

Design Optimization And Vibration Control Of Adaptive Structures Modeling Of Smart Dampers And Optimization In Semiactive Structures

The topology optimization method solves the basic engineering problem of distributing a limited amount of material in a design space. The first edition of this book has become the standard text on optimal design which is concerned with the optimization of structural topology, shape and material. This edition, has been substantially revised and updated to reflect progress made in modelling and computational procedures. It also encompasses a comprehensive and unified description of the state-of-the-art of the so-called material distribution method, based on the use of mathematical programming and finite elements. Applications treated include not only structures but also materials and MEMS.

Multidisciplinary design optimization (MDO) has recently emerged as a field of research and practice that brings together many previously disjointed disciplines and tools of engineering and mathematics. MDO can be described as a technology, environment, or methodology for the design of complex, coupled engineering systems, such as aircraft, automobiles, and other mechanisms, the behavior of which is determined by interacting subsystems.

Throughout the past few years, there has been extensive research done on structural design in terms of optimization methods or problem formulation. But, much of this attention has been on the linear elastic structural behavior, under static loading condition. Such a focus has left researchers scratching their heads as it has led to vulnerable structural configurations. What researchers have left out of the equation is the element of seismic loading. It is essential for researchers to take this into account in order to develop earthquake resistant real-world structures. Structural Seismic Design Optimization and Earthquake Engineering: Formulations and Applications focuses on the research around earthquake engineering, in particular, the field of implementation of optimization algorithms in earthquake engineering problems. Topics discussed within this book include, but are not limited to, simulation issues for the accurate prediction of the seismic response of structures, design optimization procedures, soft computing applications, and other important advancements in seismic analysis and design where optimization algorithms can be implemented. Readers will discover that this book provides relevant theoretical frameworks in order to enhance their learning on earthquake engineering as it deals with the latest research findings and their practical implementations, as well as new formulations and solutions.

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.

These papers, presented at the 14th Biennial ASME Conference on Vibration and Noise, held in Albuquerque, New Mexico, September 1993, represent a cross-section of the many directions that researchers are currently pursuing in characterizing and controlling the response of distributed parameter systems.

Civil and environmental engineers work together to develop, build, and maintain the man-made and natural environments that make up the infrastructures and ecosystems in which we live and thrive. Civil and Environmental Engineering: Concepts, Methodologies, Tools, and Applications is a comprehensive multi-volume publication showcasing the best research on topics pertaining to road design, building maintenance and construction, transportation, earthquake engineering, waste and pollution management, and water resources management and engineering. Through its broad and extensive coverage on a variety of crucial concepts in the field of civil engineering, and its subfield of environmental engineering, this multi-volume work is an essential addition to the library collections of academic and government institutions and appropriately meets the research needs of engineers, environmental specialists, researchers, and graduate-level students.

Sponsored by the Technical Committee on Structural Design of the Technical Administrative Committee on Analysis and Computation of the Technical Activities Division of the Structural Engineering Institute of ASCE. This report documents the dramatic new developments in the field of structural optimization over the last two decades. Changes in both computational techniques and applications can be seen by developments in computational methods and solution algorithms, the role of optimization during the various stages of structural design, and the stochastic nature of design in relation to structural optimization. Topics include: \emptyset methods for discrete variable structural optimization; \emptyset decomposition methods in structural optimization; \emptyset state of the art on the use of genetic algorithms in design of steel structures; \emptyset conceptual design optimization of engineering structures; \emptyset topology and geometry optimization of trusses and frames; \emptyset evolutionary structural optimization; \emptyset design and optimization of semi-rigid framed structures; \emptyset optimized performance-based design for buildings; \emptyset multi-objective optimum design of seismic-resistant structures; and \emptyset reliability- and cost-oriented optimal bridge maintenance planning. The book concludes with an extensive bibliography of journal papers on structural optimization published between 1987 and 1999.

Active shape and vibration control are means for obtaining optimal flow conditions around wings ducts and channels under different conditions. This means that the structure can be adapted (deformed or damped) such that aerodynamic or vibro-acoustic behaviour is optimal for that particular situation. The fast developments in computer technology makes it possible that more complex analyses in which aerodynamic and vibro-acoustic is included can be applied in the design process. At NLK research is carried out on the integration of advanced analysis tools in design environments. In this paper the tools which are developed for the analysis of active shape and vibration control are presented. The backbone of the design environment is an optimization algorithm which helps the designer to come up with optimal designs of structures. In the case of active shape and vibration control the optimal design of controllers is a new aspect. This means that in addition to the optimisation of the locations of sensors and actuators the control parameters have to be optimised. In this paper a method is proposed to optimise locations and control parameters at once with the standard finite element representation of the equations of motion as a base.

