Vibration Control Of Active Structures An Introduction Solid Mechanics And Its Applications

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Vibration Control of Active Structures

My objective in writing this book was to cross the bridge between the structural dynamics and control communities, while providing an overview of the potential of SMART materials for sensing and actuating purposes in active vibration c- trol. I wanted to keep it relatively simple and focused on systems which worked. This resulted in the following: (i) I restricted the text to fundamental concepts and left aside most advanced ones (i.e. robust control) whose usefulness had not yet clearly been established for the application at hand. (ii) I promoted the use of collocated actuator/sensor pairs whose potential, I thought, was strongly underestimated by the control community. (iii) I emphasized control laws with guaranteed stability for active damping (the wide-ranging applications of the IFF are particularly impressive). (iv) I tried to explain why an accurate pred- tion of the transmission zeros (usually called anti-resonances by the structural dynamicists) is so important in evaluating the performance of a control system. (v) I emphasized the fact that the open-loop zeros are more difficult to predict than the poles, and that they could be strongly influenced by the model trun- tion (high frequency dynamics) or by local effects (such as membrane strains in piezoelectric shells), especially for nearly collocated distributed actuator/sensor pairs; this effect alone explains many disappointments in active control systems.

Vibration Theory and Applications with Finite Elements and Active Vibration Control

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

Noise and Vibration Control Engineering

A guide to the application of viscoelastic damping materials to control vibration and noise of structures, machinery, and vehicles Active and Passive Vibration Damping is a practical guide to the application of passive as well as actively treated viscoelastic damping materials to control vibration and noise of structures, machinery and vehicles. The author — a noted expert on the topic — presents the basic principles and reviews the potential applications of passive and active vibration damping technologies. The text presents a combination of the associated physical fundamentals, governing theories and the optimal design strategies of various configurations of vibration damping treatments. The text presents the basics of various damping effective treatments such as constrained layers, shunted piezoelectric treatments, electromagnetic and shape memory fibers. Classical and new models are included as well as aspects of viscoelastic materials models that are analyzed from the experimental characterization of the material coefficients as well as their modeling. The use of smart materials to augment the vibration damping of passive treatments is pursued in depth throughout the book. This vital guide: Contains numerical examples that reinforce the understanding of the theories presented Offers an authoritative text from an internationally recognized authority and pioneer on the subject Presents, in one volume, comprehensive coverage of the topic that is not available elsewhere Presents a mix of the associated physical fundamentals, governing theories and optimal design strategies of various configurations of vibration damping treatments Written for researchers in vibration damping and research, engineers in structural dynamics and practicing engineers, Active and Passive Vibration Damping offers a hands-on resource for applying passive as well as actively treated viscoelastic damping materials to control vibration and noise of structures, machinery and vehicles.

Wavelet-Based Vibration Control of Smart Buildings and Bridges

A typical engineering task during the development of any system is, among others, to improve its performance in terms of cost and response. Improvements can be achieved either by simply using design rules based on the experience or in an automated way by using optimization methods that lead to optimum designs. Design Optimization of Active and Passive Structural Control Systems includes Earthquake Engineering and Tuned Mass Damper research topics into a volume taking advantage of the connecting link between them, which is optimization. This is a publication addressing the design optimization of active and passive control systems. This title is perfect for engineers, professionals, professors, and students alike, providing cutting edge research and applications.

Uncertainty Modeling in Vibration, Control and Fuzzy Analysis of Structural Systems

Vibration is a natural phenomenon that occurs in a variety of engineering systems. In many circumstances, vibration greatly affects the nature of engineering design as it often dictates limiting factors in the performance of the system. The conventional treatment is to redesign the system or to use passive damping. The former could be a costly exercise, while the latter is only effective at higher frequencies. Active control techniques have emerged as viable technologies to fill this low-frequency gap. This book is concerned with the study of feedback controllers for vibration control of flexible structures, with a view to minimizing vibration over the entire body of the structure.The book introduces a variety of flexible structures such as beams, strings, and plates with specific boundary conditions, and explains in detail how a spatially distributed model of such systems can be obtained. It addresses the problems of model reduction and model correction for spatially distributed systems of high orders, and goes on to extend robust control techniques such as H-infinity and H2 control design methodologies to spatially distributed systems arising in active vibration control problems. It also addresses other important topics, such as actuator and sensor placement for flexible systems, and system identification for flexible structures with irregular boundary conditions. The text contains numerous examples, and experimental results obtained from laboratory-level apparatus, with details of how similar test beds may be built.

