Optimization Of Tuned Mass Damper Parameters Using

This book is a printed edition of the Special Issue " Development and Application of Nonlinear Dissipative Device in Structural Vibration Control" that was published in Applied Sciences

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.

This book provides essential insights into a range of newly developed numerical optimization techniques with a view to solving real-world problems. Many of these problems can be modeled as nonlinear optimization problems, but due to their complex

nature, it is not always possible to solve them using conventional optimization theory. Accordingly, the book discusses the design and applications of non-conventional numerical optimization techniques, including the design of benchmark functions and the implementation of these techniques to solve real-world optimization problems. The book's twenty chapters examine various interesting research topics in this area, including: Pi fraction-based optimization of the Pantoja–Bretones–Martin (PBM) antenna benchmarks; benchmark function generators for single-objective robust optimization algorithms; convergence of gravitational search algorithms on linear and quadratic functions; and an algorithm for the multi-variant evolutionary synthesis of nonlinear models with real-valued chromosomes. Delivering on its promise to explore real-world scenarios, the book also addresses the seismic analysis of a multi-story building with optimized damper properties; the application of constrained spider monkey optimization to solve portfolio optimization problems; the effect of upper body motion on a bipedal robot's stability; an ant colony algorithm for routing alternate-fuel vehicles in multi-depot vehicle routing problems; enhanced fractal dimension-based feature extraction for thermal face recognition; and an artificial bee colony-based hyper-heuristic for the single machine order acceptance and scheduling problem. The book will benefit not only researchers, but also organizations active in such varied fields as Aerospace, Automotive, Biotechnology, Consumer Packaged Goods, Electronics, Finance, Business & Banking, Oil, Gas & Geosciences, and Pharma, to name a few.

Metaheuristics for Structural Design and Analysis discusses general properties and types of metaheuristic techniques, basic principles of topology, shape and size optimization of structures, and applications of metaheuristic algorithms in solving structural design problems. Analysis of structures using metaheuristic algorithms is also discussed. Comparisons are made with classical methods and modern computational methods through metaheuristic algorithms. The book is designed for senior structural engineering students, graduate students, academicians and practitioners.

This book is an up-to-date source for computation applications of optimization, prediction via artificial intelligence methods, and evaluation of metaheuristic algorithm with different structural applications. As the current interest of researcher, metaheuristic algorithms are a high interest topic area since advance and non-optimized problems via mathematical methods are challenged by the development of advance and modified algorithms. The artificial intelligence (AI) area is also important in predicting optimum results by skipping long iterative optimization processes. The machine learning used in generation of AI models also needs optimum results of metaheuristic-based approaches. This book is a great source to researcher, graduate students, and bachelor students who gain project about structural optimization. Differently from the academic use, the chapter that emphasizes different scopes and methods can take the interest and help engineer working in design and production of structural engineering projects.

The book presents research papers presented by academicians, researchers, and practicing structural engineers from India and abroad in the recently held Structural Engineering Convention (SEC) 2014 at Indian Institute of Technology Delhi during 22 – 24 December 2014. The book is divided into three volumes and encompasses multidisciplinary areas within structural engineering, such as earthquake engineering and structural dynamics, structural mechanics, finite element methods, structural vibration control, advanced cementitious and composite materials, bridge engineering, and soil-structure interaction. Advances in Structural Engineering is a useful reference material for structural engineering fraternity including undergraduate and postgraduate students, academicians, researchers and practicing engineers.

The conference aims to provide an excellent international academic forum for all the researchers, practitioner, students and teachers in related fields to share their knowledge and results in theory, methodology and application on mechanics and materials engineering. ICMME2014 features unique mixed topics of Mechanics, Materials Science and Materials Processing Technology, Emerging materials and other related ones. The ICMME2014 proceeding tends to collect the most up-to-date, comprehensive, and worldwide state-of-art knowledge on mechanics and materials engineering. All the accepted papers have been submitted to strict peer-review by 2–4 expert referees, and selected based on originality, significance and clarity for the purpose of the conference. The conference program is extremely rich, profound and

featuring high-impact presentations of selected papers and additional late-breaking contributions. We sincerely hope that the conference would not only show the participants a broad overview of the latest research results on related fields, but also provide them a significant platform for academic connection and exchange.

Active Materials: Analysis, Design, and Control will address an important need in the development of active materials technology. It will be the only book available on active materials to be written as a text for students and professionals covering both the basics and applications to industry.

