Modeling And Simulation Of Building Energy Performance For

When used appropriately, building performance simulation has the potential to reduce the environmental impact of the built environment, to improve indoor quality and productivity, as well as to facilitate future innovation and technological progress in construction. Since publication of the first edition of Building Performance Simulation for Design and Operation, the discussion has shifted from a focus on software features to a new agenda, which centres on the effectiveness of building performance simulation in building life cycle processes. This new edition provides a unique and comprehensive overview of building performance simulation for the complete building life cycle from conception to demolition, and from a single building to district level. It contains new chapters on building information modelling, occupant behaviour modelling, urban physics modelling, urban building energy modelling and renewable energy systems modelling. This new edition keeps the same chapter structure throughout including learning objectives, chapter summaries and assignments. Moreover, the book: • Provides unique insights into the techniques of building performance modelling and simulation and their application to performance-based design and operation of buildings and the systems which service them. •

Provides readers with the essential concepts of computational support of performance-based design and operation. • Provides examples of how to use building simulation techniques for practical design, management and operation, their limitations and future direction. It is primarily intended for building and systems designers and operators, and postgraduate architectural, environmental or mechanical engineering students.

EWork and eBusiness in Architecture, Engineering and Construction 2018 collects the papers presented at the 12th European Conference on Product and Process Modelling (ECPPM 2018, Copenhagen, 12-14 September 2018) The contributions cover complementary thematic areas that hold great promise towards the advancement of research and technological development in the modelling of complex engineering systems, encompassing a substantial number of high quality contributions on a large spectrum of topics pertaining to ICT deployment instances in AEC/FM, including: Information and Knowledge Management• Construction Management• Description Logics and Ontology Application in AEC• Risk Management• 5D/nD Modelling, Simulation and Augmented Reality• Infrastructure Condition Assessment• Standardization of Data Structures• Regulatory and Legal Aspects• Multi-Model and distributed Data Management• System Identification• Industrilized Production, Smart Products and Services• Interoperability• Smart Cities• Sustainable Buildings and

Urban Environments• Collaboration and Teamwork• BIM Implementation and Deployment• Building Performance Simulation• Intelligent Catalogues and Services. eWork and eBusiness in Architecture, Engineering and Construction 2018 represents a rich and comprehensive resource for academics and researchers working in the interdisciplinary areas of information technology applications in architecture, engineering and construction. In the last two decades, the biennial ECPPM (European Conference on Product and Process Modelling) conference series, as the oldest BIM conference, has provided a unique platform for the presentation and discussion of the most recent advances with regard to the ICT (Information and Communication Technology) applications in the AEC/FM (Architecture, Engineering, Construction and Facilities Management) domains.

Building Information Modeling (BIM) refers to the consistent and continuous use of digital information throughout the entire lifecycle of a built facility, including its design, construction and operation. In order to exploit BIM methods to their full potential, a fundamental grasp of their key principles and applications is essential. Accordingly, this book combines discussions of theoretical foundations with reports from the industry on currently applied best practices. The book's content is divided into six parts: Part I discusses the technological basics of BIM and addresses computational methods for the geometric and

semantic modeling of buildings, as well as methods for process modeling. Next, Part II covers the important aspect of the interoperability of BIM software products and describes in detail the standardized data format Industry Foundation Classes. It presents the different classification systems, discusses the data format CityGML for describing 3D city models and COBie for handing over data to clients, and also provides an overview of BIM programming tools and interfaces. Part III is dedicated to the philosophy, organization and technical implementation of BIM-based collaboration, and discusses the impact on legal issues including construction contracts. In turn, Part IV covers a wide range of BIM use cases in the different lifecycle phases of a built facility, including the use of BIM for design coordination, structural analysis, energy analysis, code compliance checking, quantity take-off, prefabrication, progress monitoring and operation. In Part V, a number of design and construction companies report on the current state of BIM adoption in connection with actual BIM projects, and discuss the approach pursued for the shift toward BIM, including the hurdles taken. Lastly, Part VI summarizes the book's content and provides an outlook on future developments. The book was written both for professionals using or programming such tools, and for students in Architecture and Construction Engineering programs.