Active Control of Noise and Vibration

This book presents a comprehensive introduction to the field of structural vibration reduction control, but may also be used as a reference source for more advanced topics. The content is divided into four main parts: the basic principles of structural vibration reduction control, structural vibration reduction devices, structural vibration reduction design methods, and structural vibration reduction engineering practices. As the book strikes a balance between theoretical and practical aspects, it will appeal to researchers and practicing engineers alike, as well as graduate students.

Nonlinear Vibration with Control

During the last decades, the growth of micro-electronics has reduced the cost of computing power to a level acceptable to industry and has made possible sophisticated control strategies suitable for many applications. Vibration c- trol is applied to all kinds of engineering systems to obtain the desired dynamic behavior, improved accuracy and increased reliability during operation. In this context, one can think of applications related to the control of structures' vib- tion isolation, control of vehicle dynamics, noise control, control of machines and mechanisms and control of ?uid-structure-interaction. One could continue with this list for a long time. Research in the ?eld of vibration control is extremely comprehensive. Pr- lems that are typical for vibration control of nonlinear mechanisms and str- tures arise in the ?elds of modeling systems in such a way that the model is suitable for control design, to choose appropriate actuator and sensor locations and to select the actuators and sensors. Theobjective of the Symposium was to present anddiscuss methodsthat contribute to thesolution of such problems and to demonstrate the state of the art inthe ?eld shown by typical examples. The intention was to evaluate the limits of performance that can beachievedby controlling the dynamics, and to point out gaps in present research and give links for areas offuture research.Mainly, it brought together leading experts from quite different areas presenting theirpoints of view.

Vibration Control of Active Structures

This book presents a systematic introduction to particle damping technologies, which can be used to effectively mitigate seismic-induced and wind-induced vibration in various structures. Further, it offers comprehensive information on the latest research advances, e.g. a refined simulation model based on the discrete element method and a simplified simulation model based on equivalent principles. It then intensively studies the vibration attenuation effects of particle dampers subjected to different dynamic loads; in this context, the book proposes a new damping mechanism and “global’’ measures that can be used to evaluate damping performance. Moreover, the book uses the shaking table test and wind tunnel test to verify the proposed simulation methods, and their satisfactory damping performance is confirmed. To facilitate the practical engineering application of this technology, optimization design guidelines for particle impact dampers are also provided. In closing, the book offers a preliminary exploration of semi-active particle damping technology, which holds great potential for extension to other applications in which the primary system is subjected to non-stationary excitations.

Active and Passive Vibration Control of Structures

A text/reference on analysis of structures that deform in use. Presents a new, integrated approach to analytical dynamics, structural dynamics and control theory and goes beyond classical dynamics of rigid bodies to incorporate analysis of flexibility of structures. Includes real-world examples of applications such as robotics, precision machinery and aircraft structures.

Vibration with Control

Based on many years of research and teaching, this book brings together all the important topics in linear vibration theory, including failure models, kinematics and modeling, unstable vibrating systems, rotordynamics, model reduction methods, and finite element methods utilizing truss, beam, membrane and solid elements. It also explores in detail active vibration control, instability and modal analysis. The book provides the modeling skills and knowledge required for modern engineering practice, plus the tools needed to identify, formulate and solve engineering problems effectively.

Active and Passive Vibration Damping

This book is a companion text to Active Control of Sound by P.A. Nelson and S.J. Elliott, also published by Academic Press. It summarizes the principles underlying active vibration control and its practical applications by combining material from vibrations, mechanics, signal processing, acoustics, and control theory. The emphasis of the book is on the active control of waves in structures, the active isolation of vibrations, the use of distributed strain actuators and sensors, and the active control of structurally radiated sound. The feedforward control of deterministic disturbances, the active control of structural waves and the active isolation of vibrations are covered in detail, as well as the more conventional work on modal feedback. The principles of the transducers used as actuateors and sensors for such control strategies are also given an in-depth description. The reader will find particularly interesting the two chapters on the active control of sound radiation from structures: active structural acoustic control. The reason for controlling high frequency vibration is often to prevent sound radiation, and the principles and practical application of such techniques are presented here for both plates and cylinders. The volume is written in textbook style and is aimed at students, practicing engineers, and researchers. Combines material from vibrations, signal processing, mechanics, and controls Summarizes new research in the field

Vibration Damping, Control, and Design

“Piezoelectric-Based Vibration-control Systems: Applications in Micro/Nano Sensors and Actuators” covers: Fundamental concepts in smart (active) materials including piezoelectric and piezoceramics, magnetostrictive, shape-memory materials, and electro/magneto-rheological fluids; Physical principles and constitutive models of piezoelectric materials; Piezoelectric sensors and actuators; Fundamental concepts in mechanical vibration analysis and control with emphasis on distributed-parameters and vibration-control systems; and Recent advances in piezoelectric-based microelectromechanical and nanoelectromechanical systems design and implementation.

