Acoustic Analysis Of An Active Noise Control Exhaust

This book will give a physical insight into the modern field of active sound and vibration control. It will present the latest technology and achievements. The approach is generally design orientated and has a viewpoint different to other publications.

This major work is the first to treat the active control of both sound and vibration in a unified way. It outlines the fundamental concepts, explains how a reliable and stable system can be designed and implemented, and details the pitfalls . It covers sound in ducts, sound radiation, sound transmission into enclosures, structural vibration and isolation, electronic control system design, and sensors and actuators.

Analysis, Design, and Implementation of Active Vibro-acoustic Control Systems with Random ExcitationsAutomotive NVH TechnologySpringer

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Control of Noise and Structural Vibration presents a MATLAB®-based approach to solving the problems of undesirable noise generation and transmission by structures and of undesirable vibration within structures in response to environmental or operational forces. The fundamentals of acoustics, vibration and coupling between vibrating structures and the sound fields they generate are introduced including a discussion of the finite element method for vibration analysis. Following this, the treatment of sound and vibration control begins, illustrated by example systems such as beams, plates and double walls. Sensor and actuator placement is explained as is the idea of modal sensor–actuators. The design of appropriate feedback systems includes consideration of basic stability criteria and robust active structural acoustic control. Positive position feedback (PPF) and multimode control are also described in the context of loudspeaker–duct and loudspeaker–microphone models. The design of various components is detailed including the analog circuit for PPF, adaptive (semi-active) Helmholtz resonators and shunt piezoelectric circuits for noise and vibration suppression. The text makes extensive use of MATLAB® examples and these can be simulated using files available for download from the book’s webpage at springer.com. End-of-chapter exercises will help readers to assimilate the material as they progress through the book. Control of Noise and Structural Vibration will be of considerable interest to the student of vibration and noise control and also to academic researchers working in the field. It’s tutorial features will help practitioners who wish to update their knowledge with self-study.

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This book provides the reader with empirical findings on innovative signal processing approaches to detecting pathologies in infant cries, by comparing new technological approaches to standard ones. The contributors examine novel approaches to machine adaptation to dysarthric speech.

Recent technological advances in the development of fast digital signal processors have made the active control of sound a practical proposition. This book brings together results from research in the two disciplinesof acoustics and signal processing and presents the fundamentals of noise control in a unified manner. Practical applications are presented wherever possible although the emphasis is on the algorithmic principles which form the foundation of practical systems. The volume is written in textbook style and aimed at both undergraduate and postgraduate students of acoustics and signal processing, professional acoustical and electrical engineers, and researchers in the field of active control." Key Features * Presents the fundamental principles governing both the physical properties of sound fields and modern digital techniques for processing acoustic signals * Describes the physical mechanisms and energy interchanges involved in active control of sound for one- and three-dimensional problems * Presents the principles and practicalities of the design of single- and multi-channel controllers for both random and deterministic sound fields

'The text is well written and supported by clear and useful illustrations. This would be a useful textbook for postgraduate or advanced undergraduate studies and would also make a good introductory text for engineers moving into the field. The literature survey and bibliography provide a useful starting point for further study.'The Aeronautical JournalActive Control of Aircraft Cabin Noise provides a bridge to fill the gap between robust control theory and practical applications of active noise control systems in aircraft cabin. Both the possibilities and limitations of structural solutions to enhance aircraft cabin comfort by reducing interior noise are discussed supported by a wide range of topics in engineering, from finite element modeling to multichannel adaptive feed-forward control, usually dealt separately in the literature. In addition, experimental noise attenuation results with passengers' subjective perceptions predicting the effects of cabin noise on comfort assessments is examined. Theoretical and experimental research is detailed enough to capture the interest of the non-expert in engineering who wishes to have an overview of some of the active noise control applications in aircraft. This book may be used as an advanced textbook by graduate and undergraduate students in aeronautical engineering, and would be an authoritative resource book for research into the subject.

