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BOOK REVIEWS

THE BOUNDARY ELEMENT METHOD IN ACOUSTICS, 1998, by S. Kirkup. Hebden Bridge, Yorkshire: Integrated Sound Software. vii + 148 pp. ISBN 0-953401-0-6.

This book contains both mathematical theory and a number of Fortran subroutines for the practitioner wishing to use the boundary element method for acoustic radiation and scattering problems. Formulations via Green's representation theorem and single- and double-layer potentials are described. Printouts of relevant subroutines in the body of the text do interrupt the flow a little. Perhaps this is an intentional selling point, as the author explains, "Although the mathematical development of the methods is given in this text, the software can be used without any knowledge of these details. Users of the software will need to have a working knowledge of Fortran".

Chapter 1 is an introduction to the software available, the formulation of the boundary integral equations and respective operator notations associated with both direct and indirect approaches. Piecewise constant collocation is the assumed numerical method and acoustic variables are described and comments on the available software given. Heavy reading for an introductory chapter, especially for readers with no previous knowledge. The second chapter concentrates on the boundary representation. The explanation of node numbering through an example for a sphere constitutes a worthy stand-alone chapter. In Chapter 3, a concise treatment of the approximations to the integral operators is given. A handy table of the computational cost for evaluating the integrals will prove to be useful for the user. At this point in the book the reader is expected to be familiar with the available software.

In Chapter 4, the interior acoustic problem is dealt with using both direct and indirect formulations. Theoretical comparisons are given and one "real-world application". Further discussion on interior methods are left for a later chapter. Chapter 5 deals with the exterior acoustic problem. A description of the elementary formulation and its drawbacks leads to the history of alternative methods. One of the more popular improved methods, the CHIEF method, is discussed. The chapter is supplemented by good examples and an excellent comparison with experimental data. Chapter 6 is the current author's research, at the time of writing, in the area of interior modal analysis using the boundary element method. Subroutines are presented to solve the non-linear eigenvalue problem. Computed and measured loudspeaker resonant frequencies are presented with contours of the mode shapes.

This book is more than just a technical manual to be used with the author's given software. If the subroutines were relocated in an appendix and some more examples, convergence results and some history of the method were given, then the book would afford a two-level readership — the practical user and the interested theoretical reader. The book is clearly aimed at the graduate student or professional scientist who would rather "get their hands on" the boundary element method than use some commerical software. With some careful amendments a wider audience would

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appreciate this as a stand-alone text. Describing the boundary element method to a fresh audience is an often daunting and awkward task. In this book, the author has gone some way to help furnish its place in the market.

A. PEPLOW

STABILITY OF STOCHASTIC ELASTIC AND VISCOELASTIC SYSTEMS, 1999, by V. D. Potapov. New York: John Wiley & Sons, Ltd. xi + 275 pp. Price £75.00, ISBN 047198793X.

This book is written by an expert who has worked extensively on a wide range of problems related to the dynamic stability of viscoelastic structures. The material properties of viscoelastic structures are characterized by random variations due to physical and chemical processes that take place in the material over time. In this case the stability treatment involves the influence of various perturbations on the unperturbed system motion, including its equilibrium state. Perturbed motion is described by integro-differential equations with random stationary coefficients. The major part of the book focuses on linear stochastic stability of such systems. The first five chapters address different problems dealing with asymptotic methods of estimating the stability of viscoelastic structures described by linear stochastic differential and integro-differential equations. One chapter addresses numerical techniques, while the last chapter deals with the stochastic stability of non-linear systems.

The first chapter outlines the analytical modelling of perturbed and unperturbed viscoelastic structures. The stress–strain relations of viscoelastic materials involve a function referred to as the "creep kernel", which appears in the Volterra integral equation that describes the state of the stress. Various definitions of stability measures of deterministic and stochastic systems are introduced. The sources of instability of such systems are due to perturbations in initial conditions, load perturbations, and many other sources.