Spatial Control of Vibration

Real-time model predictive controller (MPC) implementation in active vibration control (AVC) is often rendered difficult by fast sampling speeds and extensive actuator-deformation asymmetry. If the control of lightly damped mechanical structures is assumed, the region of attraction containing the set of allowable initial conditions requires a large prediction horizon, making the already computationally demanding on-line process even more complex. Model Predictive Vibration Control provides insight into the predictive control of lightly damped vibrating structures by exploring computationally efficient algorithms which are capable of low frequency vibration control with guaranteed stability and constraint feasibility. In addition to a theoretical primer on active vibration damping and model predictive control, Model Predictive Vibration Control provides a guide through the necessary steps in understanding the founding ideas of predictive control applied in AVC such as: · the implementation of computationally efficient algorithms · control strategies in simulation and experiment and · typical hardware requirements for piezoceramics actuated smart structures. The use of a simple laboratory model and inclusion of over 170 illustrations provides readers with clear and methodical explanations, making Model Predictive Vibration Control the ideal support material for graduates, researchers and industrial practitioners with an interest in efficient predictive control to be utilized in active vibration attenuation.

IUTAM Symposium on Vibration Control of Nonlinear Mechanisms and Structures

Engineers are becoming increasingly aware of the problems caused by vibration in engineering design, particularly in the areas of structural health monitoring and smart structures. Vibration is a constant problem as it can impair performance and lead to fatigue, damage and the failure of a structure. Control of vibration is a key factor in preventing such detrimental results. This book presents a homogenous treatment of vibration by including those factors from control that are relevant to modern vibration analysis, design and measurement. Vibration and control are established on a firm mathematical basis and the disciplines of vibration, control, linear algebra, matrix computations, and applied functional analysis are connected. Key Features: Assimilates the discipline of contemporary structural vibration with active control Introduces the use of Matlab into the solution of vibration and vibration control problems Provides a unique blend of practical and theoretical developments Contains examples and problems along with a solutions manual and power point presentations Vibration with Control is an essential text for practitioners, researchers, and graduate students as it can be used as a reference text for its complex chapters and topics, or in a tutorial setting for those improving their knowledge of vibration and learning about control for the first time. Whether or not you are familiar with vibration and control, this book is an excellent introduction to this emerging and increasingly important engineering discipline.

Intelligent Vibration Control in Civil Engineering Structures

This text is an introduction to the dynamics of active structures and to the feedback control of lightly damped flexible structures; the emphasis is placed on basic issues and simple control strategies that work. Now in its third edition, more chapters have been added, and comments and feedback from readers have been taken into account, while at the same time the unique premise of bridging the gap between structure and control has remained. Many examples and problems bring the subject to life and take the audience from theory to practice. The book has chapters dealing with some concepts in structural dynamics; electromagnetic and piezoelectric transducers; piezoelectric beam, plate and truss; passive damping with piezoelectric transducers; collocated versus non-collocated control; active damping with collocated systems; vibration isolation; state space approach; analysis and synthesis in the frequency domain; optimal control; controllability and observability; stability; applications; tendon control of cable structures; active control of large telescopes; and semi-active control. The book concludes with an exhaustive bibliography and index. This book is intended for structural engineers who want to acquire some background in vibration control; it can be used as a textbook for a graduate course on vibration control or active structures. A solutions manual is available through the publisher to teachers using this book as a textbook.