Active Structural Acoustic Control (ASAC) is a subcategory of the more widely known field of Active Noise control (ANC). ASAC is different from traditional ANC methods because it seeks to attenuate noise by altering the noise producing structure instead of altering the acoustic waves traveling through the air. The greatest challenge currently facing ASAC researchers is that a suitable parameter has not yet been discovered which can be easily implemented as the minimization quantity in the control algorithms. Many parameters have been tried but none effectively

attenuate the sound radiation in a way that can be easily implemented. A new parameter was recently developed which showed great potential for use as a minimization quantity. This parameter has been termed the "weighted sum of spatial gradients" (WSSG) and was shown by previous researchers to significantly reduce noise emissions from a vibrating simply supported plate in computer simulations. The computer simulations indicate that WSSG-based control provides as good or better control than volume velocity and does so with a single point measurement which is relatively insensitive to placement location. This thesis presents the experimental validation of the WSSG computer simulations. This validation consists of four major components. First, additional research was needed in to extend the use of WSSG from computer simulations to experimental setups. Second, the WSSG-based control method was performed on simply supported plates to validate the computer simulations. Third, the WSSG-based control method on was used on clamped plates to validate the computer simulations, and fourth, the WSSG-based control method was validated on plates with ribs. The important results are discussed and conclusions summarized for each of these sections. Recommendations are made for future work on the WSSG parameter.

Lists citations with abstracts for aerospace related reports obtained from world wide sources and announces documents that have recently been entered into the NASA Scientific and Technical Information Database.

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By providing all the basic knowledge needed to assess how useful active noise control will be for a given problem, this book assists in the designing, setting up, and tuning of an active noise-control system. Written for students who have no prior knowledge of acoustics, signal processing, or noise control but who do have a reasonable grasp of basic physics and mathematics, the text is short and descriptive, leaving all mathematical details and proofs concerning vibrations, signal processing and the like to more advanced texts or research monographs. The book can thus be used in independent study, in a classroom with laboratories, or in conjunction with a kit for experiment or demonstration. Topics covered include basic acoustics, human perception and sound, sound intensity and related concepts, fundamentals of passive noise- control strategies, basics of digital systems and adaptive controllers, and active noise control systems.

Since the publication of the first edition, considerable progress has been made in the development and application of active noise control (ANC) systems, particularly in the propeller aircraft and automotive industries. Treating the active control of both sound and vibration in a unified way, this second edition of Active Control of Noise and Vibra Hydroacoustic tertiary (T-) waves are seismically generated acoustic waves that propagate over great distances in the ocean sound channel with little loss in signal strength. Hydrophone recorded T-waves can provide a lower earthquake detection threshold and an improved epicenter location accuracy for oceanic earthquakes than land-based seismic networks. Thus detection and location of NE Pacific ocean earthquakes along the Blanco Transform Fault (BTFZ) and Gorda plate using the U.S. Navy's SOSUS (SOund SUrveillance System) hydrophone arrays afford greater insight into the current state of stress and crustal deformation mechanics than previously available. Acoustic earthquake information combined with bathymetry, submersible observations, earthquake source-parameter estimates, petrologic samples, and water-column chemistry renders a new tectonic view of the southern Juan de Fuca plate boundaries. Chapter 2 discusses development of seismo-acoustic analysis techniques using the well-documented April 1992 Cape Mendocino earthquake sequence. Findings include a hydrophone detection threshold estimate (M~2.4), and T-wave propagation path modeling to approximate earthquake acoustic source energy. Empirical analyses indicate that acoustic energy provides a reasonable magnitude and seismic moment estimate of oceanic earthquakes not detected by seismic networks. Chapters 3 documents a probable volcanogenic T-wave event swarm along a pull-apart basin within the western BTFZ during January 1994. Response efforts yielded evidence of anomalous water-column 3He concentrations, pillow-lava volcanism, and the first discovery of active hydrothermal vents along an oceanic fracture zone. Chapter 4 discusses the detection of a NE-SW trending microearthquake band along the mid-Gorda plate which was active from initiation of SOSUS recording in August 1991 through July 1992, then abruptly ceased. It is proposed that eventual termination of the Gorda plate seismicity band is due to strain reduction associated with the Cape Mendocino earthquake sequence. Chapter 5 combines bathymetric, hydro-acoustic, seismic, submersible, and gravity data to investigate the active tectonics of the transform parallel Blanco Ridge (BR), along the eastern BTFZ. The BR formation mechanism preferred here is uplift through strike-slip motion (with a normal component) followed by formation and intrusion of mantle-derived serpentinized-peridotite into the shallow ocean crust. The conclusion considers a potential link between the deformation patterns observed along the BTFZ and Gorda plate regions.