Chapter 2 deals with the analysis of stability of elastic and viscoelastic systems with Gaussian white-noise coefficients. The problem of an isotropic rod resting on a continuous viscoelastic foudation and subjected to transverse and longitudinal loading is modelling by a set of Itô's stochastic differential equations. An important feature which simplifies the solution of the Fokker–Planck (FP) equation is setting the response acceleration to zero and assuming the slip rate to be proportional to the foundation reaction. In this case, the problem is converted to a one-dimensional first order stochastic differential equation whose probability function is obtained by solving the non-stationary FP equation. The corresponding Lyapunov exponent is also obtained in a closed form. Under band-limited random excitation generated by passing white noise through a linear filter, the response probability density function (p.d.f.), nth response moments, and stability conditions are obtained analytically. This chapter also considers viscoelastic systems described by second order stochastic differential equations exicted by random white-noise loads. A set of moment equations up to second order are obtained to examine their stationary solution together with their stochastic stability. For rods whose material properties are changing with time (aging material) the equation of motion together with the differential equations governing the material properties form a set of four first order stochastic differential equations. A set of first order differential equations for the first and second order moments are obtained by using the Itô formula and are studied for their stochastic stability.

The third chapter treats the stability of viscoelastic structures using the stochastic averaging method. The method is used for ideal structures such as plates subjected to periodic and stochastic parametric excitations. The method of moment functions is briefly discussed. The analysis reveals that when the stability of an equilibrium state is treated with respect to statistical moments, the upper bound on the dispersion of the random excitation decreases as the number of the statistical moment grows.

Chapter 4 introduces the Lyapunov second method to analyze the stability of systems driven by arbitrary random excitations. The method is employed to analyze the almost sure stability of discrete viscoelastic structures for an arbitrary difference relaxation kernel of the material and for relaxation kernels represented as sums of exponential functions. The identification of dangerous perturbations of initial conditions is studied and it is shown that initial perturbations with higher harmonics than a single sine half-wave can be more dangerous in the case of a white noise.

The stability of non-conservative elastic and viscoelastic systems under random excitations is treated in Chapter 5. Non-conservative systems are susceptible to small internal friction in the material, and their stochastic analysis is not a simple task. However, the stability of the classical problem of a follower load acting on a double restrained pendulum is analyzed. An important result is that the critical value of the follower load parameter in the case of viscoelastic hinge is less than that for an elastic model. The influence of stochastic scattering of external damping and hinge material viscosity on the model stability is studied. The scattering in the external damping has a weaker effect on the stability than the effect of the relaxation time of the hinge material. The stability analysis of a viscoelastic rod under a random stationary follower force is considered. Other problems addressed in this chapter include the stability of viscoelastic plates exposed to supersonic gas flow under random loading.

The numerical methods for investigating the stability of stochastic systems are outlined in Chapter 6. Numerical solutions are valuable for cases where the excitation is stationary but not ergodic. They are used in estimating the maximal Lyapunov exponent of elastic and viscoelastic systems subjected to a narrow-band parametric excitation. The excitation is represented by sine plus cosine terms each with random amplitude. The dependence of the Lyapunov exponent on the stochastic scatter of the random excitation amplitudes is obtained numerically in the form of histograms. Under wide-band random excitation simulated by a finite sum of large number of sines and cosines with uncorrelated amplitudes the stability of moments of various orders is analyzed.

While the first six chapters treat the stochastic stability of linear systems, Chapter 7 considers some aspects of the behavior of geometrically and physically non-linear elastic and viscoelastic structures subjected to random loading. The slow motion of a simply supported buckled beam restrained from its mid-point by a viscous dashpot is described by a first order non-linear differential equation, after neglecting inertia forces. For this case, it is possible to obtain a closed-form solution for the stationary FP equation and conditions for the existence of the response second order moment. The problem of shallow shells in a viscous medium under random transverse excitation is described by a non-linear differential equation. Here again the excitation rate is assumed to be very small, such that inertia forces can be ignored. Furthermore, the relaxation kernel of the viscoelastic medium is expressed as a sum of exponential functions such that the governing integro-differential equation can be expressed by a first order differential equation. The response p.d.f. plots show two maxima corresponding to stable equilibria of the shell under a constant deterministic component of the excitation. The minimum p.d.f. corresponds to the unstable equilibrium of the shell. The analytical modelling of the dynamic response of a thin rectangular viscoelastic plate to a random distributed load acting at two opposite edges is formulated. The relaxation kernel of the material has an exponential form and the governing integro-differential equation is expressed in terms of four first order differential equations whose solution is obtained numerically. The non-zero mean value of the external load played an important role in the structure of the phase diagram in a similar fashion to the Duffing oscillator. The response of a viscoelastic rod with initial curvature to longitudinal random load is described by two coupled non-linear integro-differential equations. The viscoelastic properties and material non-linearity are found to have a significant effect on the critical values of the longitudinal force. The time-history response to random loading is used to estimate the "snap-through" probability where the failure is treated as an unbounded growth of the rod deflection amplitude. The stability of the unperturbed motion of the rod is studied by numerically estimating the maximal Lyapunov exponent.