This chapter presents what a future environment for building system modeling

and simulation may look like. As buildings continue to require increased performance and better comfort, their energy and control systems are becoming more integrated and complex. We therefore focus in this chapter on the modeling, simulation and analysis of building energy and control systems. Such systems can be classified as heterogeneous systems because they involve multiple domains, such as thermodynamics, fluid dynamics, heat and mass transfer, electrical systems, control systems and communication systems. Also, they typically involve multiple temporal and spatial scales, and their evolution can be described by coupled differential equations, discrete equations and events. Modeling and simulating such systems requires a higher level of abstraction and modularisation to manage the increased complexity compared to what is used in today's building simulation programs. Therefore, the trend towards more integrated building systems is likely to be a driving force for changing the status quo of today's building simulation programs. Thischapter discusses evolving modeling requirements and outlines a path toward a future environment for modeling and simulation of heterogeneous building systems. A range of topics that would require many additional pages of discussion has been omitted. Examples include computational fluid dynamics for air and particle flow in and around buildings, people movement, daylight simulation, uncertainty propagation and optimisation methods for building design and

controls. For different discussions and perspectives on the future of building modeling and simulation, we refer to Sahlin (2000), Augenbroe (2001) and Malkawi and Augenbroe (2004).

Fundamentals of Building Performance Simulation

A Spatially Explicit, Dynamic Approach

Simulation Model Design and Execution

A Practical Guide for Students and Professionals

Modelica-based Modeling and Simulation to Support Research and Development in Building Energy and Control Systems

A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers

The increased computational power and software tools available to engineers have increased the use and dependence on modeling and computer simulation throughout the design process. These tools have given engineers the capability of designing highly complex systems and computer architectures that were previously unthinkable. Every complex design project, from integrated circuits, to aerospace vehicles, to industrial manufacturing processes requires these new methods. This book fulfills the essential need of system and control engineers at all levels in understanding modeling and simulation. This book, written as a true text/reference has become a standard sr./graduate

level course in all EE departments worldwide and all professionals in this area are required to update their skills. The book provides a rigorous mathematical foundation for modeling and computer simulation. It provides a comprehensive framework for modeling and simulation integrating the various simulation approaches. It covers model formulation, simulation model execution, and the model building process with its key activities model abstraction and model simplification, as well as the organization of model libraries. Emphasis of the book is in particular in integrating discrete event and continuous modeling approaches as well as a new approach for discrete event simulation of continuous processes. The book also discusses simulation execution on parallel and distributed machines and concepts for simulation model realization based on the High Level Architecture (HLA) standard of the Department of Defense. Presents a working foundation necessary for compliance with High Level Architecture (HLA) standards Provides a comprehensive framework for continuous and discrete event modeling and simulation Explores the mathematical foundation of simulation modeling Discusses system morphisms for model abstraction and simplification Presents a new approach to discrete event simulation of continuous processes Includes parallel and distributed simulation of discrete event models Presents a concept to achieve simulator interoperability in the form of the

DEVS-Bus

Provides an introduction to modern object-oriented design principles and applications for the fast-growing area of modeling and simulation Covers the topic of multi-domain system modeling and design with applications that have components from several areas Serves as a reference for the Modelica language as well as a comprehensive overview of application model libraries for a number of application domains

Building Performance Simulation for Design and OperationRoutledge

The development of new and effective analytical and numerical models is essential to understanding the performance of a variety of structures. As computational methods continue to advance, so too do their applications in structural performance modeling and analysis. Modeling and Simulation Techniques in Structural Engineering presents emerging research on computational techniques and applications within the field of structural engineering. This timely publication features practical applications as well as new research insights and is ideally designed for use by engineers, IT professionals, researchers, and graduate-level students.