This book presents state-of-the-art technical contributions based around one of the most successful evolutionary optimization algorithms published to date: Harmony Search. Contributions span from novel technical derivations of this algorithm to applications in the broad fields of civil engineering, energy, transportation & mobility and health, among many others and focus not only on its cross-domain applicability, but also on its core evolutionary operators, including elements inspired from other meta-heuristics. The global scientific community is witnessing an upsurge in groundbreaking, new advances in all areas of computational intelligence, with a particular flurry of research focusing on evolutionary computation and bio-inspired optimization. Observed processes in nature and sociology have provided the basis for innovative algorithmic

developments aimed at leveraging the inherent capability to adapt characterized by various animals, including ants, fireflies, wolves and humans. However, it is the behavioral patterns observed in music composition that motivated the advent of the Harmony Search algorithm, a meta-heuristic optimization algorithm that over the last decade has been shown to dominate other solvers in a plethora of application scenarios. The book consists of a selection of the best contributions presented at ICHSA, a major biannual event where leading global experts on meta-heuristic optimization present their latest findings and discuss the past, present, and future of the exciting field of Harmony Search optimization. It provides a valuable reference resource for researchers working in the field of optimization meta-heuristics, and a solid technical base for frontline investigations around this algorithm.

The protection of clean water, air, and land for the habitation of humans and other organisms has become a pressing concern amid the intensification of industrial activities and the rapidly growing world population. The integration of environmental science with engineering principles has been introduced as a means of long-term sustainable development. The Handbook of Research on Advancements in Environmental Engineering creates awareness of the role engineering plays in protecting and improving the natural environment. Providing

the latest empirical research findings, this book is an essential reference source for executives, educators, and other experts who seek to improve their project's environmental costs.

These proceedings gather contributions presented at the 9th International Conference on Applied Operational Research (ICAOR 2017) in Taoyuan, Taiwan, December 18-20, 2017, published in the series Lecture Notes in Management Science (LNMS). The conference covers all aspects of Operational Research and Management Science (OR/MS) with a particular emphasis on applications.

The intense development of novel data-driven and hybrid methods for structural health monitoring (SHM) has been demonstrated by field deployments on large-scale systems, including transport, wind energy, and building infrastructure. The actionability of SHM as an essential resource for life-cycle and resilience management is heavily dependent on the advent of low-cost and easily deployable sensors Nonetheless, in optimizing these deployments, a number of open issues remain with respect to the sensing side. These are associated with the type, configuration, and eventual processing of the information acquired from these sensors to deliver continuous behavioral signatures of the monitored structures. This book discusses the latest advances in the field of sensor

networks for SHM. The focus lies both in active research on the theoretical foundations of optimally deploying and operating sensor networks and in those technological developments that might designate the next generation of sensing solutions targeted for SHM. The included contributions span the complete SHM information chain, from sensor design to configuration, data interpretation, and triggering of reactive action. The featured papers published in this Special Issue offer an overview of the state of the art and further proceed to introduce novel methods and tools. Particular attention is given to the treatment of uncertainty, which inherently describes the sensed information and the behavior of monitored systems.

This book comprises select proceedings of the National Conference on Advances in Structural Technology (CoAST 2019). It brings together different applied and technological aspects of structural engineering. The main topics covered in this book include solid mechanics, composite structures, fluid-structure interaction, soil-structure interaction, structural safety, and structural health monitoring. The book also focuses on emerging structural materials and the different behavior of civil, mechanical, and aerospace structural systems. Given its contents, this book will be a useful reference for researchers and practitioners working in structural safety and engineering.

Dynamics of Civil Structures, Volume 2: Proceedings of the 35th IMAC, A Conference and Exposition on Structural Dynamics, 2017, the second volume of ten from the Conference brings together contributions to this important area of research and engineering. The collection presents early findings and case studies on fundamental and applied aspects of the Dynamics of Civil Structures, including papers on: Modal Parameter Identification Dynamic Testing of Civil Structures Control of Human Induced Vibrations of Civil Structures Model Updating Damage Identification in Civil Infrastructure Bridge Dynamics Experimental Techniques for Civil Structures Hybrid Simulation of Civil Structures Vibration Control of Civil Structures System Identification of Civil Structures This book offers a collection of original peer-reviewed contributions presented at the 6th International Congress on Design and Modeling of Mechanical Systems (CMSM'2015), held in Hammamet, Tunisia, from the 23rd to the 25th of March 2015. It reports on both recent research findings and innovative industrial applications in the fields of mechatronics and robotics, dynamics of mechanical systems, fluid structure interaction and vibroacoustics, modeling and analysis of materials and structures, and design and manufacturing of mechanical systems. Since its first edition in 2005, the CMSM Congress has been held every two years with the aim of bringing together specialists from universities and industry to present the state-of-the-art in research and