This research monograph fills a gap in the stochastic dynamics of a special class of structures. The book requires the reader to be familiar with the stress–strain relations of viscoelastic materials. Each chapter begins with an adequate literature review of published results related to its topic.

R. A. Ibrahim

VIBRATIONS OF ELASTO-PLASTIC BODIES, 1998, by V. Palmov (translated by A. Belyaev). Berlin, Heidelberg, New York: Springer–Verlag. 311pp.

The title of this book covers a wide domain on the border between the structural dynamics and plasticity theory. However, in plasticity we have to deal with the cyclic processes. A number of phenomena are met when we enter the field of the cyclic elasto-plastic straining: cyclic hardening and softening, acquired anisotropy, stiffness degradation and ratcheting, damage accumulation and formation of low-cycle fatigue cracks, etc. In addition, for elasto-plastic bodies, one usually assumes that the dissipated part of the energy due to plasticity is at least comparable with the amount of the stored elastic energy. In this case, an elasto-plastic body may hardly be considered as an osciallating system in an ordinary sense.

The subject of this book is limited to the comparatively small contribution of plasticity in the response of a body to cyclic loading. As a matter of fact, the author considers vibrations and wave propagation processes taking into account non-linear damping, mostly in the form of the amplitude-dependent dry friction combined with the linear damping. Correspondingly, the tools used in the analysis are typical for the common theory of vibrations: it is the harmonic linearization when steady periodic vibrations are considered, and the statistical linearization in the treatment of random vibrations. In the writer's opinion, a title like "Vibrations of Bodies with Non-linear Internal Damping" would be more correct and appropriate.

This book is divided into eight chapters. Chapter 1 contains a brief overview of continuum mechanics with special attention to the models that include damping, linear or non-linear. Chapter 2 is dedicated to the internal friction in materials discussed in the context of the simplest versions of plasticity theory. The gravity centre of the book seems to be Chapter 3. Here the constitutive equations for the bodies with non-linear, amplitude-dependent dry-friction-type, internal friction are given, and the harmonic linearization method is proposed to analyse the steady vibrations of the bodies with this kind of damping. The examples of the application of this technique are given in Chapter 5. Stationary random vibrations in bodies with non-linear damping are discussed in Chapters 6 and 7. Wave propagation, mainly in one-dimensional systems, is considered in Chapter 8, in particular, to assess the distance to the cross-section beyond which the wave motion, due to the non-linear damping, does not propagate.

The Russian edition of this book was published in 1976. This edition, revised and supplemented, was translated by Prof. A. K. Belyaev. The translation is adequate and easy to read. The references, following the original version of the book, are addressed mostly to publications in Russian. Some errors are met in the reverse translation of the English references.

The book is a good supplement to the literature on the theory of vibrations and structural dynamics. It should find a proper place on the shelves of the researchers in this topic.

V. V. BOLOTIN

CRACKS AND FRACTURE, 1999, by K. B. Broberg. San Diego: Academic Press. xvi + 752 pp. Price USD 99.95. ISBN 0-12-134130-5.

This book covers the subject of fracture in relation to cracking of materials in a volume of some 700 pages, including appendices. In support of the text the author cites upwards of 900 references. The book is divided into nine chapters. Starting with a somewhat phenomenological discussion of the process region at a crack tip, it introduces the reader to the basic relationships in crack mechanics. The book covers elasto-static cracks and the associated elasto-static plastic effects together with elasto-dynamic cracks, including elasto-plastic dynamic effects. The subject of cracks in visco-elastic materials is also covered. It concludes with chapters on the physical and engineering aspects of fracture and dynamic processes.

