Multidisciplinary Design Optimization Methods For Electrical Machines And Drive Systems Power Systems

Multidisciplinary Design Methods For Electrical Machines and Drive Systems Multidisciplinary design optimization is an” emerging” discipline that integrates the efforts of mathematicians, engineers, and computer scientists to optimize the design of complex electrical machines and drive systems. This book provides a comprehensive overview of the latest methods and algorithms for the multidisciplinary design optimization of complex electrical systems.

The book covers a wide range of topics, including:

- Evolutionary optimization and game strategies for advanced multidisciplinary design evaluation of methods for multidisciplinary design optimization (MDO).
- Framework for multi-model management in single- and multidisciplinary design optimization.
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The book is intended for engineers, researchers, and students in the field of electrical machines and drive systems. It is also useful for researchers in other disciplines who are interested in the latest methods and algorithms for multidisciplinary optimization.

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Evaluation of Methods for Multidisciplinary Design Optimization (Mdo). Phase 1 Many complex aeronautical design problems can be formulated with efficient multi-objective evolutionary optimization methods and game strategies. This book describes the role of advanced innovative tools in the solution, or the set of solutions of single or multi disciplinary optimization. These tools use the concept of multi-population, asynchronous parallelization and hierarchical topology which allows different models including precise, intermediate and approximate models with each node belonging to the different hierarchical layer handled by a different Evolutionary Algorithm. The efficiency of evolutionary algorithms for both single and multi-objective optimization problems are significantly improved by the coupling of EAs with games and in particular by a new dynamic methodology named “Hybridized Nash-Pareto games”. Multi objective Optimization techniques and robust design problems taking into account uncertainties are introduced and explained in detail. Several applications dealing with aircraft and UAV, UAV systems are implemented numerically and discussed. Applications of increasing optimization complexity are presented as well as hands-on test case problems. These different models examples focus on aeronautical applications and will be useful to the practitioner in the laboratory or in industrial design environments. The evolutionary methods coupled with games presented in this volume can be applied to other areas including surface and marine transport, structures, biomedical engineering, renewable energy and environmental problems. This book will be of interest to students, young scientists and engineers involved in the field of multi physics optimization.

Multidisciplinary Design Optimization Supported by Knowledge Based Engineering Advances in Structural Optimization presents the techniques for a wide set of applications, ranging from the problems of size and shape optimization (historically the first to be studied) to topology and material optimization. Structural models are considered that use both discrete and finite elements. Structural materials can be classical or new. Emerging methods are also addressed, such as automatic differentiation, intelligent structures optimization, integration of structural optimization in concurrent engineering environments, and multidisciplinary optimization. For researchers and designers in industries such as aerospace, automotive, mechanical, civil, nuclear, naval and offshore. A reference book for advanced undergraduate or graduate courses on structural optimization and optimum design.

Application of Multidisciplinary Design Optimization (MDO) Methods to an Electronic Packaging Problem Multidisciplinary Design Optimization supported by Knowledge Based Engineering provides a comprehensive guide to the use of Multidisciplinary Design Optimization (MDO) in the modern design environment. The combination of MDO and Knowledge Based Engineering (KBE), two rapidly developing technologies, can help to improve the robustness of the conceptual design process and these technologies and some examples of their application are the subject of this book. Multidisciplinary Design Optimization supported by Knowledge Based Engineering is divided into 4 parts, covering fundamental concepts, system details, MDO/KBE in real-world environments, and examples of MDO/KBE real-world applications. The aim of the book is to support an engineer confronting a complex engineering design problem requiring the application of MDO methods and technology.