An analysis of the major topics in sound suppression and noise control for the analysis and design of acoustical mufflers, air conditioning and ventilation duct work. Both fundamentals and the latest technology are discussed, with an emphasis on applications.

This book presents seven chapters examining selected noise, vibration and harshness (NVH) topics that are highly relevant for automotive vehicle development. These include applications following the major trends toward increased passenger comfort, vehicle electrification and lightweight design. The authors of the seven chapters, all of which are

experts from the automotive industry and academia, present the foremost challenges and potential solutions in this demanding field. Among others, applications for sound optimization in downsized engines, noise optimization in electric powertrains, weight reduction options for exhaust systems, porous materials description, and the vibro-acoustic analysis of geared systems are discussed.

Offering complete and comprehensive coverage of modern sonar spectrum system analysis, Underwater Acoustics: Analysis, Design and Performance of Sonar provides a state-of-the-art introduction to the subject and has been carefully structured to offer a much-needed update to the classic text by Urick. Expanded to included computational approaches to the topic, this book treads the line between the highly theoretical and mathematical texts and the more populist, non-mathematical books that characterize the existing literature in the field. The author compares and contrasts different techniques for sonar design, analysis and performance prediction and includes key experimental and theoretical results, pointing the reader towards further detail with extensive references. Practitioners in the field of sonar design, analysis and performance prediction as well as graduate students and researchers will appreciate this new reference as an invaluable and timely contribution to the field. Chapters include the sonar equation, radiated, self and ambient noise, active sonar sources, transmission loss, reverberation, transducers, active target strength, statistical detection theory, false alarms, contacts and targets, variability and uncertainty, modelling detections and tactical decision aids, cumulative probability of detection, tracking target motion analysis and localization, and design and evaluation of sonars

Acoustics is the science concerned with the production, control, transmission, reception, and effects of sound. Its origins began with the study of mechanical vibrations and the radiation of these vibrations through mechanical waves, and still continue today. Research was done to look into the many aspects of the fundamental physical processes involved in waves and sound and into possible applications of these processes in modern life. The study of sound waves also leads to physical principles that can be applied to the study of all waves. The broad scope of acoustics as an area of interest and endeavour can be ascribed to a variety of reasons. First, there is the ubiquitous nature of mechanical radiation, generated by natural causes and by human activity. Then, there is the existence of the sensation of hearing, of the human vocal ability, of communication via sound, along with the variety of psychological influences sound has on those who hear it. Such areas as speech, music, sound recording and reproduction.

Launch loads, both mechanical and acoustic, are the prime driver of spacecraft structural design. Passive approaches for acoustic attenuation are limited in their low frequency effectiveness by constraints on total fairing mass and payload volume constraints. Active control offers an attractive approach for low frequency acoustic noise attenuation inside the payload fairing. Smart materials such as piezoceramics can be exploited as actuators for structural-acoustic control. In one active approach, structural actuators are attached to the walls of the fairing and measurements from structural sensors and/or acoustic sensors are fed back to the actuators to reduce the transmission of acoustic energy into the inside of the payload fairing. In this paper, structural-acoustic modeling and test results for a full scale composite launch vehicle payload fairing are presented. These analytical and experimental results fall into three categories: structural modal analysis, acoustic modal analysis, and coupled structural-acoustic transmission analysis. The purpose of these analysis and experimental efforts is to provide data and validated models that will be used for active acoustic control of the payload fairing. In the second part of the paper, this closed-loop acoustic transmission reduction is implemented and measured on a full-scale composite payload fairing.

