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BOOK REVIEWS

ENCYCLOPEDIA OF ACOUSTICS, 1997, editor Malcolm J. Crocker. New York: John Wiley & Sons, Inc. 2017 pp. Price (four volumes, hardbound) $475·00. ISBN 0-471-80465-7 (set).

To this reviewer's knowledge, this is the first ever *Encyclopedia of Acoustics*. In conceiving and organizing its creation, its Editor, Malcolm J. Crocker, has made a valuable contribution both to acousticians and to others seeking further knowledge of the subject.

Encyclopedias can be of various types, from the short-entries/almost-dictionary type to the very-long-entries type attempting to include "all knowledge". This one is of the "happy-medium" type. It consists of four volumes, each devoted to several relatively closely related aspects of acoustics, which in turn are comprised of a number of 5–15 pages or so summary review articles on the particular components of these aspects, each written by an acknowledged expert (or experts). In addition, there are introductions to each of the various aspects for the benefit of less sophisticated readers. This design makes the material accessible not only to university students and graduates, including professional acousticians, but also to advanced secondary school students and to other persons wishing to learn something about the science and technology of acoustics.

A principal virtue of the *Encyclopedia* is that all the articles present up-to-date authoritative information and contain numerous references for further reading. Very many of them also contain information which can be of immediate practical value to the reader. Thus, if the desired information is not in the article itself, one should be able to find it in one of the references. In this sense, the *Encyclopedia* is also an encyclopedia "Handbook of Acoustics".

Of course, any *Encyclopedia* has its "Achilles heel": it can contain only that knowledge known to its authors at the time of writing their articles, and nowadays that time is at best a year or two before publication. As in other sciences and technologies, new, important and useful knowledge is being produced very rapidly these days, so rapidly that to remain reasonably "up-to-date" in all areas an encyclopedia needs to be revised every five years or so. Despite this, one can expect most of the information in this *Encyclopedia* to have a shelf-life of 10–20 years, with a significant part of it remaining valid for even longer. Relevant here is the fact that very little has been added to our knowledge of the fundamental physics of acoustics beyond that which Lord Rayleigh presented in 1894 in his two-volume treatise *Theory of Sound*. Of these relatively few additions, the physics of ultrasonics is not all that different from the physics of audible sound; the physics of quantum acoustics is a bit different, and so are those of electroacoustics, bioacoustics and physical–chemical acoustics, but only largely because of the quantum mechanical, electromagnetic, biological and chemical aspects that have to be taken into account. Therefore this *Encyclopedia* is very unlikely to be of only ephemeral value.

The following brief summary of the *Encyclopedia*'s contents gives some indications of its scope.

There are four parts to Volume One (pp. 1–617): I, General Linear Acoustics (articles 1–16); II, Nonlinear Acoustics and Cavitation (articles 17–26); III, Aeroacoustics and Atmospheric Sound (articles 27–33); IV, Underwater Sound (articles 34–53).

Volume Two (pp. 619–1092) contains five parts: V, Ultrasonics, Quantum Acoustics and Physical Effects of Sound (articles 54–61); VI (misprinted as IV!), Mechanical

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Vibration and Shock (articles 62–75); VII, Statistical Methods in Acoustics (articles 76–78); VIII, Noise, Its effects and Control (articles 79–89).

Volume Three (pp. 1093–1554) containing four parts: IX, Architectural Acoustics (articles 90–98); X, Acoustical Signal Processing (articles 99–102); XI, Physiological Acoustics (articles 103–113); XII, Psychological Acoustics (articles 114–123).

Finally, Volume Four (pp. 1555–2017) contains six parts: XIII, Speech Communication (articles 124–129); XIV, Music and Musical Acoustics (articles 130–139); XV, Bioacoustics (articles 140–145); XVI, Animal Bioacoustics (articles 146–153); XVII, Acoustical Measurements and Instrumentation (articles 154–157); XVIII, Transducers (articles 158–166). In addition, the volume ends with a list of the reviewers (pp 1991–1992) and an index (pp. 1993–2017).