An Automated Multidisciplinary Design Optimization Method for Multi-hull Vessels "We present a novel multi-model management method for numerical design optimization. The goal is to determine whether any of the analysis models associated with lower computational cost (that are typically expected to have inferior predictive capability relative to models associated with higher computational cost) can be used in certain areas of the design space as the latter is being explored during the optimization process. The framework quantifies and utilizes the space exploration available models regardless of expected fidelity. We implement our strategy by means of a trust-region management framework that utilizes the mesh adaptive direct search derivative-free optimization algorithm. We first present the methodology for single-disciplinary engineering design optimization problems and demonstrate it using a cantilevered flexible beam example. Results show significant reduction in the computational cost of the optimization process. We also investigate the scalability of the proposed method using an airfoil shape optimization problem. We then proceed to extend our method to solve multidisciplinary design optimization problems with particular emphasis on strong coupled fluid-structure interaction. We illustrate the significant increase in computational costs that are due to the use of a multidisciplinary analysis framework. We implement our method for two multidisciplinary design optimization architectures: the monolithic multidisciplinary feasible formulation (that is commonly referred to as all-at-once) and a penalty-based distributed interdisciplinarily feasible formulation. Finally, we extend the method to allow the consideration of time-dependent multidisciplinary design optimization problems. The algorithm is modified to automate the search for adequate modeling parameters during the time-dependent multidisciplinary analysis. We demonstrate the proposed time-invariant and time-dependent optimization methods by inverting three of the problems: a flexible plate fluid-structure interaction problem, a flexible beam fluid-structure interaction problem, and a transonic fan flow problem. Results show both methods are accurate and efficient and result in significant cost savings, especially in the presence of strongly-coupled problems."– A Relative Adequacy Framework for Multi-model Management in Single- and Multidisciplinary Design Optimization Multidisciplinary Design Optimization This volume provides an up-to-date overview of major advancements, emerging trends, and projected industrial applications in the field of multidisciplinary design optimization. It concentrates on the current status of the field, exposes commonalities, innovative, promising, and speculative methods. This book provides a view of today’s multidisciplinary optimization environment through a balanced theoretical and practical treatment. The contributors are the foremost authorities in each area of specialization. Design Optimization of Fluid Machinery Modern Flexible Multi-body Dynamics Modeling Methodology for Flapping Wing Vehicles presents research on the implementation of a flexible multi-body dynamic representation of a flapping wing ornithopter that considers aerelasticity. This effort brings advances in the understanding of flapping wing flight physics and dynamics that ultimately leads to an improvement in the performance of such flight vehicles, thus reaching their high performance potential. In using this model, it is necessary to reduce body accelerations and forces of an ornithopter vehicle, as well as to improve the aerodynamic performance and enhance flight kinematics and forces which are the design optimization objectives. This book is a useful reference for postgraduates in mechanical engineering and related areas, as well as researchers in the field of multi-body dynamics. Uses Lagrange's equations of motion in terms of a generalized coordinate vector of the rigid and flexible bodies in order to model the flexible multi-body system. Provides flight verification data and flight physics of highly flexible ornithoptic vehicles includes an online companion case with files/urls used in application examples

Optimization Methods and Tools for Multicriteria/multiobjective Design Optimization Multidisciplinary Design Optimization This book contains thirty-five selected papers presented at the International Conference on Evolutionary and Deterministic Methods for Design, Optimization and Control with Applications to Industrial and Societal Problems (EUROGEN 2011). This Conference is sponsored by the Society for Computational Engineering Design and Development, and the Scientific Committee of the conference. These numerical methods are included in the field of Computational Science and Technology, and use a wide variety of methods including simulation and optimization methods. The volume focuses particularly on intelligent systems for multidisciplinary design optimization (mdo) problems based on multi-hybridized software, adjoint-based and one-shot methods, uncertainty quantification and optimization, multidisciplinary design optimization, applications of game theory to industrial optimization problems, applications in structural and civil engineering optimum design and surrogate models based optimization methods in aerodynamic design.