This is a comprehensive text and is the result of the author's efforts over a 25 year period: it might be better described as a treatise on fracture. The treatment of the material is somewhat mathematical and the book will undoubtedly appeal to those interested in fracture from a mathematical or a fundamental standpoint. The results of the mathematical derivations are illustrated throughout the text, with schematic diagrams to aid understanding. *Cracks and Fracture* predominately covers material behavior that is isotropic. Inhomogeneous materials are included only through the study of stationary and dynamic interface cracks. Also excluded is the subject of fracture in relation to fatigue resulting from cyclic loading. Predominantly, the book excludes comparisons with actual material data and fracture results, and will not be as useful to those looking for information relative to specific materials and fracture applications. The author provides coverage of analytical aspects of fracture mechanics with detailed derivations. The subject of numerical modelling has been largely excluded in the book, and will be less appealing to those whose interests lie in computational fracture mechanics. Within these limitations, *Cracks and Fracture* will find its place as a source of reference on the mathematics and concepts in fracture mechanics covering, as it does, a wide range of topics. It will be especially valuable for those researchers wishing to locate the results that are available in the important and developing field of dynamic fracture.

D. J. CARTWRIGHT

DICTIONARY OF HEARING, 1999, edited by M. C. Martin and I. F. Summers. London: Whurr Publishers. 108 pp. Price (soft cover) £19.50. ISBN 1 86156 132 6.

Hearing science and its associated topics cover a wide multidisciplinary range, covering acoustics, audiology, electronics, medicine, speech sciences and rehabilitation to mention just a few. This small specialist dictionary aims to define terms that are in use in the hearing sciences that may be unfamiliar to readers coming from one of the many disciplines. It is deliberately set out at a basic level and does not attempt to define highly specialized terms, although the authors admit that the selection of terms included is a matter of the personal preference of the authors. Some terms are defined exactly as in international standards, and the authors are well qualified in their knowledge of the standards scene. They have also sought advice from other notable experts in the U.K. and elsewhere, giving appropriate acknowledgements.

Each definition consists of one or more lines of text. In some instances there is a little further explanation extending to perhaps a dozen lines of a two-column page. In exceptional cases, there is a more extensive explanation including figures. Examples include the audiogram and the ear. Entries are arranged in a conventional alphabetic format with extensive cross-references, mainly of synonyms. The typeface is quite large for a dictionary making easy reading. A useful appendix lists British and international standards relevant to hearing, with both old and new numbering systems.

The coverage is extremely thorough and this reviewer had to think hard for the following examples that might usefully have been added: articulation index, conductance, speech transmission index, suppression, susceptance, temporal modulation, transfer function and unmasking. The main body of text is commendably free of typographic errors, but the introduction was less carefully proofed. There were a few instances where the definitions or explanations were debatable, such as for automatic volume control, noise immission level and visual response audiometry, but these few instances should be set against the huge number of items where the definitions were accurate and commendably succinct.

In summary, this volume certainly achieves its aims and would be a useful addition to the personal bookshelves of a wide variety of professionals. Libraries would find this low-cost volume an essential purchase. It would also be a suitable purchase for undergraduate students in acoustics or audiology, and to postgraduate students from a much wider range of disciplines. This reviewer anticipates using it frequently.

M. E. Lutman

COMPUTATIONAL STOCHASTIC MECHANICS, 1998, edited by P. D. Spanos. Rotterdam: A. A. Balkema. 620 pp. Price EUR 115.00, USD 135.00, £81.00. ISBN 90 5809 0396.

This volume, the Proceedings of the Third International Conference on Computational Stochastic Mechanics, held at Thera, Santorini, Greece, dedicated to Professor T. K. Caughey of the California Institute of Technology on the occasion of his 70th birthday anniversary on 27 October 1997, contains 70 papers grouped in 10 categories covering many specialized and important topics. It is a sequel to a previous volume of the same title [1]. Each of the 10 categories can itself be an international conference. The duration separating this volume and the previous one [1] is four years. The conference co-chairmen and members of the Scientific Committee include many of the who's who in the field of stochastic mechanics. The contributions by many members of the Scientific Committee and participants reflect the contemporary directions of research and interests in the field. Apparently, while all the investigations reported in these 70 papers were clearly motivated by and based on practical problems and applications, further developments of the many proposed computational techniques are required before they can be implemented in engineering practice. This is a specialist volume and therefore, the mathematical training required for the readers is that of a post graduate with at least a first degree in engineering science.

