incompressible case. The article carefully isolates the assumptions which are needed to progress from one level to the next.

The second article, written by Jean-Yves Chemin, is titled "Two-dimensional Euler System and the Vortex Patches Problem". It is concerned with solutions of the two-dimensional Euler equations for which the vorticity is bounded and supported in a compact set. The article addresses in particular the growth of the diameter of the vortex patch and questions of regularity. Such questions are delicate because, for instance, boundedness of the vorticity does not imply that the velocity field is Lipschitz. The velocity field, however, will be Lipschitz if the vorticity is the characteristic function of a domain with a smooth boundary. This raises the question of whether regularity of the boundary of a vortex patch is preserved under the Euler equations, and the core of the paper is an affirmative result.

Marco Cannone's contribution, titled "Harmonic Analysis Tools for Solving the Incompressible Navier–Stokes Equations", reviews efforts to apply wavelet transforms and Besov spaces to the study of the global regularity problem for Navier–Stokes equations. A crucial concept is that of a mild solution, which is, roughly speaking, a solution of an equivalent integral equation obtained from the variation-of-constants formula for the Stokes system. While weak solutions are not unique, mild solutions are, but require more regularity of the data. The article discusses such solutions in Besov spaces, and, in particular, it obtains a global existence and uniqueness result for highly oscillatory data. It is pointed out, however, that similar results could have been obtained using more traditional approaches, and the question of whether the new techniques could yield a major advance on the global regularity question is left open.

E. Grenier's article on "Boundary Layers" begins with a discussion of stability of shear flows, in the inviscid limit and for high-Reynolds-number viscous flows. The article then discusses negative implications of instability for the validity of formal asymptotic solutions. A final section is concerned with Ekman layers and their stability.

The next article, "Stability of Large-Amplitude Shock Waves of Compressible Navier–Stokes Equations", is by Kevin Zumbrun; it includes an appendix by Helge

Kristian Jenssen and Gregory Lyng. The article reviews the derivation of necessary and sufficient conditions for the stability of viscous shock profiles, based on dynamical systems methods and the Evans function. Although the shock profiles themselves are one-dimensional, the perturbations considered for stability are not constrained to be one-dimensional.

In the final article, "Some Mathematical Problems in Geophysical Fluid Dynamics", basic existence questions are reviewed for the "primitive" equations. These equations are the Navier–Stokes equations with Coriolis force, and coupled to heat and salt transport, but with a hydrostatic approximation to the vertical momentum balance. The state of the art regarding basic existence questions is similar to that for the full Navier–Stokes system.

MICHAEL RENARDY

SHORT NOTICES

High Temperature Gas Dynamics: an Introduction for Physicists and Engineers. By T. K. BOSE. Springer, 2004. 353 pp. ISBN 3 540 40885 1. £54.00 or $89.95.

This book is an outgrowth of lectures given by the author to graduate and undergraduate engineering students specialising in aerodynamics and propulsion. It is aimed at students, scientists and engineers interested in the physics of high-temperature gases, and assumes little specialist knowledge beyond that encountered at undergraduate level. The text starts with an introduction to quantum mechanics and statistical physics, showing how to derive thermodynamic properties from them. Later chapters cover topics such as the production of high-temperature gases, diagnostic techniques, high-temperature gas dynamics, and practical applications such as arc plasma flow in tubes, impinging plasma jets, duct flows and power generation.

Heat and Fluid Flow in Microscale and Nanoscale Structures. Edited by M. FAGHRI & B. SUNDEN. WIT Press, 2004. 374 pp. ISBN 1 85312 893 7. £137.00 or $219.00.

The study of nanostructures is, of course, a topic of considerable current interest. This book is part of a series on developments in heat transfer published by WIT Press. The objective of the text is to present an overview of our current understanding of heat transfer in micro- and nanoscale structures. It comprises 9 chapters, each written by a different author (or group of authors). The topics covered include: microscale energy systems, heat transport in super-lattices, polymer nanostructures, two-phase flow in microstructures, radiation transport at small scales, Monte Carlo methods for micro-channel gas flow, and molecular dynamics simulations of nanoscale heat and fluid flow. There is no index.

The Cambridge Aerospace Dictionary. By B. GUNSTON. Cambridge University Press, 2004. 741 pp. ISBN 0 521 84140 2. £45.00 or $75.00.

This dictionary may find a readership amongst those who get infuriated by having to wade through the acronym soup that pervades so many aerospace publications. Perhaps a minority taste though.

Wind over Waves II: Forecasting and Fundamentals of Applications. Edited by S. G. Sajjadi & J. C. R. Hunt. Horwood Publishing, 2003. 232 pp. ISBN 1 898563 81 0. £50.00.

The study of water waves continues to produce new challenges and theoretical questions for engineers and scientists across a wide range of disciplines. This is a compilation of papers presented at a conference of the same name held in Cambridge in September 2001. The contributing authors include many familiar names such as A. D. D. Craik, M. E. McIntyre, M. S. Lonquet-Higgins, J. C. R. Hunt, W. R. C. Phillips and T. J. Bridges. In total there are 17 papers, mostly ten to twenty pages in length, starting with a fascinating historical review of the work of Stokes on water waves. The topics in the various contributions range from the intensely practical to the more mathematical. There is no index.

Kinetic Theory of Granular Gases. By N. V. Brilliantov & T. Poschel. Oxford University Press, 2004. 329 pp. ISBN 0 19 853038 2. £45.00.

The subject of granular gases (gases whose particles collide inelastically) has received considerable interest over the last decade. This book seeks to provide a self-contained introduction to the statistical mechanics and the kinetic theory of granular gases, placing special emphasis on a physically correct microscopic collision law. It does not require any specialist knowledge of mathematics or physics, other than that found at undergraduate level, and may be suitable for a graduate-level course on dissipative gases.

Advances in Fluid Mechanics V. Edited by C. A. Brebbia, A. C. Mendes & M. Rahman. WIT Press, 2004. 452 pp. ISBN 1 85312 704 3. £117.00 or $187.00.

This book contains the edited version of papers presented at the Fifth International Conference on Advances in Fluid Mechanics held in Lisbon in March 2004. There are 44 contributions arranged under the general headings of: computational methods, hydrodynamics, waves, multiphase flow, biofluids and industrial applications.