Evaluation of Methods for Multidisciplinary Design Optimization (MDO) A comprehensive introduction to optimization with a focus on practical algorithms for the design of engineering systems. This book offers a comprehensive introduction to optimization with a focus on practical algorithms. The book approaches optimization from an engineering perspective, where the objective is to design a system that optimizes a set of metrics subject to constraints. Readers will learn about computational approaches for a range of challenges, including
searching high-dimensional spaces, handling problems where there are multiple competing objectives, and accommodating uncertainty in the metrics. Figures, examples, and exercises convey the intuition behind the mathematical approaches. The text provides concrete implementations of most algorithms in high-level programming languages such as C++, Fortran, and MATLAB. Topics covered include derivatives and their generalization to multipliers; local descent and first- and second-order methods that inform local descent; stochastic methods, which introduce randomness into the optimization process; linear constrained optimization, when both the objective function and the constraints are linear; surrogate models, probabilistic surrogate models, and using probabilistic surrogate models to guide optimization; optimization under uncertainty; uncertainty propagation; expression optimization; and multidisciplinary design optimization. Appendixes offer an introduction to the julia language, test functions for evaluating algorithm performance, and mathematical concepts used in the derivation and analysis of the optimization methods discussed in the text. The book can be used by advanced undergraduates and graduate students in mathematics, statistics, computer science, any engineering field, (including electrical engineering and aerospace engineering), and operations research, and as a reference for professionals.

A Multidisciplinary Design Optimization Method Applied to Stoppable Rotor Configurations Design Optimization of Fluid Machinery: Applying Computational Fluid Dynamics and Numerical Optimization Drawing on extensive research and experience, this timely reference brings together numerical optimization methods for fluid machinery and its key industrial applications. It logically lays out the context required to understand computational fluid dynamics by introducing the basics of fluid mechanics, fluid machines and their components. Readers are then introduced to single and multi-objective optimization methods, automated optimization, surrogate models, and evolutionary algorithms. Finally, design approaches and applications in the areas of pumps, turbines, compressors, and other fluid machinery systems are clearly presented. The emphasis is on renewed features and important applications, with key sections on renewable energy systems Design Optimization of Fluid Machinery is an essential guide for undergraduate students, researchers, engineers working in fluid machinery and its optimization methods. It is a comprehensive reference text for advanced students in mechanical engineering and related fields of fluid dynamics and aerospace engineering.

Advances in Structural and Multidisciplinary Design Optimization A yet accessible graduate textbook covering both fundamental and advanced optimization theory and algorithms. Progress in Multidisciplinary Design Optimization at NASA Langley This book contains state-of-the-art contributions in the field of evolutionary and deterministic methods for design, optimization and control in engineering and sciences. Specialists have written each of the 34 chapters as extended versions of selected papers presented at the Conferences on Evolutionary Multiobjective Optimization and Control in Engineering and Sciences (EMO) and 15th Europe Conference on Design, Optimization and Control in Engineering and Sciences (EUROGEN 2013). The conference was one of the Thematic Conferences of the European Community on Computational Methods in Applied Sciences (ECCOMAS). Topics treated in the various chapters are classified in the following sections: theoretical and numerical methods and tools for optimization (theoretical methods and tools; algorithms; systems analysis; parallel processing (computers); multiprocessing (computers); algorithms; systems analysis), algorithmic applications (electrical and electronics applications, focused particularly on intelligent systems for multidisciplinary design optimization (mdo) problems based on multi-hybridized software, adjoint-based and one-shot methods, uncertainty quantification and optimization, multidisciplinary design optimization, applications of game theory to industrial optimization problems, applications in structural and civil engineering optimum design and surrogate models based optimization methods in aerodynamic design.