The first category, *Monte Carlo and signal processing*, includes six papers exemplifying by the solution of solid mechanics, problems with Neumann boundary conditions (M. Grigoriu), simulation of non-Gaussian processes (K. R. Gurley and A. Kareem), and intelligent Monte Carlo simulation and discrepancy sensitivity (E. A. Johnson, L. A. Bergman and B. F. Spencer, Jr). The paper by Grigoriu also presented computed local solution of a beam in bending, a two-dimensional heat equation, and a two-dimensional transport equation.

The second category, *Random vibrations*, has 11 papers and is represented by solution of multidimensional non-linear vibration with application to non-linear plates (R. Bouc and M. Defilippi), Slepian modeling method for the analysis of hysteretic structures (O. Ditlevsen and N. J. Tarp-Johansen), and first excursion probability by pseudo-analytical method (M. Hoshiya, K. Komiya and A. Sutoh). In the above first two papers, modal transformation was applied to multi-degrees-of-freedom systems. Furthermore, the first paper assumed small dampings and external random excitations. The second paper also included computed results of a single-degree-of-freedom elasto-plastic oscillator.

The third category, *Safety and reliability*, contains 12 papers. Examples are the use of sensitivity operators in the reliability analysis of structures (A. Mohamed and M. Lemaire), time-dependent stress voiding reliability of electronic circuits (D. Robinson, S. Mahadevan and Z. Guo), and stochastic damage process and reliability analysis of wooden structures with uncertain properties (Y. Suzuki and T. Araki).

The fourth category, *Control/optimization and modelling of non-linearity*, has six papers. Examples include the adaptation of state covariance assignment method to control a system with elasto-plastic hysteresis (L. A. Bergman, S. F. Wojthiewicz and G. Turan), model updating using dynamic data: non-identifiable cases (L. S. Katafygiotis, T. Y. P. Chang and H. F. Lam), and extended Laguerre polynomials for non-linear stochastic systems (W. V. Wedig and U. von Wagner). The paper by Bergman *et al.* also presented computed result of two single-degree-of-freedom systems.

The fifth category, *Earthquake engineering* which includes six papers, exemplifies by evaluation of accidental eccentricity, provisions in codified seismic design (S. Balopoulou and M. Grigoriu), reliability assessment of wood shear walls under earthquake excitation (A. Ceccotti and R. O. Foschi), and response variability for a structure with soil–structure interacting systems and uncertain soil properties (S. Jin, S. Sarkani and L. D. Lutes).

The sixth category, *Random processes and fields*, contans six papers. It includes examples on stochastic Newmark's method (P. Bernard and G. Fleury) which is a different approach from that presented earlier by this reviewer [2], generalized cell mapping versus path integration (A. Naess and V. Moe), and extreme value theory: application to design wind predition (W. Xu, A. M. Dougherty and R. B. Corotis).

The seventh category, *Damage/fatigue-materials*, has six papers that are exemplified by zero and non-zero mean random vibration analysis of multi-degrees-of-freedom hysteretic systems using a direct linearization technique (L. Duval, S. Dobson, M. N. Noori, Z. Hou and H. Davoodi), frequency-independent dissipation and causality (N. Makris), and residual longevity and safety monitoring expert system for large-scale objects (S. A. Timashev and I. L. Yablonskikh).

The eighth category, *Applied probabilisitic analysis*, also contains six papers. Typical examples are filter approach to the stochastic analysis of multi-degrees-of-freedom offshore structures (S. Benfratello and M. Di Paola), and composite stochastic processes and road vehicle response (K. Sobczyk, L. Gajek and M. Kaluszka).

The ninth category, *Finite elements analysis and modelling*, again presents six papers exemplified by finite element solution of the Fokker–Planck equation (C. Floris and A. Frigerio), finite element method based on variational principles for stochastic beams under random loading: a case of large deviations (N. Impollonia and I. Elishakoff), stochastic response evaluation of large finite element models with non-linear hysteretic elements (H. J. Pradlwarter and G. I. Schueller). In this latter paper application of complex component mode synthesis in the context of statistical equivalent linearization was made.

The final category, *Concrete and geotechnical applications*, has five papers. This final category is exemplified by probabilistic assessment of the strength of tied high-strength columns (S. M. C. Diniz), and a semi-Markov approach in the reliability of existing buildings affected by wearing (E. Garavaglia and C. Molina).

An author index including 138 authors is also provided at the end of this volume.