A list of titles of the 166 articles would be far too long to be included here, but it can be said that this reviewer could not think of any aspect of acoustics which did not receive at least some mention. There are a few details, of course, which would have been mentioned if the readers had written their articles today, instead of a year or two ago! Perusal of the 24-page index also leads to the conclusion that the coverage is as complete as was possible.

It must be said, however, that the *Encyclopedia* is not one of *Acoustics and Vibration*; nor does it pretend to be. There is one article in part I on sound/structure interaction, and there are 14 articles in Part IV on mechanical vibrations and shock. Nevertheless, these cover only a relatively small number of the aspects of vibration which are important in, for example, mechanical and civil engineering.

As has been mentioned, each of the Parts has an Introduction (two of them being differently titled), providing an easily readable overview of the subject area. A list of the authors of these is indicative of the quality of all the authors of the articles: Malcolm J. Crocker, David T. Blackstock, James Lighthill, Ira Dyer, Phil L. Marston, Manfred A. Heckl, Richard H. Lyon, A. Harold Marshall, William J. Cavanaugh, Andrew F. Seybert, Joseph E. Hind, David M. Green, Dennis McFadden, J. L. Flanagan, Thomas D. Rossing, Floyd Dunn, Arthur N. Popper, P. V. Brüel, J. Pope, H. K. Zaveri and Harry B. Miller. Scanning through the authors of the rest of the articles reveals more than $166 - 18 = 148$ comparatively well known authorities on their subjects (''more than'' because some articles have more than one author!).

All of the authors, and especially the Editor, deserve our thanks and congratulations for providing this authoritative *Encyclopedia*.

The *Encyclopedia* deserves a place on the shelves of all libraries serving the interests of those concerned with science and technology, both in educational institutions and elsewhere. Of course $475.00 is a lot of money, but it is a very reasonable price for 2017 two-column printed pages of American Quarto size, providing valuable information on every page!

P. E. Doak

NOISE AND VIBRATION ENGINEERING, PROCEEDINGS OF ISMA21, 1996, editor P. Sas, three volumes. Leuven, Belgium, 2002 pp. ISBN 90-73802-59-8.

This three-volume book represents Proceedings of 1996 International Conference on Noise and Vibration Engineering, organized by the Katholieke Universiteit Leuven and held in Leuven, Belgium, on 18–20 September 1996.

The book contains 176 papers by 342 authors. Most of the papers (145) are written by authors from European countries. Many of them present the results of European projects (given only by abbreviations) such as RHINO (Reduction of Helicopter Interior Noise), BRAIN (Aircraft Interior Noise), PIANO (Truck Pass-by Noise), etc., supported by the Commissions of the European Community. Other countries are represented rather modestly: nine papers from the U.S.A., five from Brazil, four from Japan, four from Australia, and eight other countries are represented by one or two papers. All of the papers are divided into 23 special sessions, each session corresponding to a certain project (e.g., PIANO), method (e.g., SEA), topic (e.g., Vibro-Acoustic Modelling and Prediction) or an object of investigation (e.g., Railway Noise and Vibration). The division is made reasonably according to the main emphases in the papers.

As for the objects of investigation, most attention is paid to automobiles (32 papers), machinery (31) and aircraft (21). Vibro-acoustic problems in spacecraft, buildings, ships, on railroads, etc., are presented more or less occasionally. At the same time, about half of the papers investigate general questions and give results applicable to any object.

The main problem that is studied in most papers is noise and vibration control of industrial products at various stages of the product development process, although much attention is given also to machine diagnostics and damage (cracks) detection (22 papers).