Theory and Applications

Building Software for Simulation

System Design, Modeling, and Simulation Using Ptolemy II
Theory and Algorithms, with Applications in C++
Network Performance Modeling and Simulation

Building energy design is currently going through a period of major changes. One key factor of this is the adoption of net-zero energy as a long term goal for new buildings in most developed countries. To achieve this goal a lot of research is needed to accumulate knowledge and to utilize it in practical applications. In this book, accomplished international experts present advanced modeling techniques as well as in-depth case studies in order to aid designers in optimally using simulation tools for net-zero energy building design. The strategies and technologies discussed in this book are, however, also applicable for the design of energy-plus buildings. This book was facilitated by International Energy Agency's Solar Heating and Cooling (SHC) Programs and the Energy in Buildings and Communities (EBC) Programs through the joint SHC Task 40/EBC Annex 52: Towards Net Zero Energy Solar Buildings R&D collaboration. After presenting the fundamental concepts, design strategies, and technologies required to achieve net-zero energy in buildings, the book discusses different design processes and tools to support the design of net-zero energy buildings (NZEBs). A substantial chapter reports on four diverse NZEBs that have been operating for at least two years. These case studies are extremely high quality because they all have high resolution measured data and the authors were intimately involved in all of them from conception to operating. By comparing the projections made using the respective design tools with the actual performance data, successful (and unsuccessful) design techniques and processes, design and simulation tools, and technologies

are identified. Written by both academics and practitioners (building designers) and by North Americans as well as Europeans, this book provides a very broad perspective. It includes a detailed description of design processes and a list of appropriate tools for each design phase, plus methods for parametric analysis and mathematical optimization. It is a guideline for building designers that draws from both the profound theoretical background and the vast practical experience of the authors.

Since the appearance of the first edition of 'Energy Simulation in Building Design', the use of computer-based appraisal tools to solve energy design problems within buildings has grown rapidly. A leading figure in this field, Professor Joseph Clarke has updated his book throughout to reflect these latest developments. The book now includes material on combined thermal/lighting and CFD simulation, advanced glazings, indoor air quality and photovoltaic components. This thorough revision means that the book remains the key text on simulation for architects, building engineering consultants and students of building engineering and environmental design of buildings. The book's purpose is to help architects, mechanical & environmental engineers and energy & facility managers to understand and apply the emerging computer methods for options appraisal at the individual building, estate, city, region and national levels. This is achieved by interspersing theoretical derivations relating to simulation within an evolving description of the built environment as a complex system. The premise is that the effective application of any simulation tool requires a thorough understanding of the domain it addresses.

Traditional building simulation programs possess attributes that make them difficult to use for the

design and analysis of building energy and control systems and for the support of model-based research and development of systems that may not already be implemented in these programs. This article presents characteristic features of such applications, and it shows how equation-based object-oriented modelling can meet requirements that arise in such applications. Next, the implementation of an open-source component model library for building energy systems is presented. The library has been developed using the equation-based object-oriented Modelica modelling language. Technical challenges of modelling and simulating such systems are discussed. Research needs are presented to make this technology accessible to user groups that have more stringent requirements with respect to the numerical robustness of simulation than a research community may have. Two examples are presented in which models from the here described library were used. The first example describes the design of a controller for a nonlinear model of a heating coil using model reduction and frequency domain analysis. The second example describes the tuning of control parameters for a static pressure reset controller of a variable air volume flow system. The tuning has been done by solving a non-convex optimization problem that minimizes fan energy subject to state constraints.

The world consists of many complex systems, ranging from our own bodies to ecosystems to economic systems. Despite their diversity, complex systems have many structural and functional features in common that can be effectively si- lated using powerful, user-friendly software. As a result, virtually anyone can - plore the nature of complex systems and their dynamical behavior under a range of assumptions and conditions. This ability to model dynamic systems is already

having a powerful influence on teaching and studying complexity. The books in this series will promote this revolution in "systems thinking" by integrating computational skills of numeracy and techniques of dynamic mod- ing into a variety of disciplines. The unifying theme across the series will be the power and simplicity of the model-building process, and all books are designed to engage the reader in developing their own models for exploration of the dyn- ics of systems that are of interest to them. Modeling Dynamic Systems does not endorse any particular modeling paradigm or software. Rather, the volumes in the series will emphasize simplicity of lea- ing, expressive power, and the speed of execution as priorities that will facilitate deeper system understanding.