As stated by the editor in the introduction of the preface to this volume the aim of the series of conferences was to provide a forum for exchanging ideas on the status of computational methods as applied to stochastic mechanics and identifying needs for further research. With the many topics covered in this volume it seems that such an aim is appropriately achieved. Nevertheless, after reading this volume twice it leaves this reviewer with a feeling of a definite need to exploit fully the power of commonly available and easily accessible computing machines at levels ranging from high-end desk tops, engineering workstations and large-scale computing machines.

In conclusion and on balance, the volume being reviewed is an important addition to any serious research or practicing engineer's bookcase.

C. W. S. To

REFERENCES

1. P. D. Spanos (editor) 1995 *Computational Stochastic Mechanics*. Rotterdam: Balkerma.
2. C. W. S. To 1992 *Computers and Structures* **44**, 667–673. A stochastic version of the Newmark family of algorithms for discretized dynamic systems.

PROGRESS IN DURABILITY ANALYSIS OF COMPOSITE SYSTEMS, 1998, K. L. Reifsnider, D. A. Dillard, and A. H. Cardon, editors. Rotterdam: A. A. Balkema. xi + 358 pp. Price HFL 190.00, USD 95.00, £64.00, ISBN 90 5410 960 2.

This book comprises the Proceedings of the Third International Conference on Progress in Durability Analysis of Composite Systems, held in Blacksburg, VA, U.S.A. in September 1997. The volume includes a total of 48 papers.

Durability issues, include damage tolerance, life prediction, and reliability as well as the more traditional aspects such as creep, fatigue, fracture, aging and moisture ingestion. These issues are most crucial to the performance of composites, and thus this volume should be of interest to all researchers and practitioners in this area.

The type of composite most considered was of course, polymer–matrix composites. However, the applications were very wide ranging from marine structures to offshore-platform risers, from civil infrastructure to aircraft-engine components.

One might ask what is the connection between the subject of this volume and the technical specialties, sound and vibration, of the readers of this journal. The connection to sound is nil. However, some of the papers are indirectly related to vibration: nine papers are devoted to traditional fatigue (failure due to repeated loading), one is concerned with repeated impact, and one involves residual compressive strength after low-velocity impact.

C. W. BERT

FUNDAMENTALS OF NOISE AND VIBRATION, 1998, F. J. Fahy and J. G. Walker, editors, London: E. & F. N. Spon. xvii + 518 pp. Price (soft cover) £39.99. ISBN 0419227008.

This is the first of two books based on graduate-level courses on noise and vibration taught at the Institute of Sound and Vibration Research (ISVR) at the University of a Southampton. This book is intended to provide an introduction for those who have a degree in engineering, physics or mathematics but do not have any special training in acoustics and wish to increase their technical understanding of the control of noise and vibration. A promise is given that a companion book on advanced topics in noise and vibration will soon follow.

This, the first of the two books, contains eight chapters, each written by a different author from ISVR. Each of the eight authors has written a chapter in his area of expertise so that the book is similar to a series of guest lectures covering different but related topics in noise and vibration.

The first chapter, written by P. A. Nelson, is an introduction to many of the basic principles of acoustics in fluids. Topics in this chapter include acoustic wave propagation, superposition, acoustic impedance, intensity and power, acoustic resonances, radiation from vibrating surfaces, Green's function, the Kirchhoff–Helmholtz integral equation and the principle of reciprocity. Although this chapter does provide a good foundation, it does leave the reader hanging with only a cursory discussion of the Kirchhoff–Helmholtz integral equation which is never seen again in this book. An example of the application of this equation, e.g. to a baffled piston or a finite baffled plate vibrating at resonance, or the relation of the Kirchhoff–Helmholtz equation to boundary element methods would have been helpful in the understanding of this equation which is basic to modelling acoustic radiation.

Chapter 2 is devoted to the fundamental mechanisms of vibration. This chapter, written by N. Lalor, begins with the simple oscillator to illustrate natural frequencies of vibration, vibration transmissibility and the effects of damping on vibration response. Puretone, transient and broadband steady state excitations are considered. Coupled oscillators, including the passive dynamic absorber, are discussed in Chapter 2. There is no mention of wave propagation in structures, such as bending waves in plates and beams, in this chapter. Perhaps this will be covered in the companion book. However, because wave propagation in structures seems fundamental to noise and vibration, I would have liked to have seen it considered here early in the book, where it would have been helpful to the understanding of trace wavenumbers and critical frequency used in the discussion of sound transmission throgh partitions in Chapter 5.