applications, discuss the most recent findings and exchange and develop expertise in the field of design and modeling of mechanical systems. The CMSM Congress is jointly organized by three Tunisian research laboratories: the Mechanical Engineering Laboratory of the National Engineering School of Monastir; the Mechanical Laboratory of Sousse, part of the National Engineering School of Sousse; and the Mechanical, Modeling and Manufacturing Laboratory at the National Engineering School of Sfax. Nonlinear Dynamics, Volume 1: Proceedings of the 36th IMAC, A Conference and Exposition on Structural Dynamics, 2018, the first volume of nine from the Conference brings together contributions to this important area of research and engineering. The collection presents early findings and case studies on fundamental and applied aspects of Nonlinear Dynamics, including papers on: Nonlinear System Identification Nonlinear Modeling & Simulation Nonlinear Reduced-order Modeling Nonlinearity in PracticeNonlinearity in Aerospace Systems Nonlinearity in Multi-Physics Systems Nonlinear Modes and Modal Interactions Experimental Nonlinear Dynamics This book focuses on metaheuristic methods and its applications to real-world problems in Engineering. The first part describes some key metaheuristic methods, such as Bat Algorithms, Particle Swarm Optimization, Differential Evolution, and Particle Collision Algorithms. Improved versions of these methods and strategies for parameter tuning are also presented, both of which are essential for the practical use of these important computational tools. The second part then applies metaheuristics to problems, mainly in

Civil, Mechanical, Chemical, Electrical, and Nuclear Engineering. Other methods, such as the Flower Pollination Algorithm, Symbiotic Organisms Search, Cross-Entropy Algorithm, Artificial Bee Colonies, Population-Based Incremental Learning, Cuckoo Search, and Genetic Algorithms, are also presented. The book is rounded out by recently developed strategies, or hybrid improved versions of existing methods, such as the Lightning Optimization Algorithm, Differential Evolution with Particle Collisions, and Ant Colony Optimization with Dispersion – state-of-the-art approaches for the application of computational intelligence to engineering problems. The wide variety of methods and applications, as well as the original results to problems of practical engineering interest, represent the primary differentiation and distinctive quality of this book. Furthermore, it gathers contributions by authors from four countries – some of which are the original proponents of the methods presented – and 18 research centers around the globe.

This book gathers the peer-reviewed papers presented at the XXIV Conference of the Italian Association of Theoretical and Applied Mechanics, held in Rome, Italy, on September 15-19, 2019 (AIMETA 2019). The conference topics encompass all aspects of general, fluid, solid and structural mechanics, as well as mechanics for machines and mechanical systems, including theoretical, computational and experimental techniques and technological applications. As such the book represents an invaluable, up-to-the-minute tool, providing an essential overview of the most recent advances in the field.

This book features papers focusing on the implementation of new and future technologies, which were presented at the International Conference on New Technologies, Development and Application, held at the Academy of Science and Arts of Bosnia and Herzegovina in Sarajevo on 27th–29th June 2019. It covers a wide range of future technologies and technical disciplines, including complex systems such as Industry 4.0; robotics; mechatronics systems; automation; manufacturing; cyber-physical and autonomous systems; sensors; networks; control, energy, automotive and biological systems; vehicular networking and connected vehicles; effectiveness and logistics systems, smart grids, as well as nonlinear, power, social and economic systems. We are currently experiencing the Fourth Industrial Revolution "Industry 4.0", and its implementation will improve many aspects of human life in all segments, and lead to changes in business paradigms and production models. Further, new business methods are emerging, transforming production systems, transport, delivery, and consumption, which need to be monitored and implemented by every company involved in the global market.

The disciplines of science and engineering rely heavily on the forecasting of prospective constraints for concepts that have not yet been proven to exist, especially in areas such as artificial intelligence. Obtaining quality solutions to the problems presented becomes increasingly difficult due to the number of steps required to sift through the possible solutions, and the ability to solve such problems relies on the