The papers are of high quality; many of them are written by leading researchers and engineers. Besides two key-note lectures' ''Beyond 2000—concepts in structural vibrations and acoustics'' by D. L. Brown (U.S.A.)—not printed in the Proceedings—and ''Is NVH still an obstacle in automotive product design'' by U. Sorgatz (Germany)—with the author's answer YES (NVH means Noise and Vibration Harshness, a main subject of the Conference)—there are many papers of the highest scientific level; for example, the work ''Active control of vibration and sound: an overview of the patent literature'' by D. Guicking (Germany) containing over 500 patent references.

By their scientific content, the papers can be divided into the following six main groups.

1. *Structural Modelling* (more than 70 papers) is the dominant topic for several special sessions: ''Substructuring'', ''Modal Testing'', ''Model Updating'', ''Structural Dynamics Optimisation'' and ''System Identification Techniques''. Adequate models of structures are also the necessary components in vibro-acoustic methods of damage detection and diagnostics; two special sessions are dedicated to it: ''Failure Detection and Condition Assessment using Dynamic Characteristics'' and ''Failure Detection in Large Structures using Dynamic Responses''. In all of these works, modal analysis and model parameter identification from the experimental data are widely used.

2. *Sound/Vibration Interaction* (about 20 papers) is another topic gaining much attention because analysis of coupled fluid/structure wave motion is the basis for noise prediction and control in passenger vehicle cabins. The development of appropriate numerical methods for such analysis is the main question under consideration. Two special sessions are dedicated to this topic: ''Vibro-acoustic Modelling and Prediction'' and ''Vibro-acoustic Modelling and Testing''.

3. *Source Modelling* (15 papers) is a traditional topic of such conferences. As a rule, it comprises works studying sound generation mechanisms. However, at this particular conference, a relatively new method of source modelling (called the Source Descriptor or Substitution Monopole Technique) gained much attention. It consists of replacing an extended noise source by a set of monopoles placed at its surface. The method resembles the so-called Simple Source Method that is well known in hydroacoustics. It is adjusted here for industrial noise sources and, judging from the results presented, works well even for non-stationary (moving) sound sources.

4. *Methods of Analysis* are represented by full spectrum in the papers being applied to different particular problems. The most popular methods are modal analysis, statistical energy analysis (special session ''Applications of SEA''), power flow technique (special session ''Energy Flow Analysis''), Frequency Transfer Function techniques, wavelet analysis and others.

5. Many practical *Means of Control* are presented. Methods of active control (22 papers) dominate over the traditional methods (18 papers) based on isolation and dissipation.

6. *New Instruments and Experimental Devices* are described in the Proceedings (12 papers) such as a low frequency acoustic source, and a device for moment excitation of structures. Six papers are dedicated to Signal Processing.

In conclusion, this is a very good and useful collection of papers with a lot of new results. The only remark that can be made concerns the large number of abbreviations. The word ISMA in the title, for example, is not deciphered and could easily be confused with the International Seminar on Musical Acoustics. This, of course, does not diminish the high value of the book. Three of its main features are also worth mentioning. First, there is a lot of experiment; even theoretical results are as a rule validated experimentally. The second is the distinct orientation to the needs of industry. Third, there are many practical results and findings in the papers that readers can readily use in their work. The book is a real contribution to ''the treasure box of vibro-acoustic experience''. It is strongly recommended to researchers and engineers working on industrial noise and vibration problems.

Y. I. Bobrovnitskii

AN INTRODUCTION TO THE PSYCHOLOGY OF HEARING (fourth edition) 1997 Brian C. J. Moore. London: Academic Press. xvii + 373 pp. Price £24.95. ISBN 0-12-505627-3.

This is the fourth edition of a well-established textbook first published in 1978. Sound perception and the study of hearing can be a somewhat complex and dense area for the uninitiated. Over the years Brian Moore has established a reputation for producing a readable textbook that provides a more readily digestible appreciation of this sometimes difficult topic. The contents cover all the main areas of the subject, and include a description of the basic structure, function and responses of the auditory peripheral and neural systems; the perception of loudness, frequency selectivity, temporal processing, pitch and space perception, auditory pattern recognition and speech perception. He also dedicates a whole chapter to some of the practical applications of the topic, including hearing aids and cochlear implants, and the requirements of hi-fi sound reproduction systems. Apart from the use of the slightly old-fashioned term ''cochlear echoes'' instead of the now widely accepted ''oto-acoustic emissions'', the nomenclature employed throughout the book is informative and straightforward.