Guide to Modeling and Simulation of Systems of Systems

BIM Handbook

Building a Business Case for Modeling and Simulation

Building Digital Worlds

Modeling and Simulation of HVAC Faulty Operations and Performance Degradation Due to Maintenance Issues

Design by Simulation

Discover BIM: A better way to build better buildings Building Information Modeling (BIM) offers a novel approach to design, construction, and facility management in which a digital representation of the building product and process is used to facilitate the exchange and interoperability of information in digital format. BIM is beginning to change the way buildings

look, the way they function, and the ways in which they are designed and built. The BIM Handbook, Third Edition provides an in-depth understanding of BIM technologies, the business and organizational issues associated with its implementation, and the profound advantages that effective use of BIM can provide to all members of a project team. Updates to this edition include: Information on the ways in which professionals should use BIM to gain maximum value New topics such as collaborative working, national and major construction clients, BIM standards and guides A discussion on how various professional roles have expanded through the widespread use and the new avenues of BIM practices and services A wealth of new case studies that clearly illustrate exactly how BIM is applied in a wide variety of conditions Painting a colorful and thorough picture of the state of the art in building information modeling, the BIM Handbook, Third Edition guides readers to successful implementations, helping them to avoid needless frustration and costs and take full advantage of this paradigm-shifting approach to construct better buildings that consume fewer materials and require less time, labor, and capital resources.

Buildings consume nearly 50% of the total energy in the United States, which drives the need to develop high-fidelity models for building energy systems. Extensive methods and techniques have been developed, studied,

and applied to building energy simulation and forecasting, while most of work have focused on developing dedicated modeling approach for generic buildings. In this study, an integrated computationally efficient and high-fidelity building energy modeling framework is proposed, with the concentration on developing a generalized modeling approach for various types of buildings. First, a number of data-driven simulation models are reviewed and assessed on various types of computationally expensive simulation problems. Motivated by the conclusion that no model outperforms others if amortized over diverse problems, a meta-learning based recommendation system for data-driven simulation modeling is proposed. To test the feasibility of the proposed framework on the building energy system, an extended application of the recommendation system for short-term building energy forecasting is deployed on various buildings. Finally, Kalman filter-based data fusion technique is incorporated into the building recommendation system for on-line energy forecasting. Data fusion enables model calibration to update the state estimation in real-time, which filters out the noise and renders more accurate energy forecast. The framework is composed of two modules: off-line model recommendation module and on-line model calibration module. Specifically, the off-line model recommendation module includes 6 widely used data-driven

simulation models, which are ranked by meta-learning recommendation system for off-line energy modeling on a given building scenario. Only a selective set of building physical and operational characteristic features is needed to complete the recommendation task. The on-line calibration module effectively addresses system uncertainties, where data fusion on off-line model is applied based on system identification and Kalman filtering methods. The developed data-driven modeling framework is validated on various genres of buildings, and the experimental results demonstrate desired performance on building energy forecasting in terms of accuracy and computational efficiency. The framework could be easily implemented into building energy model predictive control (MPC), demand response (DR) analysis and real-time operation decision support systems.

Modeling and Simulation in Python teaches readers how to analyze real-world scenarios using the Python programming language, requiring no more than a background in high school math. Modeling and Simulation in Python is a thorough but easy-to-follow introduction to physical modeling—that is, the art of describing and simulating real-world systems. Readers are guided through modeling things like world population growth, infectious disease, bungee jumping, baseball flight trajectories, celestial mechanics, and more while simultaneously developing a strong

understanding of fundamental programming concepts like loops, vectors, and functions. Clear and concise, with a focus on learning by doing, the author spares the reader abstract, theoretical complexities and gets right to hands-on examples that show how to produce useful models and simulations.

Presentation of the research project. Theory. Model building and simulation. Problem areas in model building. The simulation approach to modelling. Testing of simulation models. Analysis of simulation models. Analysis of simulation models. Analysis of modelled systems. Alignment of the applications presented. Simulation modelling of education.

