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Book Reviews

Direct and Large Eddy Simulation I: Selected Papers from the First ERCOFTAC Workshop

P. R. Voke, L. Kleiser, and J.-P. Chollet (eds.), Kluwer Academic Publishers, Dordrecht, The Netherlands, 1994, 434 pp., $183.00

The title describes this book adequately; it is a collection of 36 papers, divided into six categories, presented at a workshop on Flow, Turbulence, and Combustion sponsored by the European Research Community. Only two of the papers originated outside Europe; two not included were published elsewhere. The authors include almost everyone active in turbulence simulation in Europe. This collection is testimony to the tremendous growth in the use of simulation as a tool in turbulence research over the past several years. Taken together with the efforts in the United States, Japan, and other countries, this collection shows how important direct and large eddy simulation have become.

The papers in this volume are of generally high quality; the most important deficiency this reviewer can find is that many of them are too short to cover the material in sufficient depth; it is hoped that more detailed versions will appear in journals. Some highlights of the book are discussed below.

Only three papers are found in the section on structure, indicating that this kind of work, which is very important and closely related to what experimentalists do, may not be receiving enough attention. Bech and Andersson show the importance of sufficient domain length for producing accurate simulations in Couette flow (and, presumably, other wall-bounded flows). Lo applies a pattern recognition technique to structure eduction; the technique is powerful but the problem is to find the template against which to compare the data.

Increasing interest in subgrid scale modeling is demonstrated by a section containing nine papers on this topic. Perhaps the most novel is the one by Liu et al., which uses data from a high Reynolds number experiment to test models. New nonlinear models, which may be necessary to simulate complex flows, are introduced and investigated by Horiuti and Goutorbe et al. The issue of modeling wall layers, which is equally important, is not the focus of any of the papers, although these models are used in the section on atmospheric flows.

In the stratified and atmospheric flow section of five papers (plus two published elsewhere), perhaps the most valuable contribution is that of Andren et al. They compare the results of four different large eddy simulation (LES) codes for the neutral planetary boundary layer and find acceptable agreement in meteorological terms. The quality of these results might not be as well regarded by engineers for whom higher accuracy is often important.

The five papers on transition, all but one based on direct numerical simulation (DNS), include one on receptivity (Casalis and Cantaloube), another that presents a novel numerical method for the spatially growing boundary layer (Guo et al.), and one on bypass transition (Yang et al.). The establishment of simulation as a tool for transition research is amply demonstrated by these papers.

Under the heading of complex geometries, we find six papers on simulations of interesting flows, including those in a complex heat exchanger passage (Ciafolo et al.) and a bend (Breuer and Rodi), and flows over hemispheres (Manshart and Wengle) and wavy walls (Maass and Schumann). These illustrate the trend toward the use of LES for simulations of more complex flows. A major issue here is that experimental data for these flows are not of the quality available for simpler flows. Validation of the simulations by performing calculations on more than one grid then becomes a necessity, but this appears not to have been done by any of the contributors.

Finally, the eight papers grouped in the category of compressible, reacting, and thermal flows contain simulations of buoyant flows, compressible boundary layers and shock–turbulence interaction, and one involving chemical reaction.

As noted earlier, the quality of the papers is, on the whole, quite good; a reader unfamiliar with the field can get a good idea of what can be done with simulation methods. It should be noted that, other than the papers on subgrid scale models and the one devoted primarily to a numerical method, the papers in this volume have as their principal goal understanding of the simulated flows. Simulations of this type are best presented together with contributions from experimentalists on the same flows. Much more useful information can be produced in a workshop on comparison of results for a particular flow or small set of related flows obtained by different techniques than by presentations in which almost every paper is devoted to a different flow. It is hoped that future workshops will be of this kind.

Despite these minor objections, the editors are to be congratulated for having put together an excellent workshop. Many of the papers are of a quality such that, were they a little longer, they would be acceptable for publication in archival journals. That and the presentation of a wide range of material that shows what DNS and LES are capable of doing today make this a worthwhile volume. The beginnings of applications to industrial problems are also found in this volume. Unfortunately, the price of this book will probably restrict its purchase to libraries.

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