Since the publication of the third edition in 1989, Brian Moore has reviewed over 160 new articles and updated many sections for the fourth edition. This incorporates many recent advances in the field, including the effect of peripheral compression, the processing of modulation and the discrimination of duration. Recent advances in auditory physiology have mean that some of the physiological processes underlying the perception of sound are now better understood, and these links have also been included and emphasized in this edition.

An Introduction to the Psychology of Hearing has become a standard textbook for many instructional courses. It is aimed in particular at advanced university undergraduate

courses in auditory perception and postgraduate courses in audiology and sensory physiology. Certainly, it is the standard text book for the sound perception lecture course of the M.S.c. Audiology Course run at the ISVR, University of Southampton. It also has much to offer hearing and speech researchers, speech pathologists and linguists, as well as neuroscientists, otologists and physicians. With recent advances in signal processing, this book should also help audio engineers and those concerned with the development of hearing aids and modern spatial sound reproduction systems come to grips with the relevant subjective and perceptual aspects of the topic.

Brian Moore is to be congratulated on maintaining the modernity and relevance of this book, which will continue to serve and inform all those with an interest in the psychology of hearing.

A. Martin

THEORETICAL AND EXPERIMENTAL MODAL ANALYSIS, 1997, editors, N. M. M. Maia and J. M. M. Silva. Chichester: John Wiley & Sons. Price £60.00. ISBN 0-863-80208-7.

This textbook consists of eight chapters each written by a different author. That this does not harm the readability of the book is to the credit of the editors.

The book deals with theoretical and experimental modal analysis with emphasis on the experimental side. The layout of the book is as follows. Chapter 1 provides a comprehensive explanation of the fundamentals of vibration theory with a view to modal analysis. Chapter 2 treats some signal processing concepts revelant for modal testing. Modal testing practice is covered in chapter 3. Chapter 4 brings an extensive overview of most of the modal parameter estimation techniques. Chapter 5 deals with substructuring coupling methods and Chapter 6 addresses the direct and inverse techniques for local structural modification. Chapter 7 discusses various techniques for finite element updating and Chapter 8 deals with non-linear modal analysis methods.

The book gives a good overview of most aspects of theoretical and experimental modal analysis. The topics dealt with are similar to those found in other textbooks on modal analysis; Chapter 8, dealing with non-linearities, deviates from this classic structure and is a valuable addition. The book is well written and clearly illustrated, but some of the material is covered in much more detail than other equally important aspects, which does not benefit the homogeneity. For example, one could wonder why it is necessary to treat all parameter estimation techniques in detail and not mention any of the model validation techniques.

In general, when reading this book from the viewpoint of a modal analysis user one gets the impression that a number of practical aspects of experimental modal analysis have been neglected. For example, no attempt has been made to compare critically the various parameter estimation techniques nor to guide the user in selecting one of those methods, nor in defining the appropriate order of the estimated model. In Chapter 2 averaging concepts and the interpretation of the coherence function are only briefly mentioned. Chapter 3 gives only a superficial overview of the modal testing procedure, important accuracy related items such as optimized excitation schemes (burst random, or multisine) are missing, only one transducer calibration method is discussed and no reference is made to the various equipment that has been specially designed to facilitate the modal testing procedure.

Finally, the fact that no case studies or practical examples are given is a shortcoming of a textbook that deals with practice oriented technique such as experimental modal analysis.