Principles of Object-Oriented Modeling and Simulation with Modelica 2.1

Modeling and Simulation of Computer Networks and Systems

User's Reference

Theory of Modeling and Simulation

Building Energy Modeling with OpenStudio

Modeling and Simulation Techniques in Structural Engineering

Customized M&S applications deployed upon supercomputing infrastructure may enable supercomputing centers to holistically offer Modeling and Simulation as a Service (M&SaaS). The Ohio Supercomputer Center (OSC) has built an application store named

Ondemand.osc.edu that packages a suite of web applications (portals) for a variety of M&S projects. In this thesis, we present an SPLE based approach to building application stores similar to OnDemand to support HPC based M&S. We explain how the common framework components and architecture of OnDemand were derived through and benefitted from application of SPLE methodologies. We propose an automation framework for building applications to provide HPC based M&S. We finally present a detailed analysis of our approach and challenges in adopting it.

This is a design guide for architects, engineers, and contractors concerning the principles and specific applications of building information modeling (BIM). BIM has the potential to revolutionize the building industry, and yet not all architects and construction professionals fully understand what the benefits of BIM are or even the fundamental concepts behind it. As part of the PocketArchitecture Series it includes two parts: fundamentals and applications, which provide a comprehensive overview of all the necessary and essential issues. It also includes case studies from a range of project sizes that illustrate the key concepts clearly and use a wide range of visual aids. Building Information Modeling addresses the key role that BIM is playing in shaping the software tools and office processes in the architecture, engineering, and construction professions. Primarily aimed at professionals, it is also useful for faculty who wish to incorporate this information into their

courses on digital design, BIM, and professional practice. As a compact summary of key ideas it is ideal for anyone implementing BIM. Fundamentals of Building Performance Simulation pares the theory and practice of a multi-disciplinary field to the essentials for classroom learning and real-world applications. Authored by a veteran educator and researcher, this textbook equips graduate students and emerging and established professionals in engineering and architecture to predict and optimize buildings' energy use. It employs an innovative pedagogical approach, introducing new concepts and skills through previously mastered ones and deepening understanding of familiar themes by means of new material. Covering topics from indoor airflow to the effects of the weather, the book's 19 chapters empower learners to: Understand the models and assumptions underlying popular BPS tools Compare models, simulations, and modelling tools and make appropriate selections Recognize the effects of modelling choices and input data on simulation predictions And more. Each subject is introduced without reference to particular modelling tools, while practice problems at the end of each chapter provide hands-on experience with the tools of the reader's choice. Curated reading lists orient beginners in a vast, cross-disciplinary literature, and the critical thinking skills stressed throughout prepare them to make contributions of their own. Fundamentals of Building Performance Simulation provides a much-needed resource for new and

aspiring members of the building science community.

This book unifies all aspects of flight dynamics for the efficient development of aerospace vehicle simulations. It provides the reader with a complete set of tools to build, program, and execute simulations. Unlike other books, it uses tensors for modeling flight dynamics in a form invariant under coordinate transformations. For implementation, the tensors are converted to matrices, resulting in compact computer code. The reader can pick templates of missiles, aircraft, or hypersonic vehicles to jump-start a particular application. It is the only textbook that combines the theory of modeling with hands-on examples of three-, five-, and six-degree-of-freedom simulations. Included is a link to the CADAC Web Site where you may apply for the free CADAC CD with eight prototype simulations and plotting programs. Amply illustrated with 318 figures and 44 examples, the text can be used for advanced undergraduate and graduate instruction or for self-study. Also included are 77 problems that enhance the ability to model aerospace vehicles and nine projects that hone the skills for developing three-, five-, and six-degree-of-freedom simulations.

