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REVIEWS

Macroscopic Modelling of Turbulent flows. Edited by U. FRISCH, J. B. KELLER, G. PAPANICOLAOU and O. PIRONNEAU. Springer, 1985. 360 pp. DM 52.00.

This book contains the proceedings of a workshop of the same title held at Sophia – Antipolis, France in 1984 as part of the USA–France bilateral scientific programme. The fact that it contains 28 papers on large-eddy simulation and related topics, of which more than two thirds originated in France shows the degree of effort being put into this subject area in that country. The first part of the book, following the order of the workshop, consists mainly of papers dealing with large-eddy simulation and sub-grid modelling of homogeneous three-dimensional turbulence. A number of papers (Aupoix, Bertoglio, Chollet among others) discuss the coupling procedure between the eddy-damped quasi-normal Markovian (EDQNM) statistical model for subgrid scales and the large-eddy motions computed on the grid. The problem of the cusp-like behaviour of the eddy viscosity coefficient near the cut-off wave number k_c, which can be reduced in strength by suitable choice of k_c, is discussed in several papers. Simpler constant-eddy-viscosity models and those such as Smagorinsky's model relating ν_T to the rates of strain in the large eddies are also reviewed. Bertoglio discusses the introduction of a memory effect in the model showing it to give improved results for both isotropic and anisotropic turbulence simulations. Several of the papers present the results of actual simulations ranging from decay of homogeneous isotropic turbulence to studies of turbulence in ducts with more complicated inlet and outlet conditions.

A second, smaller group of papers deal with the simulation of two-dimensional turbulence. The computations in these cases can be performed on a much larger mesh because of the reduced number of dimensions. For example Brachet *et al.* in the last paper present some moderately high-Reynolds-number computations of two-dimensional turbulence on a 1024 × 1024 grid. They were able to reach high enough Reynolds numbers for a proper enstrophy cascade to develop leading to a k^{-3} energy spectrum. Applications of such two-dimensional turbulence calculations for atmospheric and rotational turbulence are also presented. The paper by Basdevant *et al.* looks at the behaviour of pairs of vortices as a model of coherent structures in two-dimensional turbulence.

The rest of the book contains papers that deal with particular flows in which instability or other convective phenomena are important, as for example in the study of flame fronts. But Reynolds-averaged turbulence modelling, apart from one paper on computation of shock-wave turbulent-boundary-layer interactions is not a subject of the book. In contrast to these there are also some contributions describing more fundamental studies such as analysis of closure of model nonlinear equations (e.g. Carleman's). However the major practical use of large-eddy and full simulations at the present time is probably that discussed by Ferziger, namely to be a source of numerical experiments to validate closure for practical turbulent flows. His paper reviews much of this application.

The book as a whole therefore comprises a representative sample of much of the current research in the field of large-eddy modelling and related areas. It should be of interest to anyone who is concerned with the prediction of turbulent flows from a fundamental viewpoint and is a useful current reference on this work.

J. M. R. GRAHAM

Sound and Structural Vibration. By Frank Fahy. Academic, 1985. 309 pp. $60.00 or £50.00.

Linear acoustics is not a subject held in high regard by most practitioners of 'real' fluid mechanics. This Cinderella image is rather unjustified, as the subject covers many problems that are both hard and of practical importance. That remark is particularly well illustrated by the area of the subject covered by this book, the multifarious aspects of the interaction of sound waves in a fluid with the vibration of a solid body in contact with it. There are very few books on this area, and none at all which present it, as Frank Fahy does here, at the level of an undergraduate course-book. That fact alone would be sufficient for the book to deserve a welcome and a place in many libraries.

Fahy's style is to concentrate on problems that can be done analytically, and draw qualitative insights for more general problems from these. He treats in turn the various types of problem: radiation from a vibrating structure, transmission of sound through a barrier, fluid loading effects on the structural modes, acoustically induced vibration of the structure, and problems involving fully coupled structural and acoustic modes. While all this is a perfectly respectable tactic, in this subject there are so few analytic example problems that the same old friends keep recurring in successive chapters. Personally, I would have preferred one connected account of all aspects of the hinged-boundary rectangular plate in a rigid plane baffle, rather than trying to grasp precisely how each new invocation related to and differed from the previous ones.

Inevitably, one has a few grumbles. More use could surely have been made of case studies from less idealized problems, numerical though these would have to be. In fact, although Fahy gives a final chapter on numerical methods, he seems not to be a computer enthusiast himself – in particular there are several figures in the book that are described as 'diagrammatic' and are obviously hand-drawn, when one would have thought that the real thing could have been calculated and plotted by computer, with some benefit to the readership. Another related grumble is that certain topics, such as creeping waves around the surface of immersed bodies, are either not mentioned at all or are dismissed as too advanced. While it is obviously true that such topics are mathematically difficult to treat in detail, they can be described qualitatively in a way appropriate to the spirit of this book, so that the student is not left entirely in the dark about what physical phenomena these 'advanced problems' treat.

On the whole, though, this is a competently presented account, which will be found most sympathetic by those who habitually think in terms of travelling waves in preference to normal modes. All but the most well-versed experts in this field will learn something from the book, although, as has been said above, it is aimed primarily at students (with interpolated problems, often of the 'check this for yourself' variety). The book is a little marred by a lack of attention to detail (some sloppily drawn figures, a questionable index, no list of notation, etc.), but these are all small things which could be fixed in a second edition – the book deserves to run to one.

J. Woodhouse