Building Control with Passive Dampers

This book provides a comprehensive discussion of nonlinear multi-modal structural vibration problems, and shows how vibration suppression can be applied to such systems by considering a sample set of relevant control techniques. It covers the basic principles of nonlinear vibrations that occur in flexible and/or adaptive structures, with an emphasis on engineering analysis and relevant control techniques. Understanding nonlinear vibrations is becoming increasingly important in a range of engineering applications, particularly in the design of flexible structures such as aircraft, satellites, bridges, and sports stadia. There is an increasing trend towards lighter structures, with increased slenderness, often made of new composite materials and requiring some form of deployment and/or active vibration control. There are also applications in the areas of robotics, mechatronics, micro electrical mechanical systems, non-destructive testing and related disciplines such as structural health monitoring. Two broader themes cut across these application areas: (i) vibration suppression – or active damping – and, (ii) adaptive structures and machines. In this expanded 2nd edition, revisions include: An additional section on passive vibration control, including nonlinear vibration mounts. A more in-depth description of semi-active control, including switching and continuous schemes for dampers and other semi-active systems. A complet e reworking of normal form analysis, which now includes new material on internal resonance, bifurcation of backbone curves and stability analysis of forced responses. Further analysis of the nonlinear dynamics of cables including internal resonance leading to whirling. Additional material on the vibration of systems with impact friction. The book is accessible to practitioners in the areas of application, as well as students and researchers working on related topics. In particular, the aim is to introduce the key concepts of nonlinear vibration to readers who have an understanding of linear vibration and/or linear control, but no specialist knowledge in nonlinear dynamics or nonlinear control.

Active Control of Vibration

With Active Control of Structures, two global pioneers present the state-of-the-art in the theory, design and application of active vibration control. As the demand for high performance structural systems increases, so will the demand for information and innovation in structural vibration control; this book provides an effective treatise of the subject that will meet this requirement. The authors introduce active vibration control through the use of smart materials and structures, semi-active control devices and a variety of feedback options; they then discuss topics including methods and devices in civil structures, modal analysis, active control of high-rise buildings and bridge towers, active tendon control of cable structures, and active and semi-active isolation in mechanical structures. Active Control of Structures: Discusses new types of vibration control methods and devices, including the newly developed reduced-order physical modelling method for structural control; Introduces triple high-rise buildings connected by active control bridges as devised by Professor Seto; Offers a design strategy from modelling to controller design for flexible structures; Makes prolific use of practical examples and figures to describe the topics and technology in an intelligible manner.

Dynamics and Control of Structures

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.

Twelve Lectures on Structural Dynamics

Slender structures, such as towers, masis, high-rise buildings and bridges, are especially prone to wind excited vibrations. The lectures show how the susceptibility of a structure to wind excited vibrations can be assessed in early stages of design and what measures are effective for control or avoidance of vibrations. The book will be a help for all dealing with dynamic response of structures.

Advances in Rotor Dynamics, Control, and Structural Health Monitoring

This book consists of selected and peer-reviewed papers presented at the 13th International Conference on Vibration Problems (ICOVP 2017). The topics covered in this book are broadly related to the fields of structural health monitoring, vibration control and rotor dynamics. In the structural health monitoring section studies on nonlinear dynamic analysis, damage identification, viscoelastic model of concrete, and seismic damage assessment are thoroughly discussed with analytical and numerical techniques. The vibration control part includes topics such as multi-storeyed stacked tuned mass dampers, vibration isolation with elastomeric mounts, and nonlinear active vibration absorber. This book will be useful for beginners, researchers and professionals interested in the field of vibration control, structural health monitoring and rotor dynamics.

Design Optimization of Active and Passive Structural Control Systems

Structural vibrations have become the critical factor limiting the performance of many engineering systems, typical amplitudes ranging from meters to a few nanometers. Many acoustic nuisances in transportation systems and residential and office buildings are also related to structural vibrations. The active control of such vibrations involves nine orders of magnitude of vibration amplitude, which exerts a profound influence on the technology. Active vibration control is highly multidisciplinary, involving structural vibration, acoustics, signal processing, materials science, and actuator and sensor technology. Chapters 1-3 of this book provide a state-of-the-art introduction to active vibration control, active sound control, and active vibroacoustic control, respectively. Chapter 4 discusses actuator/sensor placement, Chapter 5 deals with robust control of vibrating structures, Chapter 6 discusses finite element modelling of piezoelectric continua and Chapter 7 addresses the latest trends in piezoelectric multiple-degree-of-freedom actuators/sensors. Chapters 8-12 deal with example applications, including semi-active joints, active isolation and health monitoring. Chapter 13 addresses MEMS technology, while Chapter 14 discusses the design of power amplifiers for piezoelectric actuators.