Recent research has aimed to apply multi-channel active noise control (ANC) to the sound transmitted through open windows. Moderate success, i.e. overall reductions of -10 dB, has been reported in the literature, though not all results have been over a wide range of frequencies, and not all reductions have necessarily been identified as global. Typical loudspeaker arrays used in multi-channel ANC systems for window noise have fallen into two categories: uniformly distributed and edge distributed. The acoustically superior former has demonstrated larger reductions in sound energy over wide frequency ranges, while the the latter has been shown to retain normal functionality of a window at the expense of limited sound reduction. The research outlined in this thesis was undertaken to assess the feasibility of using a cell-based sparse array of loudspeakers for multi-channel active control of window noise. The overarching objectives were to design, model, build, and test a sparse array system that would feature both of the above advantages: large reductions in sound energy and retained window functionality. Analytical models of an array-fitted open window system were developed, eventually culminating in an optimization-based scheme to solve for the ideal source strengths for the array elements and to predict the level of reduction in total sound power. The results of this model suggested that for a 0.45 m square rectangular opening, fitted with a 72-element 4-cell sparse array, large reductions (greater than -60 dB) were possible up to a frequency of 1200 Hz. Desirable reductions (at least -10 dB) were predicted up to 1550 Hz for the given system. A prototype array and window system was constructed and calibrated through measurement. Directivity measurements were performed on the prototype array to assess the reproducibility of the theoretically derived beam patterns. The measured data showed desirable reproduction below 700 Hz.

The advent of instruments capable of measuring sound intensity, which represents the flow of energy in sound fields, has revolutionised audio-frequency acoustical metrology. Since publication of the first edition, two International Standards for the use of sound intensity for sound source power determination, and one International Standard for sound intensity instrumentation, have also been published. A number of International Standards have also been developed.

This volume presents the proceedings of the Asia-Pacific Vibration Conference (APVC) 2019, emphasizing work devoted to Vibration Engineering for a Sustainable Future. The APVC is one of the larger conferences held biannually with the intention to foster scientific and technical research collaboration among Asia-Pacific countries. The APVC provides

a forum for researchers, practitioners, and students from, but not limited to, areas around the Asia-Pacific countries in a collegial and stimulating environment to present, discuss and disseminate recent advances and new findings on all aspects of vibration and noise, their control and utilization. All aspects of vibration, acoustics, vibration and noise control, vibration utilization, fault diagnosis and monitoring are appropriate for the conference, with the focus this year on the vibration aspects in dynamics and noise & vibration. This 18th edition of the APVC was held in November 2019 in Sydney, Australia. The previous seventeen conferences have been held in Japan (‘85, ’93, ‘07), Korea (’87, ’97, ‘13), China (’89, ’01, ’11, ‘17), Australia (’91, ‘03), Malaysia (’95, ‘05), Singapore (‘99), New Zealand (‘09) and Vietnam (‘15).

A complete analysis of the structure-borne noise transmission paths of an automotive suspension assembly is presented. First, a fully-instrumented test bench consisting of a wheel/suspension/lower suspension A-arm assembly was de- signed in order to identify the vibro-acoustic transmission paths (up to 250 Hz) for white noise excitation of the wheel. Second, an analysis of the vibro-acoustics of the suspension is presented; an overview of the Frequency Response Functions (FRF) is introduced and their respective modal behaviors are described. Frequency response function measurements between the excitation signal and each suspen- sion/chassis linkages are used to characterize the di(r)erent transmission paths that transmit energy through the chassis of the car. Finally, a synthesis of the major modal contributions of the suspension is drawn, with the objective of indicating which suspension transfer paths contribute the most to the structural forces trans- mitted to the chassis. Modal transmissibility factors (MTF) were calculated to pro- vide an overall classi-cation of the modes to the vibration transmission through the individual suspension linkages and the orthogonal directions."