Simulation Modeling and Arena

Statistical Methods for Building Simulation Models

A Software Product Line Engineering Approach to Building a Modeling and Simulation as a Service (M&SaaS) Application Store

Building Energy Modeling
Building Performance Modeling by Architects in the Conceptual Design Process
Discrete-Event Modeling and Simulation

Almost half of the total energy used in the U.S. buildings is consumed by heating, ventilation and air conditionings (HVAC) according to EIA statistics. Among various driving factors to energy performance of building, operations and maintenance play a significant role. Many researches have been done to look at design efficiencies and operational controls for improving energy performance of buildings, but very few study the impacts of HVAC systems maintenance. Different practices of HVAC system maintenance can result in substantial differences in building energy use. If a piece of HVAC equipment is not well maintained, its performance will degrade. If sensors used for control purpose are not calibrated, not only building energy usage could be dramatically increased, but also mechanical systems may not be able to satisfy indoor thermal comfort. Properly maintained HVAC systems can operate efficiently, improve occupant comfort, and prolong equipment service life. In the paper, maintenance practices for HVAC systems are presented based on literature reviews and discussions with HVAC engineers, building operators, facility managers, and commissioning agents. We categorize the maintenance practices into

three levels depending on the maintenance effort and coverage: 1) proactive, performance-monitored maintenance; 2) preventive, scheduled maintenance; and 3) reactive, unplanned or no maintenance. A sampled list of maintenance issues, including cooling tower fouling, boiler/chiller fouling, refrigerant over or under charge, temperature sensor offset, outdoor air damper leakage, outdoor air screen blockage, outdoor air damper stuck at fully open position, and dirty filters are investigated in this study using field survey data and detailed simulation models. The energy impacts of both individual maintenance issue and combined scenarios for an office building with central VAV systems and central plant were evaluated by EnergyPlus simulations using three approaches: 1) direct modeling with EnergyPlus, 2) using the energy management system feature of EnergyPlus, and 3) modifying EnergyPlus source code. The results demonstrated the importance of maintenance for HVAC systems on energy performance of buildings. The research is intended to provide a guideline to help practitioners and building operators to gain the knowledge of maintaining HVAC systems in efficient operations, and prioritize HVAC maintenance work plan. The paper also discusses challenges of modeling building maintenance issues using energy simulation programs.

Essentials of Monte Carlo Simulation focuses on the fundamentals of

Monte Carlo methods using basic computer simulation techniques. The theories presented in this text deal with systems that are too complex to solve analytically. As a result, readers are given a system of interest and constructs using computer code, as well as algorithmic models to emulate how the system works internally. After the models are run several times, in a random sample way, the data for each output variable(s) of interest is analyzed by ordinary statistical methods. This book features 11 comprehensive chapters, and discusses such key topics as random number generators, multivariate random variates, and continuous random variates. Over 100 numerical examples are presented as part of the appendix to illustrate useful real world applications. The text also contains an easy to read presentation with minimal use of difficult mathematical concepts. Very little has been published in the area of computer Monte Carlo simulation methods, and this book will appeal to students and researchers in the fields of Mathematics and Statistics.

For every weapons system being developed, the U.S. Department of Defense (DOD) must make a critical decision: Should the system go forward to full-scale production? The answer to that question may involve not only tens of billions of dollars but also the nation's security and military capabilities. In the milestone process used by DOD to answer the basic acquisition question, one component near the

end of the process is operational testing, to determine if a system meets the requirements for effectiveness and suitability in realistic battlefield settings. Problems discovered at this stage can cause significant production delays and can necessitate costly system redesign. This book examines the milestone process, as well as the DOD's entire approach to testing and evaluating defense systems. It brings to the topic of defense acquisition the application of scientific statistical principles and practices.

The second edition of Building Energy Simulation includes studies of various components and systems of buildings and their effect on energy consumption, with the help of DesignBuilderTM, a front-end for the EnergyPlus simulation engine, supported by examples and exercises. The book employs a "learning by doing" methodology. It explains simulation-input parameters and how-to-do analysis of the simulation output, in the process explaining building physics and energy simulation. Divided into three sections, it covers the fundamentals of energy simulation followed by advanced topics in energy simulation and simulation for compliance with building codes and detailed case studies for comprehensive building energy simulation. Features: Focuses on learning building energy simulation while being interactive through examples and exercises. Explains the building physics and the science behind the energy performance of buildings. Encourages an integrated

design approach by explaining the interactions between various building systems and their effect on energy performance of building. Discusses a how-to model for building energy code compliance including three projects to practice whole building simulation. Provides hands-on training of building energy simulation tools: DesignBuilderTM and EnergyPlus. Building Energy Simulation is intended for students and researchers in building energy courses, energy simulation professionals, and architects.