Responsive Systems for Active Vibration Control

This book formulates and consolidates a coherent understanding of how harnessing the dynamics of bistable structures may enhance the technical fields of vibration control, energy harvesting, and sensing. Theoretical rigor and practical experimental insights are provided in numerous case studies. The three fields have received significant research interest in recent years, particularly in regards to the advantageous exploitation of nonlinearities. Harnessing the dynamics of bistable structures--that is, systems with two configurations of static equilibria--is a popular subset of the recent efforts. This book provides a timely consolidation of the advancements that are relevant to a large body of active researchers and engineers in these areas of understanding and leveraging nonlinearities for engineering applications. Coverage includes: Provides a one-source reference on how bistable system dynamics may enhance the aims of vibration control, energy harvesting, and sensing with a breadth of case studies Includes details for comprehensive methods of analysis, numerical simulation, and experimentation that are widely useful in the assessment of the dynamics of bistable structures Details approaches to evaluate, by analytical and numerical analysis and experiment, the influences of harmonic and random excitations, multiple degrees-of-freedom, and electromechanical coupling towards tailoring the underlying bistable system dynamics Establishes how intelligently utilizing bistability could enable technology advances that would be useful in various industries, such as automotive engineering, aerospace systems, microsystems and microelectronics, and manufacturing

Wind-Excited Vibrations of Structures

Active and Passive Vibration Control of Structures form an issue of very actual interest in many different fields of engineering, for example in the automotive and aerospace industry, in precision engineering (e.g. in large telescopes), and also in civil engineering. The papers in this volume bring together engineers of different background, and it fill gaps between structural mechanics, vibrations and modern control theory. Also links between the different applications in structural control are shown.

Vibration Control of Active Structures

The first edition of Sound and Structural Vibration was written in the early 1980s. Since then, two major developments have taken place in the field of vibroacoustics. Powerful computational methods and procedures for the numerical analysis of structural vibration, acoustical fields and acoustical interactions between fluids and structures have been developed and these are now universally employed by researchers, consultants and industrial organisations. Advances in signal processing systems and algorithms, in transducers, and in structural materials and forms of construction, have facilitated the development of practical means of applying active and adaptive control systems to structures for the purposes of reducing or modifying structural vibration and the associated sound radiation and transmission. In this greatly expanded and extensively revised edition, the authors have retained most of the analytically based material that forms the pedagogical content of the first edition, and have expanded it to present the theoretical foundations of modern numerical analysis. Application of the latter is illustrated by examples that have been chosen to complement the analytical approaches to solving fairly simple problems of sound radiation, transmission and fluid-structural coupling that are presented in the first edition. The number of examples of experimental data that relate to the theoretical content, and illustrate important features of vibroacoustic interaction, has been augmented by the inclusion of a selection from the vast amount of material published during the past twenty five years. The final chapter on the active control of sound and vibration has no precursor in the first edition. * Covers theoretical approaches to modeling and analysis * Highly applicable to challenges in industry and academia * For engineering students to use throughout their career

Piezoelectric Transducers for Vibration Control and Damping

Intelligent Vibration Control in Civil Engineering Structures provides readers with an all-encompassing view of the theoretical studies, design methods, real-world implementations, and applications relevant to the topic The book focuses on design and property tests on different intelligent control devices, innovative control strategies, analysis examples for structures with intelligent control devices, and designs and tests for intelligent controllers. Focuses on the principles, methods, and applications of intelligent vibration control in civil engineering Covers intelligent control, including active and semi-active control Includes comprehensive contents, such as design and properties of different intelligent control devices, control strategies, and dynamic analysis, intelligent controller design, numerical examples, and experimental data

Sound and Structural Vibration

Science is for those who learn; poetry for those who know. —Joseph Roux This book is a continuation of my previous book, Dynamics and Control of Structures [44]. The expanded book includes three additional chapters and an additional appendix: Chapter 3, “Special Models”; Chapter 8, “Modal Actuators and Sensors”; and Chapter 9, “System Identification. ” Other chapters have been significantly revised and supplemented with new topics, including discrete-time models of structures, limited-time and -frequency grammians and reduction, almo- balanced modal models, simultaneous placement of sensors and actuators, and structural damage detection. The appendices have also been updated and expanded. Appendix A consists of thirteen new Matlab programs. Appendix B is a new addition and includes eleven Matlab programs that solve examples from each chapter. In Appendix C model data are given. Several books on structural dynamics and control have been published. Meirovitch’s textbook [108] covers methods of structural dynamics (virtual work, d’Alambert’s principle, Hamilton’s principle, Lagrange’s and Hamilton’s equations, and modal analysis of structures) and control (pole placement methods, LQG design, and modal control). Ewins’s book [33] presents methods of modal testing of structures. Natke’s book [111] on structural identification also contains excellent material on structural dynamics. Fuller, Elliot, and Nelson [40] cover problems of structural active control and structural acoustic control.