recognition of patterns and the categorization of data into specific sets. Predictive modeling and optimization methods allow unknown events to be categorized based on statistics and classifiers input by researchers. The Handbook of Research on Predictive Modeling and Optimization Methods in Science and Engineering is a critical reference source that provides comprehensive information on the use of optimization techniques and predictive models to solve real-life engineering and science problems. Through discussions on techniques such as robust design optimization, water level prediction, and the prediction of human actions, this publication identifies solutions to developing problems and new solutions for existing problems, making this publication a valuable resource for engineers, researchers, graduate students, and other professionals. The book provides readers with a snapshot of recent research and industrial trends in field of industrial acoustics and vibration. Each chapter, accepted after a rigorous peer-review process, reports on a selected, original piece of work presented and discussed at the Third International Conference on Acoustics and Vibration (ICAV2021), which was organized by the Tunisian Association of Industrial Acoustics and Vibration (ATAVI) and held online on March 15-16, 2021, from Sfax, Tunisia. The contributions cover advances in both theory and practice in a variety of subfields, such as: smart materials and structures; fluid-structure interaction; structural acoustics as well as computational vibro-acoustics and numerical methods. Further topics include: engines control, noise identification, robust design, flow-induced vibration and many others. This

book provides a valuable resource for both academics and professionals dealing with diverse issues in applied mechanics. By combining advanced theories with industrial issues, it is expected to facilitate communication and collaboration between different groups of researchers and technology users.

The steel diagrid structural system is a recent load bearing and lateral resisting structural system for tall building structures that is relatively unexplored in the western United States. One possible reason for the little use of diagrid systems in earthquake prone regions is the lack of guidelines and application examples illustrating the design and analysis of these structures. In this work, a prototype building with 72 stories is used as an example for which the design and analysis of the diagrid system is performed. To mitigate the possible large displacement and base shear demands that these structures may undergo under seismic events, two new design solutions consisting of one or two friction tuned mass damper (TMD) units are explored. In the first solution, a TMD is placed on the top four stories of the building and is tuned to reduce the contribution of the fundamental mode of vibration of the structure. The second solution uses a double TMD system, in which a second TMD unit - tuned to the second period of the structure - is added at mid-height of the building. Using a nonlinear finite element model of the tuned mass damper, the effectiveness of the friction mass damper design is studied. The mass damper system consists of a concrete tank containing sand or water. The tank is placed in between the building reinforce concrete structural core and the exterior steel diagrid system. This mass damper is connected to the structure using friction pendulum isolators which are chosen due to their ability to undergo large deformations. The models are then subjected to

earthquake ground motions from historical shallow crustal and subduction-zone events. Parametric studies are carried out to optimize the mass damper design in improving the seismic performance of the building. Optimization of the seismic performance is assessed in terms of minimization of inter-story drift ratios, base and story forces, as well as floor absolute accelerations. The results show that the single TMD system can reduce significantly the peak base reaction and inter-story drift envelopes. Addition of the second TMD provides further improvements in terms of reducing the peak base reactions, while also producing notable reductions in peak absolute floor accelerations, which are not observed when only one TMD unit is used.

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.

Abstract: The present paper deals with the optimization of a hybrid tuned mass damper (TMD) in reducing the transient structural response due to impulse loading. In particular, a unit impulse excitation has been assumed, acting as base displacement, which is a situation that may occur in different real applications. The proposed hybrid TMD is composed of a previously optimized passive TMD and an added optimized active controller. Such configuration has been conceived in view of reducing both the global and the peak response. Especially on the latter task, the introduction of the active controller brings in a significant contribution. Prior, a bounded-input-bounded-output stability analysis on the control gains is developed. Different control laws have been investigated, assuming as primary structures, first a single-degree-of-freedom benchmark system and then a multi-degree-of-freedom building, in order to point out the most appropriate control law for the given structural context. In particular, a new control law, based on a linear combination of acceleration and velocity, allowed for remarkable peak response reduction. The achieved dynamic response exhibits a time settling weakly oscillating response, an indication of a stable behavior, and therefore represents a suitable option for the active controller, in view of various engineering applications.

Due to an ever-decreasing supply in raw materials and stringent constraints on conventional energy sources, demand for lightweight, efficient and low-cost structures has become crucially important in modern engineering design. This requires engineers to search for optimal and robust design options to address design problems that are commonly large in scale and highly nonlinear, making finding solutions challenging. In the past two decades, metaheuristic algorithms have shown promising power, efficiency and versatility in solving these difficult