Building Energy Simulation

A Workbook Using DesignBuilderTM

Modeling and Simulation of Everyday Things

Modeling, Design, and Optimization of Net-Zero Energy Buildings

New Approaches and Methodological Improvements

Methodologies and Applications

How can computer modeling and simulation tools be used to understand and analyze common situations and everyday problems? Readers will find here an easy-to-follow, enjoyable introduction for anyone even with little background training. Examples are incorporated throughout to stimulate interest and engage the reader. Build the necessary skillsets with operating systems, editing, languages, commands, and visualization. Obtain hands-on examples from sports, accidents, and disease to problems of heat transfer, fluid flow, waves, and groundwater flow. Includes discussion of parallel computing and graphics processing units. This introductory, practical guide is suitable for students at any level up to professionals

looking to use modeling and simulation to help solve basic to more advanced problems. Michael W. Roth, PhD, serves as Dean of the School of STEM and Business at Hawkeye Community College in Waterloo, Iowa. He was most recently Chair for three years at Northern Kentucky University's Department of Physics, Geology and Engineering Technology, and holds several awards for teaching excellence.

Effective building performance simulation can reduce the environmental impact of the built environment, improve indoor quality and productivity, and facilitate future innovation and technological progress in construction. It draws on many disciplines, including physics, mathematics, material science, biophysics and human behavioural, environmental and computational sciences. The discipline itself is continuously evolving and maturing, and improvements in model robustness and fidelity are constantly being made. This has sparked a new agenda focusing on the effectiveness of simulation in building life-cycle processes. Building Performance Simulation for Design and Operation begins with an introduction to the concepts of performance indicators and targets, followed by a discussion on the role of building simulation in performance-based building design and operation. This sets the ground for in-depth discussion of performance prediction for energy demand, indoor environmental quality (including thermal, visual, indoor air quality and moisture phenomena), HVAC and renewable system performance, urban level modelling, building operational optimization and automation. Produced in cooperation with the International Building Performance Simulation Association (IBPSA), and featuring contributions from fourteen internationally recognised experts in this field, this book provides a unique and comprehensive overview of building performance simulation for the complete building life-cycle from conception to demolition. It is primarily

intended for advanced students in building services engineering, and in architectural, environmental or mechanical engineering; and will be useful for building and systems designers and operators.

The author offers the first text to cover all three areas of simulation-Model Design, Model Execution, and Execution Analysis-in one source. He focuses on model design (using an extension of object- oriented design called multimodeling) and algorithms for serial and parallel model execution. Also covered is the SimPack simulation toolkit, with a full chapter devoted to using SimPack programs.

This book is a definitive introduction to models of computation for the design of complex, heterogeneous systems. It has a particular focus on cyber-physical systems, which integrate computing, networking, and physical dynamics. The book captures more than twenty years of experience in the Ptolemy Project at UC Berkeley, which pioneered many design, modeling, and simulation techniques that are now in widespread use. All of the methods covered in the book are realized in the open source Ptolemy II modeling framework and are available for experimentation through links provided in the book. The book is suitable for engineers, scientists, researchers, and managers who wish to understand the rich possibilities offered by modern modeling techniques. The goal of the book is to equip the reader with a breadth of experience that will help in understanding the role that such techniques can play in design.

Modeling and Simulation of Weapons Effects on Building Structural Integrity and Personnel for DIS Virtual Environments

Proceedings of the 11th European Conference on Product and Process Modelling (ECPPM 2018), September 12-14, 2018, Copenhagen, Denmark