Vibration Control for Building Structures

Earthquakes, bridge collapses, and other natural disasters have dominated news coverage in the last few years. Aging infrastructure needs to be rehabilitated and new infrastructure needs to be designed differently. Presenting a highly innovative, modern approach verging on the futuristic, Wavelet-Based Vibration Control of Smart Buildings and Bridges discusses a new generation of building and bridge structures that not only withstands [generation is singular] the destructive effects of nature but is also impact and explosion resistant. Based on the groundbreaking work of Hojit Adeli, the book introduces the new mathematical concept of wavelets into the field of structural vibration control. It presents a new control algorithm for robust control of smart civil structures subjected to destructive environmental forces, such as earthquakes and wind. It then discusses a new hybrid control system, the hybrid tuned liquid column damper (TLCD) system. The new hybrid control system, which combines passive and semi-active control systems, is intended to achieve increased reliability and maximum operability of the control system during power failure and to eliminate the need for a larger power requirement. The great majority of papers published in this area of active structural vibration control deal with small or academic problems. The models in this book have been tested and their effectiveness evaluated extensively on small problems for the sake of comparison with other methods and results reported in the literature. The authors go one step further and apply them to realistic and large building and bridge structures to demonstrate the applicability of the new smart technology to large real-world civil structures. Balancing coverage between theory and application, the book demonstrates the benefits of the new smart technology in the design of structures that are safer and more sustainable.

Structural Vibration

This book gives an overview of the current state of uncertainty modeling in vibration, control, and fuzzy analysis of structural and mechanical systems. It is a coherent compendium written by leading experts and offers the reader a sampling of exciting research areas in several fast-growing branches in this field. Uncertainty modeling and analysis are becoming an integral part of system definition and modeling in many fields. The book consists of ten chapters that report the work of researchers, scientists and engineers on theoretical developments and diversified applications in engineering systems. They deal with modeling for vibration, control, and fuzzy analysis of structural and mechanical systems under uncertain conditions. The book designed for readers who are familiar with the fundamentals and wish to study a particular topic or use the book as an authoritative reference. It gives readers a sophisticated toolbox for tackling modeling problems in mechanical and structural systems in real-world situations. The book is part of a series on Stability, Vibration and Control of Structures, and provides vital information in these areas.

Vibration Control and Actuation of Large-Scale Systems

This textbook is an introduction to the dynamics of active structures and to the feedback control of lightly damped flexible structures; the emphasis is placed on basic issues and simple control strategies that work. Now in its fourth edition, more chapters have been added, and comments and feedback from readers have been taken into account, while at the same time the unique premise of bridging the gap between structure and control has remained. Many examples, covering a broad field of applications from bridges to satellites and telescopes, and problems bring the subject to life and take the audience from theory to practice. The book has 19 chapters dealing with some concepts in structural dynamics; electromagnetic and piezoelectric transducers; piezoelectric beam, plate and truss; passive damping with piezoelectric transducers; collocated versus non-collocated control; active damping with collocated systems; vibration isolation; state space approach; analysis and synthesis in the frequency domain; optimal control; controllability and observability; stability; applications; tendon control of cable structures; active control of deformable mirrors for Adaptive Optics and large earth-based and space telescopes; and semi-active control. The book concludes with an exhaustive bibliography and index. This book is intended for structural engineers who want to acquire some background in vibration control, and for control engineers who are dealing with flexible structures. It can be used as a textbook for a graduate course on vibration control or active structures. A solutions manual is available through the publisher to teachers using this book as a textbook.

Vibration Analysis and Control in Mechanical Structures and Wind Energy Conversion Systems

This book focuses on recent and innovative methods on vibration analysis, system identification, and diverse control design methods for both wind energy conversion systems and vibrating systems. Advances on both theoretical and experimental studies about analysis and control of oscillating systems in several engineering disciplines are discussed. Various control devices are synthesized and implemented for vibration attenuation tasks. The book is addressed to researchers and practitioners on the subject, as well as undergraduate and postgraduate students and other experts and newcomers seeking more information about the state of the art, new challenges, innovative solutions, and new trends and developments in these areas. The six chapters of the book cover a wide range of interesting issues related to modeling, vibration control, parameter identification, active vehicle suspensions, tuned vibration absorbers, electronically controlled wind energy conversion systems, and other relevant case studies.