At this point, the subject changes from the objective, i.e. basic mechanics of sound and vibration, to the subjective, i.e. the human responses to sound (in Chapter 3) and vibration (in Chapter 4). Chapter 3, written by I. H. Flindell, begins with discussions on the effects of noise on disturbing human activities, such as speech and sleep, as well as subjective responses, such an annoyance. A brief discussion of sound quality is included, followed by consideration of the mechanisims of human hearing and measures of subjective human responses to noise, such as loudness and masking. The subject then shifts to the measurement of noise levels, and the use of measured levels in noise ratings, such as noise rating (NR) curves, sound exposure level (SEL) and statistical levels (L_n). A brief discussion of digital frequency analysis is presented. The chapter closes with a discussion of community noise. Although it contains good review of human responses to noise, this chapter fails to provide the reader with methods for the quantification of the effects of noise necessary for the setting of definitive goals for noise treatments. This is reflected in the fact that, unlike other chapters, this chapter and Chapter 4 do not have problems at the end of the chapter.

In Chapter 4, M. J. Griffin considers human responses to vibration. These include whole-body vibration, such as that experienced by someone seated in a vehicle, and vibration transmitted to the hand holding a vibrating tool. The effects of frequency and duration of exposure are reviewed, and criteria for acceptable vibration levels presented. A brief discussion on motion sickness is included in this chapter.

Methods for the control of noise and vibration are discussed by F. J. Fahy in Chapter 5. This chapter begins with an overview of the basic mechanisms and methods of characterizing noise from several common sources. Methods of measuring the power of sound radiated by sources of noise in reverberation and anechoic rooms are discussed. Passive methods of controlling airborne noise at the source and along transmission paths from the source to a receiver are reviewed. Mechanisms of sound absorption by porous materials, sound transmission through partitions and around barriers are discussed. Methods of vibration control are considered next, which includes resilient mounting systems and damping treatments. Unlike most books on noise and vibration control, there is a nice balance between theory and practical guidelines in this chapter which provides the reader with many useful approaches to noise and vibration control that are underpinned by an understanding of the basic mechanisms involved in the treatment.

Chapter 6 on the fundamentals of signal processing is authored by J. K. Hammond. This chapter begins by introducing the Fourier transform which forms the basis for narrow-band digital processing of noise signals. Properties of Fourier transforms, such as the effect of a time delay, convolution, windowing and uncertainty, are reviewed. Digital sampling of analog signals and the fast Fourier transform (FFT) are discussed. The statistics of random processes are considered next in this chapter. This includes treatments of probability distributions, power spectral densities, and auto- and cross-covariances. Relations between random signal inputs and system outputs are discussed. The chapter closes with an overview of signal processing based on single recordings. Methods of estimating the power spectral density and coherence, and the errors associated with these estimates are discussed. In my judgement, this chapter meets its objective in providing a solid introduction to most of the common methods of signal processing that are used in the analysis of noise and vibration signals. It also provides information often essential to the experimentalist in obtaining quality processing of measured data.

Chapter 7 is devoted to underwater acoustics and is authored by T. G. Leighton. The first topic in this chapter is the propagation of sound in the ocean and ray tracing where the sound speed varies with depth. Geometric and absorptive propagation losses are discussed. The effects of bubbles on sound propagation and ambient noise are given extensive treatment, with the effect of the ocean bottom on propagation given only cursory treatment. There are sections on non-linear underwater acoustics in shock waves, acoustic streaming, self-focusing of radiation from transducers and receiving properties of parametric arrays. The chapter closes with a section on medical ultrasonics. The only justification offered for adding the section on medical ultrasonics to this chapter on ocean acoustics is that propagation properties in oceans and living tissue are similar.

The final chapter in this book is Chapter 8 written by R. J. Pinnington on measurement and analysis techniques. Ideal transfer functions are the first topic in this chapter. Four-pole parameters and electro-mechanical analogs are used in the analysis of the interaction between the mechanical system and measuring sensor. Limitations on the frequency range over which valid measurements can be obtained are discussed. The chapter closes with a brief discussion on sources of measurement noise and calibration. The importance of proper calibration is mentioned and then dropped with little discussion. Also, there is little discussion on the working mechanisms of transducers, which play an important role in any measurement system.

