Modeling Analysis And Optimization Of Process And Energy

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.

Asynchronous circuits provide efficient solutions for many of the recent nanometric technologies, although the lack of analysis and optimization tools has limited the commercial spread of this technology. This book helps readers to understand the difficulties of modeling and analyzing asynchronous circuits. A new modeling methodology is introduced; it is used to build Asynchronous Static Timing Analysis (ASTA) and Asynchronous Statistical Static Timing Analysis (ASSTA). These fast and accurate methods are used to optimize the circuit speed against its hardware size. In addition, the book investigates the handshaking protocol effect on different asynchronous circuit performance metrics (speed, power consumption, EMI and robustness against process variability). The book is accompanied by AHMOSE (Asynchronous High-speed Modeling and Optimization Tool-set), a demonstrative software, which provides to the user a better understanding and usage of the explained methods.

Many physical and engineered systems (e.g., smart grid, transportation and biomedical systems) are increasingly being monitored and controlled over a communication network. These systems where sensing, communication, computation and real time control are closely integrated are referred to as cyber physical systems (CPS). Cyber physical systems present a plethora of challenges related to their design, analysis, optimization and control. In this dissertation, we present some fundamental methodologies to analyze the optimization of physical systems over a communication network. Specifically, we consider a medium voltage DC shipboard smart grid (SSG) reconfiguration problem as a test case to demonstrate our approach. The main goal of SSG reconfiguration is to change the topology of the physical power system by switching circuit breakers, switches, and other devices in the system in order to route power effectively to loads especially in the event of faults/failures. A majority of the prior work has focused on centralized approaches to optimize the switch configuration to maximize specific objectives. These methods are prohibitively complex and not suited for agile reconfiguration in mission critical situations. Decentralized solutions proposed do reduce complexity and implementation time at the cost of optimality. Unfortunately, none of the prior efforts in this arena address the cyber physical aspects of an SSG. This dissertation aims to bridge this gap by proposing a suite of methods to analyze both centralized and decentralized SSG reconfigurations that incorporate the effect of the underlying cyber infrastructure. The SSG reconfiguration problem is a mixed integer non convex optimization problem for which branch and bound based solutions have been proposed earlier. Here, optimal reconfiguration strategies prioritize the power delivered to vital loads over semi-vital and non vital loads. In this work, we propose a convex approximation to the original non convex problem that significantly reduces complexity of the SSG reconfiguration. Tradeoff between power delivered and number of switching operations after reconfiguration is discussed at steady state. Second, the distribution of end-to-end delay associated with fault diagnosis and reconfiguration in SSG is investigated from a cyber-physical system perspective. Specifically, a cross-layer total (end-to-end) delay analysis framework is introduced for SSG reconfiguration. The proposed framework stochastically models the heterogeneity of actions of various sub-systems viz., the reconfiguration of power systems, generation of fault information by sensor nodes associated to the power system, processing actions at control center to resolve fault locations and reconfiguration, and information flow through communication network to:(1) analyze the distribution of total delay in SSG reconfiguration after the occurrence of faults; and (2) propose design options for real-time reconfiguration solutions for shipboard CPS, that meet total delay requirements. Finally, the dissertation focuses on the quality of SSG reconfiguration solution with incomplete knowledge of the overall system state, and communication costs that may affect the quality (optimality) of the resulting reconfiguration. A dual decomposition based decentralized optimization in which the shipboard system is decomposed into multiple separable subsystems with agents is proposed. Specifically, agents monitoring each subsystem solve a local concave dual function of the original objective while neighboring agents share information over a communication network to obtain a global solution. The convergence of the proposed approach under varying network delays and quantization noise is analyzed and comparisons with centralized approaches are presented. Results demonstrate the effectiveness as well as tradeoffs involved in centralized and decentralized SSG reconfiguration approaches.