P. Sas

POWDERS AND GRAINS 97, 1997, editors Robert P. Behringer and James T. Jenkins. Rotterdam: A. A. Balkema, xiii + 387 pp Price £78. ISBN 90-5410-8843

A few decades ago, one of the few definitive texts on small particle mechanics was Ralph Bagnold's book on *The Physics of Blown Sand and Desert Dunes*. Indeed, Bagnold's work is still referred to quite regularly in recent publications in this field. However, as the science of granular materials goes, a few decades is an eternity. Since the mid 1950s, the importance and significance of particulate media has greatly increased. Furthermore, there have been enormous contributions made to this field of study by industrial practitioners, engineers and scientists from many academic disciplines. I feel that *Powders and Grains* 97 presents a cohesive collection of reports that includes the fundamental and distinct characteristics of fine particle behaviour; it also highlights new theoretical approaches and new experimental techniques for studying granular comportment.

Powders and Grains 97 is a compilation of 128 papers that were presented at the Third International Conference on Powders and Grains, held in Durham, North Carolina, in May 1997. It covers a range of subjects including industrial and field studies, powder compaction, agglomeration and fracture, quasi-static deformations, stress fluctuations, vibrated beds and granular flow. Many of the authors are major contributors and leading researchers in the field of fine particles. Approximately half of the volume is devoted to the study of stresses in static piles of granular materials and new approaches to numerical simulation of flowing powders. The material covered in the text has been evolving for more than a half century, and the resulting maturity of the ideas, especially when related to the references to earlier work, is evident.

A powder is a very complex material, which exhibits behaviour that is unique to its state. Experiments on the formation of piles of powder show a variety of stress distributions, which, under certain conditions, can lead to arching. Numerous papers dealing with stress distributions in static piles of granular materials have been published recently. Much of this work, including that reported in *Powders and Grains* 97, appears to have been much stimulated by experiments of nearly 20 years ago in which it was observed that the vertical normal stress showed a dip below the apex of a free pile. One of the newest models proposed to explain this result is the Fixed Principal Axis (FPA) theory, which assumes that the direction of principal stress is determined for ever when the material element is first buried and remains everywhere constant. This model gives good quantitative agreement with published experimental results for the dip. Another group of investigators attempts to explain the phenomenon by discrete models of granular media such as Finite Element Analysis. The debate between these groups is very lively and promises to be very beneficial. It will no doubt lead to greater insight into the study of stress distributions generally; the stress dip is but one manifestation of this more general field of study.

Vibrated beds of granular material display dilatancy, convection, segregation, compaction and pattern formation. These co-operative phenomena associated with interactions between particles in a granular material are not well understood, despite the fact that the macroscopic properties of the individual grains are known. A new Nuclear Magnetic Resonance (NMR) imaging method offers a non-invasive technique for studying diffusion and flow in granular material. It has been proposed to measure concentration and velocity of granular flow in rotating drums, on inclined planes and channels and from hoppers and silos. Video systems are sometimes used to record the evolution of powders in motion. The complexity of the particle interactions limits the detail that can be gathered from physical experimentation. Dynamic phenomena such as stratification, lamination, fingering and avalanching may have important scientific and technological implications.

Computer modelling is often used to investigate the sensitivity to certain parameters associated with flow mechanics which are impractical to measure by using MRI.

The rapid increase in computer capability has greatly enhanced the scope of experimental and numerical simulations. As well as assisting theorists in modelling, computers are being used extensively for scaling-up of laboratory science to field observations and measurements. Simulation is also becoming recognized in industry as an important tool for reducing the costs and timescales involved in product development and processing.

Scientists in many different disciplines have often complained that the mechanics of small particles have not received adequate treatment. Several authors in *Powders and Grains* 97 point out that the body of knowledge in this field consists mostly of studies which are found scattered in the literature. There appears to be a lack of awareness of other groups' contributions and a deficiency in communication. Ways must be found to bring these different disciplinary groups together to share ideas, to learn from each other, and perhaps to decide together what may be valuable and fruitful avenues of research to pursue. In my opinion, the "Powders and Grains Conference", and this publication of its proceedings, have succeeded in providing a forum that can help to accomplish these ideals.

M. F. Leach