Vehicle noise, vibration and harshness (NVH) problems can be analyzed using numerical methods such as finite element and boundary element analysis approaches, which are generally complex and time consuming. In order to speed the analysis and reduce the calculation burden, an enhanced, simplified numerical acoustic cavity formulation is developed, used and verified for the analysis of several vehicle NVH problems. The simplified model can incorporate multiple acoustic cavities joined by flexible panels to represent adjacent vehicle compartments. Several models are created with different cavity and panel configurations, and transfer functions predicted by these models are compared with corresponding transfer functions from measured vehicle data. The comparison results show that the developed simplified model provides reasonable accuracy for the analysis and simulation of vehicle compartment acoustics. While the initial goal of the simplified model was to develop a tool to observe general trends and effects associated with perturbations in the dimensions and configurations of joined vehicle compartments, results show sufficient accuracy for the model to be used for more detailed analyses as well. Additionally, an active noise control (ANC) system is proposed for tuning vehicle interior response, whereas traditional vehicle ANC is intended to suppress unwanted vehicle response. The proposed concept is adapted from the basic filtered-x least mean squares (FXLMS) algorithm and is studied numerically, utilizing simulated control input speakers inside the passenger compartment. An optimal configuration of these speakers is determined in order to maximize the effectiveness of the ANC system and then the proposed approach is demonstrated using a powertrain noise example in which individual engine firing orders are targeted for shaping either by reducing or enhancing the spectral content.

About the book: This book is the first comprehensive review on acoustic metamaterials; novel materials which can manipulate sound waves in surprising ways, which include collimation, focusing, cloaking, sonic screening and extraordinary transmission. It covers both experimental and theoretical aspects of acoustic and elastic waves propagating in structured composites, with a focus on effective properties associated with negative refraction, lensing and cloaking. Most related books in the field address electromagnetic metamaterials and focus on numerical methods, and little (or no) experimental section. Each chapter will be authored by an acknowledged expert, amongst the topics covered will be experimental results on non-destructive imaging, cloaking by surface water waves, flexural waves in thin plates. Applications in medical ultrasound imaging and modeling of metamaterials will be emphasized too. The book can serve as a reference for researchers who wish to build a solid foundation of wave propagation in this class of novel materials.

Signal Processing for Active Control sets out the signal processing and automatic control techniques that are used in the analysis and implementation of active systems for the control of sound and vibration. After reviewing the performance limitations introduced by physical aspects of active control, Stephen Elliott presents the calculation of the optimal performance and the implementation of adaptive real time controllers for a wide variety of active control systems. Active sound and vibration control are technologically important problems with many applications. 'Active control' means controlling disturbance by superimposing a second disturbance on the original source of disturbance. Put simply, initial noise + other specially-generated noise or vibration = silence [or controlled noise]. This book presents a unified approach to techniques that are used in the analysis and implementation of different control systems. It includes practical examples at the end of each chapter to illustrate the use of various approaches. This book is intended for researchers, engineers, and students in the field of acoustics, active control, signal processing, and electrical engineering.

Vibration and structural acoustics analysis has become an essential requirement for high-quality structural and mechanical design in order to assure acoustic comfort and the integrity, reliability and fail-safe behavior of structures and machines. The underlying technologies of this field of multidisciplinary research are evolving very fast and their dissemination is usually scattered over different and complementary scientific and technical publication means. In order to make it easy for developers and technology end-users to follow the latest developments and news in the field, this book collects into a single volume selected, extended, updated and revised versions of papers presented at the Symposium on Vibration and Structural Acoustics Analysis, coordinated by J. Dias Rodrigues and C. M. A. Vasques, which was organised as part of the 3rd International

Conference on Integrity, Reliability & Failure (IRF'2009), co-chaired by J. F. Silva Gomes and Shaker A. Meguid, held at the Faculty of Engineering of the University of Porto, Portugal, 20-24 July 2009. These papers where chosen from the more than 60 papers presented at the conference symposium. Written by experienced practitioners and researchers in the field, this book brings together recent developments in the field, spanning across a broad range of themes: vibration analysis, analytical and computational structural acoustics and vibration, material systems and technologies for noise and vibration control, vibration-based structural health monitoring/evaluation, machinery noise/vibration and diagnostics, experimental testing in vibration and structural acoustics, applications and case studies in structural acoustics and vibration. Each chapter presents and describes the state of the art, presents current research results and discusses the need for future developments in a particular aspect of vibration and structural acoustics analysis. The book is envisaged to be an appealing text for newcomers to the subject and a useful research study tool for advanced students and faculty members. Practitioners and researchers may also find this book a one-stop reference that addresses current and future challenges in this field. The variety of case studies is expected to stimulate a holistic view of sound and vibration and related fields and to appeal to a broad spectrum of engineers such as the ones in the mechanical, aeronautical, aerospace, civil and electrical communities.