Choose statistically significant stock selection models using SAS® Portfolio and Investment Analysis with SAS®: Financial Modeling Techniques for Optimization is an introduction to using SAS to choose statistically significant stock selection models, create mean-variance efficient portfolios, and aggressively invest to maximize the geometric mean. Based on the pioneering portfolio selection techniques of Harry Markowitz and others, this book shows that maximizing the geometric mean maximizes the utility of final wealth. The authors draw on decades of experience as teachers and practitioners of financial modeling to bridge the gap between theory and application. Using real-world data, the book illustrates the concept of risk-return analysis and explains why intelligent investors prefer stocks over bonds. The authors first explain how to build expected return models based on expected earnings data, valuation ratios, and past stock price performance using PROC ROBUSTREG. They then show how to construct and manage portfolios by combining the expected return and risk models. Finally, readers learn how to perform hypothesis testing using Bayesian methods to add confidence when data mining from large financial databases.

Energy Storage in Energy Markets reviews the modeling, design, analysis, optimization and impact of energy storage systems in energy markets in a way that is ideal for an audience of researchers and practitioners. The book provides deep insights on potential benefits and revenues, economic evaluation, investment challenges, risk analysis, technical requirements, and the impacts of energy storage integration. Heavily referenced and easily accessible to policymakers, developers, engineer, researchers and students alike, this comprehensive resource aims to fill the gap in the role of energy storage in pool/local energy/ancillary service markets and other multi-market commerce. Chapters elaborate on energy market fundamentals, operations, energy storage fundamentals, components, and the role and impact of storage systems on energy systems from different aspects, such as environmental, technical and economics, the role of storage devices in uncertainty handling in energy systems and their contributions in resiliency and reliability improvement. Provides integrated techno-economic analysis of energy storage systems and the energy markets Reviews impacts of electric vehicles as moving energy storage and loads on the electricity market Analyzes the role and impact of energy storage systems in the energy, ancillary, reserve and regulatory multi-market business Applies advanced methods to the economic integration of large-scale energy storage systems Develops an evaluation framework for energy market storage systems

Modelling, Assessment, and Optimization of Energy Systems provides comprehensive methodologies for the thermal modelling of energy systems based on thermodynamic, exergoeconomic and exergoenviromental approaches. It

provides advanced analytical approaches, assessment criteria and the methodologies to obtain analytical expressions from the experimental data. The concept of single-objective and multi-objective optimization with application to energy systems is provided, along with decision-making tools for multi-objective problems, multi-criteria problems, for simplifying the optimization of large energy systems, and for exergoeconomic improvement integrated with a simulator EIS method. This book provides a comprehensive methodology for modeling, assessment, improvement of any energy system with guidance, and practical examples that provide detailed insights for energy engineering, mechanical engineering, chemical engineering and researchers in the field of analysis and optimization of energy systems. Offers comprehensive analytical tools for the modeling and simulation of energy systems with applications for decision-making tools Provides methodologies to obtain analytical models of energy systems for experimental data Covers decision-making tools in multi-objective problems

Energy costs impact the profitability of virtually all industrial processes. Stressing how plants use power, and how that power is actually generated, this book provides a clear and simple way to understand the energy usage in various processes, as well as methods for optimizing these processes using practical hands-on simulations and a unique approach that details solved problems utilizing actual plant data. Invaluable information offers a complete energy-saving approach essential for both the chemical and mechanical engineering curricula, as well as for practicing engineers.

The heavy-tailed traffic from wireless users, caused by the emerging Internet and multimedia applications, induces extremely dynamic and variable network environment, which can fundamentally change the way in which wireless networks are conceived, designed, and operated. This thesis is concerned with modeling, analysis, and optimization of wireless networks in the presence of heavy tails. First, a novel traffic model is proposed, which captures the inherent relationship between the traffic dynamics and the joint effects of the mobility variability of network users and the spatial correlation in their observed physical phenomenon. Next, the asymptotic delay distribution of wireless users is analyzed under different traffic patterns and spectrum conditions, which reveals the critical conditions under which wireless users can experience heavy-tailed delay with significantly degraded QoS performance. Based on the delay analysis, the fundamental impact of heavy-tailed environment on network stability is studied. Specifically, a new network stability criterion, namely moment stability, is introduced to better characterize the QoS performance in the heavy-tailed environment. Accordingly, a throughput-optimal scheduling algorithm is proposed to maximize network throughput while guaranteeing moment stability. Furthermore, the impact of heavy-tailed spectrum on network connectivity is investigated. Towards this, the necessary conditions on the existence of delay-bounded connectivity are derived. To enhance network connectivity, the mobility-assisted data forwarding scheme is exploited, whose important design parameters, such as critical mobility radius, are derived. Moreover, the latency in wireless mobile networks is analyzed, which exhibits asymptotic linearity in the initial distance between mobile users.