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.

Passive vibration control plays a crucial role in structural engineering. Common solutions include seismic isolation and damping systems with various kinds of devices, such as viscous, viscoelastic, hysteretic, and friction dampers. These strategies have been widely utilized in engineering practice, and their efficacy has been demonstrated in mitigating damage and preventing the collapse of buildings, bridges, and industrial facilities. However, there is a need for more sophisticated analytical and numerical tools to design structures equipped with optimally configured devices. On the other hand, the family of devices and dissipative elements used for structural protection keeps evolving, because of growing performance demands and new progress achieved in materials science and mechanical engineering. This Special Issue collects 13 contributions related to the development and application of passive vibration control strategies for structures, covering both traditional and innovative devices. In particular, the contributions concern experimental and theoretical investigations of high-efficiency dampers and isolation bearings; optimization of conventional and innovative energy dissipation devices; performance-based and probability-based design of damped structures; application of nonlinear dynamics, random vibration theory, and modern control theory to the design of structures with passive energy dissipation systems; and critical discussion of implemented isolation/damping technologies in significant or emblematic engineering projects.

This book discusses efforts to control the low-frequency vibration transmission of typical power equipment and pipeline systems of ships, exploring the use of active and passive hybrid vibration isolation and adjustable dynamic vibration absorption technologies. It also proposes an adaptive feed-forward control strategy and studies a distributed feed-forward control hardware system. In addition, the book presents a three-way dynamic vibration absorption theory used to design a pipeline-system adjustable dynamic vibration absorber, which offers a number of advantages, such as compact structure, easy assembly and disassembly, low power consumption, excellent vibration control effect and wide frequency band adjustable ability, etc. This book is a valuable resource for researchers and engineers in the fields of noise and vibration control, active control systems, active vibration isolation and adaptive dynamic vibration absorption.

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.

This report summarizes new results on spacecraft dynamics and control. Perturbation methods are presented for computing nonlinear open and closed loop optimal maneuver control. Homotopy optimization algorithms are presented for tuning linear regulators vis-a-vis eigenvalue placement and robustness. A simultaneous structure/controller design optimization algorithm is developed. Keywords: active control; structural analysis; optimization integrated design; spacecraft dynamics.

Maintaining the outstanding features and practical approach that led the bestselling first edition to become a standard textbook in engineering classrooms worldwide, Clarence de Silva's *Vibration: Fundamentals and Practice, Second Edition* remains a solid instructional tool for modeling, analyzing, simulating, measuring, monitoring, testing, controlling, and designing for vibration in engineering systems. It condenses the author's distinguished and extensive experience into an easy-to-use, highly practical text that prepares students for real problems in a variety of engineering fields. What's New in the Second Edition? A new chapter on human response to vibration, with practical considerations Expanded and updated material on vibration monitoring and diagnosis Enhanced section on vibration control, updated with the latest techniques and methodologies New worked examples and end-of-chapter problems. Incorporates software tools, including LabVIEWW™, SIMULINK®, MATLAB®, the LabVIEW Sound and Vibration Toolbox, and the MATLAB Control Systems Toolbox Enhanced worked examples and new solutions using MATLAB and SIMULINK The new chapter on human response to vibration examines representation of vibration detection and perception by humans as well as specifications and regulatory guidelines for human vibration environments.

Remaining an indispensable text for advanced undergraduate and graduate students, *Vibration: Fundamentals and Practice, Second Edition* builds a unique and in-depth understanding of vibration on a sound framework of practical tools and applications.

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 control 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' vibration isolation, control of vehicle dynamics, noise control, control of machines and mechanisms and control of fluid-structure-interaction. One could continue with this list for a long time. Research in the field of vibration control is extremely comprehensive. Problems that are typical for vibration control of nonlinear mechanisms and structures arise in the fields 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. The objective of the Symposium was to present and discuss methods that contribute to the solution of such problems and to demonstrate the state of the art in the field shown by typical examples. The intention was to evaluate the limits of performance that can be achieved by controlling the dynamics, and to point out gaps in present research and give links for areas of future research. Mainly, it brought together leading experts from quite different areas presenting their points of view.

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.

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.