Each chapter has a very useful list of references. There are questions and problems at the end of all of the chapters, except Chapters 2 and 3 on human responses to sound and vibration respectively. The book includes a subject index.

This book contains a lot of information that should be very useful to anyone involved in the control of noise and vibration. Each chapter is well written and easy to follow. Most of the chapters are backed by an appropriate level of mathematics and theory. The book does require some technical training and familiarity with calculus to be easily read with comprehension. However, I would find it difficult to use it as a textbook for a graduate-level course in acoustics and vibration. The changes in topics between chapters are not cohesive and the depth of the treatment of some of the subjects are inadequate for a course at the graduate level.

C. B. Burroughs

ACOUSTICAL ASPECTS OF WOODWIND INSTRUMENTS (revised edition), 1999, by C. J. Nederveen. DeKalb, Illinois: Northern Illinois University Press. 160 pp. Price (soft cover) USD 28.00. ISBN 0-87580-577-9.

The book "Acoustical Aspects of Woodwind Instruments" was first publised in 1969 by Frits Knuf, and served also as a thesis for the Ph.D. degree, under the supervision of Prof. C. W. Kosten. The present second edition is a reprint of the 1969 edition (108 pp.) with an addendum (34 pp.) entitled "Developments since 1969".

As stated by the author, "the aim of the investigation was to find a method for calculating the right position and size of the holes of a woodwind instrument". It is actually focussed on an essential attribute of musical instruments: the pitch, i.e., for the physicist, the natural frequencies. The whole book investigates the different parameters influencing tuning, the initial version giving the essential features, and the addendum giving more precise results or treating some problems absent in the first edition.

The first edition was presented with a very logical organization, each chapter being concluded by a useful recapitulation. The first investigated subject (Chapter 2) is the behaviour of instruments of simple shape, either cylindrical or conical: a study of the deviation from the simplest theory is given, analyzing with many details the effects of viscosity, heat conduction, temperature, etc., and the effects of the excitation mechanism, such as flute-like excitation, and single or double reeds. Many original results, both theoretical and experimental, can be found, e.g., the visco-thermal effects in cones, or the effect of the different parameters of a reed.

The second topic (Chapter 3) to be investigated is concerned with bore perturbations, such as toneholes, open or closed, or cross-sectional variations. Again, many original results are given, such as approximation for holes effects, and the analysis of the effect of a closed hole. The first edition is terminated by a very impressive, systematic comparison between theory and experiment for flutes, clarinets, saxophones, oboes, and bassoons (Chapter 4). It must be emphasized that the first task to be done for such a comparison is a precise measurement of the geometry of the instruments: all details are given, everybody being able to check all results. It represents an enormous work. This comparison is, in general, very satisfactory, with a profound analysis of the possible causes of discrepancies. Thanks to its concrete character, this chapter is probably a fine possible entry in the book for makers.

In the Appendix, C. J. Nederveen revisits many subjects treated in the first version: holes, flanges, bends, damping, etc., Like the first version, it is based upon a very careful knowledge of the literature (with a rather exhaustive list of references) and also on new personal results and views. It is impossible to quote all useful remarks and original explanations; one can choose as a good example the comparison between a clarinet and a soprano saxophone. In the conclusions section, the author gives proposals for investigations on woodwind instruments.

One can conclude by general comments on this book. Because numerical computation was rather difficult in the 1960s, many efforts have been devoted to the statement of approximate, analytical formulae. Such results are very useful in order to modify an instrument, e.g., a hole or the bore, a very common work of makers (actually makers seldom design a new instrument *ex nihilo*). Because woodwind instruments are, in general, built with rather simple basic shapes, a very efficient approach to their natural frequencies is the addition of the different "length corrections" due to the different deviations from the simplest shapes analyzed by using the simplest models. Obviously, the work is limited to one attribute of woodwinds only, the tuning, but the other attributes, such as amplitudes, tone colour or intonation, are much more difficult to investigate, and research advances in this domain are rather recent and much less precise, because of the complexity of non-linear phenomena. Fortunately, these other attributes have, in general, a small influence, either physical or perceptive, on tuning. Fortunately also, for makers or even instrumentalists, natural frequencies are also the most easy to measure and to relate to perceptive attributes. All these remarks explain why this book, containing numerous data (geometric, formulae, references, etc.) will be very useful, today and for long into the future, not only to scientists but also to makers.

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