This document contains the proceedings of the Air Force/NASA Workshop on Modeling, Analysis, and Optimization Issues for Large Space Structures held in Williamsburg, Virginia, May 13-14 1982. The theme of the workshop was modeling, analysis, and optimization of large space structures, including structure control interaction. Speakers were drawn primarily from industry, with participation from universities and government. The workshop was organized into three sessions: mathematical modeling, analysis methodology, and optimization for controllability. Results of the workshop were discussed in a final session. The workshop presentations ranged over many topics in large space structures, including structure-control interaction, structural and structural dynamics modeling, thermal analysis, testing, design, and optimization. The interdisciplinary area of structure-control interaction, which is a challenge to analysts, designers, and test engineers, was clearly emphasized. Not addressed in the workshop was the important subject of structural deployment.

The book focuses on the modeling, analysis and optimization of Automatic Retransmission reQuest (ARQ) protocols as part of a wireless communications system. The work considers systems in increasing complexity and is divided into two parts. The first considers single link communications while the second investigates point-to-multipoint systems and wireless networks. The first part provides a thorough discussion on performance measures in ARQ communications. A definition for reliable protocols and conditions to achieve this are provided. In case that, due to delay constraints, reliability cannot be guaranteed, conditions for the optimal truncation of the ARQ chain are derived, considering both ARQ protocols in isolation as well as at the server of a single queue. The second part investigates power control policies to maximize the amount of data being transfered at the downlink of a cellular communications system as well as at a network with per hop retransmissions, taking interference between nodes into account. The stability regions of such systems is explicitly provided, while algorithms that can achieve this are provided and their performance is analyzed.

This book proposes a method to solve land use problems, and has made some significant contributions to the land use analysis and optimization study fields. Firstly, three spatio-temporal logit models for land use change analysis, namely, geographically and temporally weighted logit model (GTWLM), spatio-temporal panel logit model (ST-PLM) and generalized spatio-temporal logit model (GSTLM), are proposed. GTWLM, which considers spatio-temporal non-stationarity, includes temporal data in a spatio-temporal framework by proposing a spatiotemporal distance. ST-PLM incorporates the spatio-temporal correlation and individual effect in one model. By integrating GTWLM and ST-PLM, the GSTLM explores spatio-temporal non-stationarity and correlations simultaneously, whilst considering their individual effects to construct an integrated model. Secondly, a MOO-based two-level spatial planning of land use is proposed. The spatial planning aims at managing and coordinating the land use at different geographic extents and involves spatial layouts and structures of land use at different levels. In spatial planning, GIS and Remote Sensing are used to evaluate, analyze, and measure environmental, economic and social issues. The quantitative relationships between these objectives and spatial land use allocation are then used as rules in the MOO process to simulate environmental conditions under different spatial land use allocation scenarios. The book features a case study of Shenzhen city, the most important Special Economic Zone in China. This book will be of interest to academics and professionals in the fields of urban planning, land resource management, remote sensing and geographic information systems.

As our modern information-age society grows in complexity both in terms of embedded systems and applications, the problems and

challenges in reliability become ever more complex. Bringing together many of the leading experts in the field, this volume presents a broad picture of current research on system modeling and optimization in reliability and its applications.The book comprises twenty-three chapters organized into four parts: Reliability Modeling, Software Quality Engineering, Software Reliability, and Maintenance and Inspection Policies. These sections cover a wide range of important topics, including system reliability modeling, optimization, software reliability and quality, maintenance theory and inspection, reliability failure analysis, sampling plans and schemes, software development processes and improvement, stochastic process modeling, statistical distributions and analysis, fault-tolerant performance, software measurements and cost effectiveness, queueing theory and applications, system availability, reliability of repairable systems, testing sampling inspection, software capability maturity model, accelerated life modeling, statistical control, and HALT testing.