A comprehensive and versatile treatment of an important and complex topic in vehicle design Written by an expert in the field with over 30 years of NVH experience, Noise and Vibration Control of Automotive Body offers nine informative chapters on all of the core knowledge required for noise, vibration, and harshness engineers to do their job properly. It starts with an introduction to noise and vibration problems; transfer of structural-borne noise and airborne noise to interior body; key techniques for body noise and vibration control; and noise and vibration control during vehicle development. The book then goes on to cover all the noise and vibration issues relating to the automotive body, including: overall body structure; local body structure; sound package; excitations exerted on the body and transfer functions; wind noise; body sound quality; body squeak and rattle; and the vehicle development process for an automotive body. Vehicle noise and vibration is one of the most important attributes for modern vehicles, and it is extremely important to understand and solve NVH problems. Noise and Vibration Control of Automotive Body offers comprehensive coverage of automotive body noise and vibration analysis and control, making it an excellent guide for body design engineers and testing engineers. Covers all the noise and vibration issues relating to the automotive body Features a thorough set of tables, illustrations, photographs, and examples Introduces automotive body structure and noise and vibration problems Pulls together the diverse topics of body structure, sound package, sound quality, squeak and rattle, and target setting Noise and Vibration Control of Automotive Body is a valuable reference for engineers, designers, researchers, and graduate students in the fields of automotive body design and NVH.

Vibrations are a part of our environment and daily life. Many of them are useful and are needed for many purposes, one of the best example being the hearing system. Nevertheless, vibrations are often undesirable and have to be suppressed or reduced, as they may be harmful to structures by generating damages or compromise the comfort of users through noise generation of mechanical wave transmission to the body. the purpose of this book is to present basic and advanced methods for efficiently controlling the vibrations and limiting their effects. Open-access publishing is an extraordinary opportunity for a wide dissemination of high quality research. This book is not an exception to this, and I am proud to introduce the works performed by experts from all over the world.

Motion and vibration control is a fundamental technology for the development of advanced mechanical systems such as mechatronics, vehicle systems, robots, spacecraft, and rotating machinery. Often the implementation of high performance, low power consumption designs is only possible with the use of this technology. It is also vital to the mitigation of natural hazards for large structures such as high-rise buildings and tall bridges, and to the application of flexible structures such as space stations and satellites. Recent innovations in relevant hardware, sensors, actuators, and software have facilitated new research in this area. This book deals with the interdisciplinary aspects of emerging technologies of motion and vibration control for mechanical, civil and aerospace systems. It covers a broad range of applications (e.g. vehicle dynamics, actuators, rotor dynamics, biologically inspired mechanics, humanoid robot dynamics and control, etc.) and also provides advances in the field of fundamental research e.g. control of fluid/structure integration, nonlinear control theory, etc. Each of the contributors is a recognised specialist in his field, and this gives the book relevance and authority in a wide range of areas.

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.

The aim of the book is to give a clear picture of some new modern trends in composite mechanics and to give a presentation of the current state-of-the-art of the theory and application of composite laminates. The book addresses the basics as well as recent developments in the theory of laminates and their effective properties, the problem of testing and identification of properties, strength, damage, and failure of composite laminates, lightweight construction principles, optimization techniques, the generation of smart structures, and a number of special technical aspects (e.g. stress localization), their modelling and analysis. The intention of the book is to provide deeper understanding, to give mathematical and algorithmic techniques for analysis, simulation and optimization and to link various aspects of composite mechanics as necessary to exploit the full potential that is possible for composite structures.

This book discusses performance-based seismic and wind-resistant design for high-rise building structures, with a particular focus on establishing an integrated approach for performance-based wind engineering, which is currently less advanced than seismic engineering. This book also provides a state-of-the-art review of numerous methodologies, including computational fluid dynamics (CFD), extreme value analysis, structural optimization, vibration control, pushover analysis, response spectrum analysis, modal parameter identification for the assessment of the wind-resistant and seismic performance of tall buildings in the design stage and actual tall buildings in use. Several new structural optimization methods, including the augmented optimality criteria method, have been developed and employed in the context of performance-based design. This book is a valuable resource for students, researchers and engineers in the field of civil and structural engineering.

A controls-structures interaction design method is presented. The method coordinates standard finite-element structural analysis, multivariable controls, and nonlinear programming codes and allows simultaneous optimization of the structure and control system of a spacecraft. Global sensitivity equations are used to account for coupling between the disciplines. Use of global sensitivity equations helps solve optimization problems that have a large number of design variables and a high degree of coupling between disciplines. The preliminary design of a generic geostationary platform is used to demonstrate the multidisciplinary optimization method. Design problems using 15, 63, and 150 design variables to optimize truss member sizes and feedback gain values are solved and the results are presented. The goal is to reduce the total mass of the structure and the vibration control system while satisfying constraints on vibration decay rate. Incorporation of the nonnegligible mass of actuators causes an essential coupling between structural design variables and control design variables. James, Benjamin B. Unspecified Center NAS1-19000; RTOP 506-43-41...