Harnessing Bistable Structural Dynamics

Reducing and controlling the level of vibration in a mechanical system leads to an improved work environment and product quality, reduced noise, more economical operation, and longer equipment life. Adequate design is essential for reducing vibrations, while damping and control methods help further reduce and manipulate vibrations when design strategies reach their limits. There are also useful types of vibration, which may require enhancement or control. Vibration Damping, Control, and Design balances theoretical and application-oriented coverage to enable optimal vibration and noise suppression and control in nearly any system. Drawn from the immensely popular Vibration and Shock Handbook, each expertly crafted chapter of this book includes convenient summary windows, tables, graphs, and lists to provide ready access to the important concepts and results. Working systematically from general principles to specific applications, coverage spans from theory and experimental techniques in vibration damping to isolation, passive control, active control, and structural dynamic modification. The book also discusses specific issues in designing for and controlling vibrations and noise such as regenerative chatter in machine tools, fluid-induced vibration, hearing and psychological effects, instrumentation for monitoring, and statistical energy analysis. This carefully edited work strikes a balance between practical considerations, design issues, and experimental techniques. Complemented by design examples and case studies, Vibration Damping, Control, and Design builds a deep understanding of the concepts and demonstrates how to apply these principles to real systems.

Active Control of Bidirectional Structural Vibration

Base isolation, passive energy dissipation and active control represent three innovative technologies for protection of structures under environmental loads. Increasingly, they are being applied to the design of new structures or to the retrofit of existing structures against wind, earthquakes and other external loads. This book, with contributions from leading researchers from Japan, Europe, and the United States, presents a balanced view of current research and world-wide development in this exciting and fast expanding field. Basic principles as well as practical design and implementational issues associated with the application of base isolation systems and passive and active control devices to civil engineering structures are carefully addressed. Examples of structural applications are presented and extensively discussed.

Control of Noise and Structural Vibration

Vibration Control and Actuation of Large-Scale Systems gives a systematically and self-contained description of the many facets of envisaging, designing, implementing, or experimentally exploring advanced vibration control systems. The book is devoted to the development of mathematical methodologies for vibration analysis and control problems of large-scale systems, including structural dynamics, vehicle dynamics and wind turbines, for example. The research problems addressed in each chapter are well motivated, with numerical and simulation results given in each chapter that reflect best engineering practice. Provides a series of the latest results in vibration control, structural control, actuation, component failures, and more Gives numerical and simulation results to reflect best engineering practice Presents recent advances of theory, technological aspects, and applications of advanced control methodologies in vibration control

Vibration Control of Active Structures

Many structures suffer from unwanted vibrations and, although careful analysis at the design stage can minimise these, the vibration levels of many structures are excessive. In this book the entire range of methods of control, both by damping and by excitation, is described in a single volume. Clear and concise descriptions are given of the techniques for mathematically modelling real structures so that the equations which describe the motion of such structures can be derived. This approach leads to a comprehensive discussion of the analysis of typical models of vibrating structures excited by a range of periodic and random inputs. Careful consideration is also given to the sources of excitation, both internal and external, and the effects of isolation and transmissability. A major part of the book is devoted to damping of structures and many sources of damping are considered, as are the ways of changing damping using both active and passive methods. The numerous worked examples liberally distributed throughout the text, amplify and clarify the theoretical analysis presented. Particular attention is paid to the meaning and interpretation of results, further enhancing the scope and applications of analysis. Over 80 problems are included with answers and worked solutions to most. This book provides engineering students, designers and professional engineers with a detailed insight into the principles involved in the analysis and damping of structural vibration while presenting a sound theoretical basis for further study. Suitable for students of engineering to first degree level and for designers and practising engineers Numerous worked examples Clear and easy to follow