Advances in Evolutionary and Deterministic Methods for Design, Optimization and Control in Engineering and Sciences A new MDO method, BLISS, and two different variants of the method, BLUSS/RS and BLUSS/S, have been implemented using iSIGHT's scripting language and evaluated. The new non-linear optimization method can be used for exploiting the concurrent processing capabilities in a multiprocessor system. Several methods, including the local sensitivity analysis, local optimization, response surfaces construction and updates are all ideally suited for exploiting concurrent processing capabilities. However, such sensitivity methods that can be used to address challenging vehicle safety structure problems and how to explore the limitations of the approaches given. The authors draw on research work with the likes of MIRA, Jaguar Land Rover and Tata Motors European Technology Centre as part of multi-million pound European funded research projects, emphasizing the industry applications of recent advances. The book is intended for crash engineers, restraint systems engineers and vehicle dynamics engineers, as well as other mechanical, automotive and aerospace engineers, researchers and students with a structural focus. Focuses on non-linear, large deformation structural optimization problems relating to vehicle safety Discusses the limitations of different algorithms in use and offers guidance on best practice approaches using different optimization methods for advanced electrical machines and drive systems. Readers will discover novel design optimization concepts developed by the authors and other researchers in the last decade, including application-oriented, multi-disciplinary, multi-objective, multi-level, deterministic, and robust design optimization methods. A multidisciplinary analysis includes various aspects of materials, electromagnetics, thermotics, mechanics, power electronics, applied mathematics, manufacturing technology, and quality control and management. This book will benefit both researchers and engineers in the field of motor and drive design and manufacturing, thus enabling the effective development of the high-quality production of innovative, high-performance drive systems for challenging applications, such as green energy systems and electric vehicles.

Emerging Methods for Multidisciplinary Optimization Metahuristic Applications in Structures and Infrastructures This book presents various computationally efficient component- and system-level design optimization methods for advanced electrical machines and drive systems. Readers will discover novel design optimization concepts developed by the authors and other researchers in the last decade, including application-oriented, multi-disciplinary, multi-objective, multi-level, deterministic, and robust design optimization methods. A multidisciplinary analysis includes various aspects of materials, electromagnetics, thermotics, mechanics, power electronics, applied mathematics, manufacturing technology, and quality control and management. This book will benefit both researchers and engineers in the field of motor and drive design and manufacturing, thus enabling the effective development of the high-quality production of innovative, high-performance drive systems for challenging applications, such as green energy systems and electric vehicles.

Multidisciplinary Design Optimization and its Application in Deep Manned Submersible Design This book presents various computationally efficient component- and system-level design optimization methods for advanced electrical machines and drive systems. Readers will discover novel design optimization concepts developed by the authors and other researchers in the last decade, including application-oriented, multi-disciplinary, multi-objective, multi-level, deterministic, and robust design optimization methods. A multidisciplinary analysis includes various aspects of materials, electromagnetics, thermotics, mechanics, power electronics, applied mathematics, manufacturing technology, and quality control and management. This book will benefit both researchers and engineers in the field of motor and drive
design and manufacturing, thus enabling the effective development of the high-quality production of innovative, high-performance drive systems for challenging applications, such as green energy systems and electric vehicles.

Aerospace System Analysis and Optimization in Uncertainty Spotlighting the field of Multidisciplinary Design Optimization (MDO), this book illustrates and implements state-of-the-art methodologies within the complex process of aerospace system design under uncertainties. The book provides approaches to integrating a multitude of components and constraints with the ultimate goal of reducing design cycles. Insights on a vast assortment of problems are provided, including discipline modeling, sensitivity analysis, uncertainty propagation, reliability analysis, and global multidisciplinary optimization. The extensive range of topics covered include areas of current open research. This Work is destined to become a fundamental reference for aerospace systems engineers, researchers, as well as for practitioners and engineers working in areas of optimization and uncertainty. Part I is largely comprised of fundamentals. Part II presents methodologies for single discipline problems with a review of existing uncertainty propagation, reliability analysis, and optimization techniques. Part III is dedicated to the uncertainty-based MDO and related issues. Part IV deals with three MDO related issues: the multifidelity, the multi-objective optimization and the mixed continuous/discrete optimization and Part V is devoted to test cases for aerospace vehicle design.

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