This volume offers edited papers presented at the IUTAM-Symposium Topological design optimization of structures, machines and materials - status and perspectives, October 2005. The papers cover the application of topological design

optimization to fluid-solid interaction problems, acoustics problems, and to problems in biomechanics, as well as to other multiphysics problems. Also in focus are new basic modelling paradigms, covering new geometry modelling such as level-set methods and topological derivatives.

International Symposium on Engineering under Uncertainty: Safety Assessment and Management (ISEUSAM - 2012) is organized by Bengal Engineering and Science University, India during the first week of January 2012 at Kolkata. The primary aim of ISEUSAM 2012 is to provide a platform to facilitate the discussion for a better understanding and management of uncertainty and risk, encompassing various aspects of safety and reliability of engineering systems. The conference received an overwhelming response from national as well as international scholars, experts and delegates from different parts of the world. Papers received from authors of several countries including Australia, Canada, China, Germany, Italy, UAE, UK and USA, besides India. More than two hundred authors have shown their interest in the symposium. The Proceedings presents ninety two high quality papers which address issues of uncertainty encompassing various fields of engineering, i.e. uncertainty analysis and modelling, structural reliability, geotechnical engineering, vibration control, earthquake engineering, environmental engineering, stochastic dynamics, transportation system, system identification and damage assessment, and infrastructure engineering.

En conception de produits ou de systèmes, les approches d'optimisation déterministe sont de nos jours largement utilisées. Toutefois, ces approches ne tiennent pas compte des incertitudes inhérentes aux modèles utilisés, ce qui peut parfois aboutir à des solutions non fiables. Il convient alors de s'intéresser aux approches d'optimisation stochastiques. Les approches de conception robuste à base d'optimisation stochastique (Reliability Based Robust Design Optimization, RBRDO) tiennent compte des incertitudes lors de l'optimisation au travers d'une boucle supplémentaire d'analyse des incertitudes (Uncertainty Analysis, UA). Pour la plupart des applications pratiques, l'UA est réalisée par une simulation de type Monte Carlo (Monte Carlo Simulation, MCS) combinée avec l'analyse structurale. L'inconvénient majeur de ce type d'approche réside dans le coût de calcul qui se révèle être prohibitif. Par conséquent, nous nous sommes intéressés dans nos travaux aux développements de méthodologies efficaces pour la mise en place de RBRDO s'appuyant sur une analyse MCS. Nous présentons une méthode d'UA s'appuyant sur une analyse MCS dans laquelle la réponse aléatoire est approximée sur une base du chaos polynomial (Polynomial Chaos Expansion, PCE). Ainsi, l'efficacité de l'UA est grandement améliorée en évitant une trop grande répétition des analyses structurales. Malheureusement, cette approche n'est pas pertinente dans le cadre de problèmes en grande dimension, par exemple pour des applications en dynamique. Nous proposons ainsi d'approximer la réponse dynamique en ne tenant compte que de la résolution aux valeurs propres aléatoires. De cette façon, seuls les paramètres structuraux aléatoires apparaissent dans le PCE. Pour traiter le problème du mélange des modes dans notre approche, nous nous sommes appuyés sur le facteur MAC qui permet de le quantifier. Nous avons développé une méthode univariable permettant de vérifier quelle variable génère un mélange de modes de manière à le réduire ou le supprimer. Par la suite, nous présentons une approche de RBRDO séquentielle pour améliorer l'efficacité et éviter les problèmes de non-convergence présents dans les approches de RBRDO. Dans notre approche, nous avons étendu la stratégie séquentielle classique, visant principalement à découpler l'analyse de fiabilité de la procédure d'optimisation, en séparant l'évaluation des moments de la boucle d'optimisation. Nous avons utilisé une approximation exponentielle locale autour du point de conception courant pour construire des objectifs déterministes équivalents ainsi que des contraintes stochastiques. De manière à obtenir les différents coefficients pour notre approximation, nous avons développé une analyse de sensibilité de la robustesse basée sur une distribution auxiliaire ainsi qu'une analyse de sensibilité des moments basée sur l'approche PCE. Nous montrons la pertinence ainsi que l'efficacité des approches proposées au travers de différents exemples numériques. Nous appliquons ensuite notre approche de RBRDO pour la conception d'un amortisseur dans le domaine du contrôle passif vibratoire d'une structure présentant des grandeurs aléatoires. Les résultats obtenus par notre approche permettent non seulement de réduire la variabilité de la réponse, mais aussi de mieux contrôler l'amplitude de la réponse au travers d'un seuil choisi par avance.

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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