Model Predictive Vibration Control

The recent introduction of active and passive structural control methods has given structural designers powerful tools for performance-based design. However, structural engineers often lack the tools for the optimal selection and placement of such systems. In Building Control with Passive Dampers , Takewaki brings together most the reliable, state-of-the-art methods in practice around the world, arming readers with a real sense of how to address optimal selection and placement of passive control systems. The first book on optimal design, sizing, and location selection of passive dampers Combines theory and practical applications Describes step-by-step how to obtain optimal damper size and placement Covers the state-of-the-art in optimal design of passive control Integrates the most reliable techniques in the top literature and used in practice worldwide Written by a recognized expert in the area MATLAB code examples available from the book's Companion Website This book is essential for post-graduate students, researchers, and design consultants involved in building control. Professional engineers and advanced undergraduates interested in seismic design, as well as mechanical engineers looking for vibration damping techniques, will also find this book a helpful reference. Code examples available at www.wiley.com/go/takewaki

Active Control of Structures

This book presents recent developments in vibration control systems that employ embedded piezoelectric sensors and actuators, reviewing ways in which active vibration control systems can be designed for piezoelectric laminated structures, paying distinct attention to how such control systems can be implemented in real time. Includes numerous examples and experimental results obtained from laboratory-scale apparatus, with details of how similar setups can be built.

Advanced Structural Dynamics and Active Control of Structures

This book consists of 14 chapters. Chapters 2 and 3 are devoted to the dynamics of active structures; the open loop transfer functions are derived from the constitutive equations; the discussion includes active trusses with piezoelectric struts, and beams and shells with embedded laminar piezoelectric actuators and sensors. Chapters 4 and 5 discuss the virtues of collocated actuator/sensor configurations and how they can be exploited to develop active damping with guaranteed stability. Chapter 6 addresses vibration isolation for one and 6 d.o.f.. Chapter 7 discusses optimal control for SISO systems with symmetric root locus. Chapter 8 discusses the design tradeoffs for SISO systems in the frequency domain, including the Bode amplitude/phase relationship. Chapter 9 provides a more general discussion of optimal control using of optimal control using the Riccati equation; spillover is examined. Chapters 10 and 11 review briefly the concepts of controllability, observability and stability. Chapter 12 discusses the semi-active control, including some materials on magneto-rheological fluids. Chapter 13 describes various practical applications to active damping, precision positioning and vibroacoustics, and chapter 14 discusses the active damping of cable- structures.

Piezoelectric-Based Vibration Control

Noise and Vibration Control Engineering: Principles and Applications, Second Edition is the updated revision of the classic reference containing the most important noise control design information in a single volume of manageable size. Specific content updates include completely revised material on noise and vibration standards, updated information on active noise/vibration control, and the applications of these topics to heating, ventilating, and air conditioning.

Particle Damping Technology Based Structural Control

This book focuses on safeguarding civil structures and residents from natural hazards such as earthquakes through the use of active control. It proposes novel proportional-derivative (PD) and proportional-integral-derivative (PID) controllers, as well as discrete-time sliding mode controllers (DSMCs) for the vibration control of structures involving nonlinearities. Fuzzy logic techniques are used to compensate for nonlinearities. The first part of the book addresses modelling and feedback control in inelastic structures and presents a design for PD/PID controllers. In the second part, classical PD/PID and type-2 fuzzy control techniques are combined to compensate for uncertainties in the structures of buildings. The methodology for tuning the gains of PD/PID is obtained using Lyapunov stability theory, and the system's stability is verified. Lastly, the book puts forward a DSMC design that does not require system parameters, allowing it to be more flexibly applied. All program codes used in the paper are presented in a MATLAB®/Simulink® environment. Given its scope, the book will be of interest to mechanical and civil engineers, and to advanced undergraduate and graduate engineering students in the areas of structural engineering, structural vibration, and advanced control.

Passive and Active Structural Vibration Control in Civil Engineering

This text addresses the modeling of vibrating systems with the perspective of finding the model of minimum complexity which accounts for the physics of the phenomena at play. The first half of the book (Ch.1-6) deals with the dynamics of discrete and continuous mechanical systems; the classical approach emphasizes the use of Lagrange's equations. The second half of the book (Ch.7-12) deals with more advanced topics, rarely encountered in the existing literature: seismic excitation, random vibration (including fatigue), rotor dynamics, vibration isolation and dynamic vibration absorbers; the final chapter is an introduction to active control of vibrations. The first part of this text may be used as a one semester course for 3rd year students in Mechanical, Aerospace or Civil Engineering. The second part of the text is intended for graduate classes. A set of problems is provided at the end of every chapter. The author has a 35 years experience in various aspects of Structural dynamics, both in industry (nuclear and aerospace) and in academia; he was one of the pioneers in the field of active structures. He is the author of several books on random vibration, active structures and structural control.