Efficient management of product information is vital for manufacturing enterprises in this information age. Considering the proliferation of product information, tight production schedules, and intense market competition, human intelligence alone cannot meet the requirements of efficient product development. Technologies and tools that support information management are urgently needed. This volume presents the design reuse methodology to support product development. Significant efforts have been made to create an intelligent and optimal design environment by incorporating the contemporary technologies in product family design, artificial intelligence, neural networks, information theories, etc. This volume covers both theoretical topics and implementation strategies, with detailed case studies to help readers gain an insight in areas such as product information modeling, information analysis, engineering optimization, production cost estimation, and product performance evaluation.

For sound transmission control inside a duct, acoustic silencers are considered whose modeling is systematically tackled by the proposed numerical tools. Reactive silencers with rigid internal partitions are studied for their parametric influences and noise attenuation mechanisms. With the introduction of MPPs as dissipative elements, a unit cell treatment is proposed to model the complex side-branch configuration, and investigations reveal the hybrid attenuation mechanism of such device, which combines the reflection and absorption effects. Benefiting from the modular nature of the sub-structuring approach, the size of the perforated hole and the perforation ratio can be optimized to strike a balance between the dissipative and reactive effect, for ultimately achieving a desired Transmission Loss (TL) within a prescribed frequency range. The calculation accuracy for both reactive and hybrid MPP silencers using the proposed approach have been confirmed with finite element method (FEM) simulations and experiments. For the tuning and optimization of a silencer, the broadband TL performance realized by a number of cascade-connected sub-chambers is investigated. A theoretical basis for the description of the overall system TL is presented. The characteristics of the sub-chambers, along with the understandings of influences of the parameters, provide guidelines for their optimizations, and a desired broadband performance is achieved by connecting sub-chambers with optimized TLs to tackle different frequency regions. Based on the sub-chamber strategy, a multi-level approach for the design, analysis and optimization of acoustic silencers with cascaded sub-chambers is proposed. Through numerical case studies and a retrofitted design of a mining truck muffler, the effectiveness of the proposed methodology is demonstrated, which greatly reduces the design variables and computational costs compared with global design and optimization.

Reflects the latest applied research and features state-of-the-art software for building and solving spreadsheet optimization models Thoroughly updated to reflect the latest topical and technical advances in the field, Optimization Modeling with Spreadsheets, Second Edition continues to focus on solving real-world optimization problems through the creation of mathematical models and the use of spreadsheets to represent and analyze those models. Developed and extensively classroom-tested by the author, the book features a systematic approach that equips readers with the skills to apply optimization tools effectively without the need to rely on specialized algorithms. This new edition uses the powerful software package Risk Solver Platform (RSP) for optimization, including its Evolutionary Solver, which employs many recently developed ideas for heuristic programming. The author provides expanded coverage of integer programming and discusses linear and nonlinear programming using a systematic approach that emphasizes the use of spreadsheet-based optimization tools. The Second Edition also features: Classifications for the various problem types, providing the reader with a broad framework for building and recognizing optimization models Network models that allow for a more general form of mass balance A systematic introduction to Data Envelopment Analysis (DEA) The identification of qualitative patterns in order to meaningfully interpret linear programming solutions An introduction to stochastic programming and the use of RSP to solve problems of this type Additional examples, exercises, and cases have been included throughout, allowing readers to test their comprehension of the material. In addition, a related website features Microsoft Office® Excel files to accompany the figures and data sets in the book. With its accessible and comprehensive presentation, Optimization Modeling with Spreadsheets, Second Edition is an excellent book for courses on deterministic models, optimization, and spreadsheet modeling at the upper-undergraduate and graduate levels. The book can also serve as a reference for researchers, practitioners, and consultants working in business, engineering, operations research, and management science.

In general, several mathematical models can be designed in order to describe a biological or medical process and there is no unique criterion which model gives the best description. This book presents several of these models and shows applications of them to different biological and medical problems. The book shows that operations research expertise is necessary in respect to modeling, analysis and optimization of biosystems.

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.