optimization problems. This book examines the latest developments of metaheuristics and their applications in structural engineering, construction engineering and earthquake engineering, offering practical case studies as examples to demonstrate real-world applications. Topics cover a range of areas within engineering, including big bang-big crunch approach, genetic algorithms, genetic programming, harmony search, swarm intelligence and some other metaheuristic methods. Case studies include structural identification, vibration analysis and control, topology optimization, transport infrastructure design, design of reinforced concrete, performance-based design of structures and smart pavement management. With its wide range of everyday problems and solutions, Metaheursitic Applications in Structures and Infrastructures can serve as a supplementary text for design courses and computation in engineering as well as a reference for researchers and engineers in metaheuristics, optimization in civil engineering and computational intelligence. Review of the latest development of metaheuristics in engineering. Detailed algorithm descriptions with focus on practical implementation. Uses practical case studies as examples and applications. Nowadays, numerical computation has become one of the most vigorous tools for scientists, researchers and professional engineers, following the enormous progress made during the last decades in computing technology, in terms of both computer hardware and software development. Although this has led to tremendous achievements in computer-based structural engineering, the increasing necessity of solving complex problems in engineering requires the development of new ideas and innovative methods for providing accurate numerical solutions in affordable computing times. This collection aims at providing a forum for the presentation and discussion of state-of-the-art innovative developments, concepts, methodologies and

approaches in scientific computation applied to structural engineering. It involves a wide coverage of timely issues on computational structural engineering with a broad range of both research and advanced practical applications. This Research Topic encompasses, but is not restricted to, the following scientific areas: modeling in structural engineering; finite element methods; boundary element methods; static and dynamic analysis of structures; structural stability; structural mechanics; meshless methods; smart structures and systems; fire engineering; blast engineering; structural reliability; structural health monitoring and control; optimization; and composite materials, with application to engineering structures.

Safety, Reliability, Risk and Life-Cycle Performance of Structures and Infrastructures contains the plenary lectures and papers presented at the 11th International Conference on STRUCTURAL SAFETY AND RELIABILITY (ICOSSAR2013, New York, NY, USA, 16-20 June 2013), and covers major aspects of safety, reliability, risk and life-cycle performance of str

This book reports on the state of the art in the field of multiphysics systems. It consists of accurately reviewed contributions to the MMSSD'2014 conference, which was held from December 17 to 19, 2004 in Hammamet, Tunisia. The different chapters, covering new theories, methods and a number of case studies, provide readers with an up-to-date picture of multiphysics modeling and simulation. They highlight the role played by high-performance computing and newly available software in promoting the study of multiphysics coupling effects, and show how these technologies can be practically implemented to bring about significant improvements in the field of design, control and monitoring of machines. In addition to providing a detailed description of the methods and their applications, the book also identifies new research issues, challenges and opportunities, thus providing researchers and

practitioners with both technical information to support their daily work and a new source of inspiration for their future research.

This second of three volumes from the inaugural NODYCON, held at the University of Rome, in February of 2019, presents papers devoted to Nonlinear Dynamics and Control. The collection features both well-established streams of research as well as novel areas and emerging fields of investigation. Topics in Volume II include influence of nonlinearities on vibration control systems; passive, semi-active, active control of structures and systems; synchronization; robotics and human-machine interaction; network dynamics control (multi-agent systems, leader-follower dynamics, swarm dynamics, biological networks dynamics); and fractional-order control.

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. The topology optimization method solves the basic enginee- ring 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.

Offshore wind turbines have the potential to be an important part of the United States' energy production profile in the coming years. In order to accomplish this wind integration, offshore wind turbines need to be made more reliable and cost efficient to be competitive with other sources of energy. To capitalize on high speed and high quality winds over deep water, floating platforms for offshore wind turbines have been developed, but they suffer from greatly increased loading. One method to reduce loads in offshore wind turbines is the application of structural control techniques usually used in skyscrapers and bridges. Tuned

mass dampers are one structural control system that have been used to reduce loads in simulations of offshore wind turbines. This thesis adds to the state of the art of offshore wind energy by developing a set of optimum passive tuned mass dampers for four offshore wind turbine platforms and by quantifying the effects of actuator dynamics on an active tuned mass damper design. The set of optimum tuned mass dampers are developed by creating a limited degree-of-freedom model for each of the four offshore wind platforms. These models are then integrated into an optimization function utilizing a genetic algorithm to find a globally optimum design for the tuned mass damper. The tuned mass damper parameters determined by the optimization are integrated into a series of wind turbine design code simulations using FAST. From these simulations, tower fatigue damage reductions of between 5 and 20% are achieved for the various TMD configurations. A previous study developed a set of active tuned mass damper controllers for an offshore wind turbine mounted on a barge. The design of the controller used an ideal actuator in which the commanded force equaled the applied force with no time lag. This thesis develops an actuator model and conducts a frequency analysis on a limited degree-of-freedom model of the barge including this actuator model. Simulations of the barge with the active controller and the actuator model are conducted with FAST, and the results are compared

with the ideal actuator case. The realistic actuator model causes the active mass damper power requirements to increase drastically, by as much as 1000%, which confirms the importance of considering an actuator model in controller design.

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