

Book Reviews

Turbulent Shear-Layer/Shock Wave Interactions,

J. Détery, Editor, Springer-Verlag, Inc., New York, 1986, 430 pp., \$75.90.

Shock waves and shear layers, two of the most incompatible of all fluid phenomena, unfortunately meet in a variety of important aerospace applications. The results are often extremely difficult to understand, predict, or control. After years of evolutionary research, although our overall grasp of the problem is still spotty and sophomoric, we have gained some significant knowledge.

That knowledge is apparent in this volume, which contains the Proceedings of the 1985 IUTAM Symposium on Turbulent Shear-Layer/Shock Wave Interactions. Its contents, consisting primarily of original research papers, are well organized by editor Jean Détery, himself a noted contributor in the field.

Most of the 32 papers in the volume concern interactions of shock waves and turbulent boundary layers. This emphasis reflects the importance of such interactions, for example, in limiting the cruise speed of current jet transports. However, only a few of these papers deal directly with aircraft aerodynamics. Most are basic research studies aimed at a better understanding of the problem.

The "problem" is, in fact, many problems. Shock/boundary-layer interactions vary widely in their characteristics, depending on such parameters as Mach number, shock strength, and degree of three-dimensionality. The latter parameter is the basis for the organization of contents of the volume. Roughly two-thirds of the papers concern two-dimensional interactions, an idealization that may not actually occur in nature, but is nonetheless convenient for study.

The international flavor of the Symposium is reflected in contributions by United States, French, British, German, and Japanese authors. The Soviet Union, known to be interested and active in this field, sent observers but did not otherwise participate.

The volume also reflects the emergence of computational fluid dynamics as an important issue in this field.

Several papers report the results of Navier-Stokes solutions employing various turbulence models and requiring hours of time on the largest computers available. Shock-wave/shear-layer interactions are not so easily predicted in this way as are many low-speed flows, but the results do show promise. Perhaps because of their difficulty, interaction problems have become pacing items for the latest CFD algorithms and turbulence models.

Theoretical analyses of several types are also well represented in the volume. Together, CFD and analytical papers comprise about half the contents. The remainder is devoted to experiments that, as the traditional means of generating new knowledge about complex flows, are still the mainstay of this research area.

Of special note is a group of five papers on the unsteady aspects of interaction phenomena. Two of these concern the basic shock/turbulence interaction mechanism, which is an issue of current practical importance in supersonic combustion for high-speed propulsion, as well as in the aeroacoustics of helicopters. This section of the volume is headed by a competent review of unsteadiness in shock/boundary-layer interactions by D. S. Dolling. The two other review papers in the volume concern turbulence modeling and three-dimensional interactions.

In summary, this volume is an important collection of recent detailed research on the shock-wave/shear-layer interaction problem. It is not recommended as immediate reading for the newcomer to this field but should definitely be acquired by active researchers and technical libraries.

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Transsonische Turbomaschinen (in German)

A. Bölcs and P. Suter, G. Braun Karlsruhe Publishing, West Germany, 1986, 373 pp., DM 49.80.

This book was developed from lectures given by Professors Bölcs and Suter at the technical universities of Lausanne and Zurich. It is the authors' objective to provide an introduction to transonic turbomachinery aerodynamics and aeroelasticity for engineering students and for practicing engineers.

In the first chapter the reasons for transonic stages in steam turbines, industrial gas turbines, and compressors

as well as in-flight propulsion systems are explained. The second and third chapters present the gasdynamic fundamentals, including the method of characteristics, and the transonic phenomena occurring on single airfoils. In the fourth and fifth chapters transonic inviscid compressor and turbine cascade flows are discussed. The sixth chapter is devoted to the viscous phenomena and losses occurring in cascades. In chapter 7 the unsteady rotor-stator

interference effects are treated and the aeroelastic phenomena that may be encountered in transonic stages are explained. This is followed by a brief discussion of three-dimensional effects in chapter 8. The final chapter provides a discussion of linear and annular test rigs and of various measuring techniques, including laser velocimetry, interferometry, and holography.

The emphasis throughout the book is on the explanation of the basic physical phenomena and on the presentation of analysis methods that provide a useful engineering approximation with modest effort. Consequently, modern computational techniques and results are omitted and no attempt is made to give a comprehensive survey of the existing literature, methods, and state-of-

the-art. Instead, the authors draw heavily on their own experience and results. The text is well illustrated with over 200 figures. In addition, detailed solutions to 34 problems are provided to reinforce the reader's understanding.

This is the first textbook on transonic turbomachinery. It will be welcomed as an introductory text by engineering students, faculty, and practicing engineers. Specialists will find it equally useful, especially those seeking information about current Swiss and German research on transonic turbomachinery.

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Advances in Turbulence (Proceedings of the First European Turbulence Conference, Lyon, France, July 1-4, 1986),

Comte-Bellot and J. Mathieu, Editors, Springer-Verlag, Inc., New York, 1987, 586 pp., \$87.50.

As indicated by the title, this book is an edited collection of conference papers. Some papers are complete research papers, while others are not much more than abstracts of referenced works. One-third of the 58 contributions were from France (as expected because of the meeting location), and another third were from the United Kingdom and the Federal Republic of Germany. Two-thirds of the participants were from these countries. This meeting was primarily on advances made in turbulence research in Western Europe, although the United States and a few other countries participated. With one exception, all papers are written in English.

The book is organized into eight parts, each dealing with a subtopic of current turbulence research interest: instability and transition; chaos; direct and large eddy simulation; coupling of Fourier modes and spectral analysis; two-dimensional velocity fields, geophysical and astrophysical turbulence; coherent structures, conditional averaging and pattern recognition; experimental techniques; and engineering applications.

The coherent structures section seemed to be particularly outstanding, perhaps because of this reviewer's interests and background. The invited paper by H. Fiedler of Berlin is a very readable, informative, and concise review of some coherent structures ideas from 138 references. Well-known active researchers from throughout the world presented another dozen papers on coherent structures in various turbulent shear flows, covering both theoretical and experimental approaches.

The invited paper by U. Schumann and R. Friedrich of Germany is a good review of the Western world's activity

on direct and large eddy simulation of turbulence. Other papers in this section demonstrate the potential strength of this approach by discussing pressure-strain correlations and the effects of flow stratification. The interesting article by M. Farge shows the power of high-resolution raster displays of simulation results.

The lucid review paper by H. K. Moffatt on geophysical and astrophysical turbulence is followed by nine articles covering a spectrum of related problems. Three other papers deal with the experimental measurement of vorticity while others deal with the use of hot-wire anemometers and with image processing of flow visualization films. The papers on coupling of Fourier modes and spectral behavior are interesting. The several boundary-layer papers on large eddy breakup (LEBU) devices, oscillatory flows, and relaxation effects reflect the types of applications research going on throughout the world. The papers on chaos did not convince this reviewer that they were indeed dealing with fluid turbulence.

This is a good book for a survey of recent turbulence research primarily in Western Europe. The conference provided a forum for a wide variety of ideas. Researchers on each subtopic can probably find something of interest in this book; certainly this reviewer did. Considering the price, however, one should borrow a library copy, if possible.

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