Traditionally, design space exploration for Systems-on-Chip (SoCs) has focused on the computational aspects of the problem at hand. However, as the number of components on a single chip and their performance continue to increase, the communication architecture plays a major role in the area, performance and energy consumption of the overall system. As a result, a shift from computation-based to communication-based design becomes mandatory. Towards this end, network-on-chip (NoC) communication architectures have emerged recently as a promising alternative to classical bus and point-to-point communication architectures. In this dissertation, we study outstanding research problems related to modeling, analysis and optimization of NoC communication architectures. More precisely, we present novel design

methodologies, software tools and FPGA prototypes to aid the design of application-specific NoCs.
In packet communication systems, a header is attached to the transmitted packet at each layer. The overhead due to the transmission of the individual header can have a significant impact on the performance of the communication system especially when the system operates in heavy load. In order to increase data throughput, a number of packets sharing a single header can be aggregated into a frame. In this dissertation, we present a mathematical model for a packet aggregation system assuming a general distribution for the packet length. For a given header size, we obtain the minimum system utilization where packet aggregation improves the system performance. We also analyze the asymptotic behavior of such systems leading to a simple heuristic policy on the optimum aggregation level. It is shown that the impact of the variability of the packet length distribution on different system performance measures is rather insignificant when the system load is low or moderate. In many applications, it would be necessary or desirable to group together a number of demands before it is worthwhile to allocate system resources to serve them. In the second part of this dissertation, we propose to use a threshold-based timer which dynamically controls the size of the batches and their release times. A complete characterization and a clear understanding of the stochastic characteristics of the timer behavior and its departure processes are presented. Such processes are inherently "friendlier" than their classical counterparts due to the positive correlation between the size of the released batches and the time interval between them. In traditional batch arrival models, such a dependency is absent. We examine the departure process of the timer by analyzing its queue response and the peakedness.
Discover the latest research results for both uncoded and coded caching techniques in future wireless network design.
Discrete event systems (DES) have become pervasive in our daily lives. Examples include (but are not restricted to) manufacturing and supply chains, transportation, healthcare, call centers, and financial engineering. However, due to their complexities that often involve millions or even billions of events with many variables and constraints, modeling these stochastic simulations has long been a “hard nut to crack”. The advance in available computer technology, especially of cluster and cloud computing, has paved the way for the realization of a number of stochastic simulation optimization for complex discrete event systems. This book will introduce two important techniques initially proposed and developed by Professor Y C Ho and his team; namely perturbation analysis and ordinal optimization for stochastic simulation optimization, and present the state-of-the-art technology, and their future research directions. Contents:Part I: Perturbation Analysis:The IPA Calculus for Hybrid SystemsSmoothed Perturbation Analysis: A Retrospective and Prospective LookPerturbation Analysis and Variance Reduction in Monte Carlo SimulationAdjoints and AveragingInfinitesimal Perturbation Analysis and Optimization AlgorithmsSimulation-based Optimization of Failure-prone Continuous Flow LinesPerturbation Analysis, Dynamic Programming, and BeyondPart II: Ordinal Optimization:Fundamentals of Ordinal OptimizationOptimal Computing Budget Allocation FrameworkNested PartitionsApplications of Ordinal Optimization Readership: Professionals in industrial and systems engineering, graduate reference for probability & statistics, stochastic analysis and general computer science, and research. Keywords:Simulation;Optimization;Stochastic Systems;Discrete-Even Systems;Perturbation Analysis;Ordinal Optimization
This book provides readers with a detailed reference regarding two of the most important long-term reliability and aging effects on nanometer integrated systems, electromigrations (EM) for interconnect and biased temperature instability (BTI) for CMOS devices. The authors discuss in detail recent developments in the modeling, analysis and optimization of the reliability effects from EM and BTI induced failures at the circuit, architecture and system levels of abstraction. Readers will benefit from a focus on topics such as recently developed, physics-based EM modeling, EM modeling for multi-segment wires, new EM-aware power grid analysis, and system level EM-induced reliability optimization and management techniques. Reviews classic Electromigration (EM) models, as well as existing EM failure models and discusses the limitations of those models; Introduces a dynamic EM model to address transient stress evolution, in which wires are stressed under time-varying current flows, and the EM recovery effects. Also includes new, parameterized equivalent DC current based EM models to address the recovery and transient effects; Presents a cross-layer approach to transistor aging modeling, analysis and mitigation, spanning multiple abstraction levels; Equips readers for EM-induced dynamic reliability management and energy or lifetime optimization techniques, for many-core dark silicon microprocessors, embedded systems, lower power many-core processors and datacenters.
Wireless -- Stochastic -- Cellular -- Networks.