Fundamentals of Traffic Simulation
Landscape Simulation Modeling
Essentials of Monte Carlo Simulation
Technology Foundations and Industry Practice
Fundamentals of Turbulent and Multiphase Combustion Detailed coverage of advanced combustion topics from the author of Principles of combustion, Second Edition Turbulence, turbulent combustion, and multiphase reacting flows have become major research topics in recent decades due to their application across diverse fields, including energy, environment, propulsion, transportation, industrial safety, and nanotechnology. Most of the knowledge accumulated from this research has never been published in book form—until now. Fundamentals of Turbulent and Multiphase Combustion presents up-to-date, integrated coverage of the fundamentals of turbulence, combustion, and multiphase phenomena along with useful experimental techniques, including non-intrusive, laser-based measurement techniques, providing a firm background in both contemporary and classical approaches. Beginning with two full chapters on laminar premixed and non-premixed flames, this book takes a multiphase approach, beginning with more common topics and moving on to higher-level applications. In addition, Fundamentals of Turbulent and Multiphase Combustion: Addresses seven basic topical areas in combustion and multiphase flows, including laminar premixed and non-premixed flames, theory of turbulence, turbulent premixed and non-premixed flames, and multiphase flows Covers spray atomization and combustion, solid-propellant combustion, homogeneous propellants, nitramines,

reacting boundary-layer flows, single energetic particle combustion, and granular bed combustion Provides experimental setups and results whenever appropriate Supported with a large number of examples and problems as well as a solutions manual, Fundamentals of Turbulent and Multiphase Combustion is an important resource for professional engineers and researchers as well as graduate students in mechanical, chemical, and aerospace engineering.

This book makes the argument that performance modeling and simulation have become central issues in computer science and engineering, in part due to applications to the structures comprising the Internet. Dealing primarily with theory, tools and techniques as related to communications systems, the volume provides tutorials and surveys and relates new important research results. Each chapter presents background information, describes and analyzes important work done in the field and provides direction to the reader on future work and further readings. The topics covered include traffic models for A TM networks, simulation environments, analytical methods, interprocessor communications, and an evaluation of process architectures.

The increasing power of computer technologies, the evolution of software en- neering and the advent of the intelligent transport systems has prompted traf c simulation to become one of the most used approaches for traf c analysis in s- port of the design and evaluation of traf c systems. The ability of traf c simulation to emulate the time variability of traf c phenomena makes it a unique tool for capturing the complexity of traf c systems. In recent years, traf c simulation – and namely microscopic traf c simulation – has moved from the academic to the professional world. A wide variety of

traf- c simulation software is currently available on the market and it is utilized by thousands of users, consultants, researchers and public agencies. Microscopic traf c simulation based on the emulation of traf c ows from the dynamics of individual vehicles is becoming one the most attractive approaches. However, traf c simulation still lacks a uni ed treatment. Dozens of papers on theory and applications are published in scienti c journals every year. A search of simulation-related papers and workshops through the proceedings of the last annual TRB meetings would support this assertion, as would a review of the minutes from speci cally dedicated meetings such as the International Symposiums on Traf c Simulation (Yokohama, 2002; Lausanne, 2006; Brisbane, 2008) or the International Workshops on Traf c Modeling and Simulation (Tucson, 2001; Barcelona, 2003; Sedona, 2005; Graz 2008). Yet, the only comprehensive treatment of the subject to be found so far is in the user's manuals of various software products.

Emphasizes a hands-on approach to learning statistical analysis and model building through the use of comprehensive examples, problems sets, and software applications With a unique blend of theory and applications, Simulation Modeling and Arena®, Second Edition integrates coverage of statistical analysis and model building to emphasize the importance of both topics in simulation. Featuring introductory coverage on how simulation works and why it matters, the Second Edition expands coverage on static simulation and the applications of spreadsheets to perform simulation. The new edition also introduces the use of the open source statistical package, R, for both performing statistical testing and fitting distributions. In addition, the models are

presented in a clear and precise pseudo-code form, which aids in understanding and model communication. Simulation Modeling and Arena, Second Edition also features: Updated coverage of necessary statistical modeling concepts such as confidence interval construction, hypothesis testing, and parameter estimation Additional examples of the simulation clock within discrete event simulation modeling involving the mechanics of time advancement by hand simulation A guide to the Arena Run Controller, which features a debugging scenario New homework problems that cover a wider range of engineering applications in transportation, logistics, healthcare, and computer science A related website with an Instructor's Solutions Manual, PowerPoint® slides, test bank questions, and data sets for each chapter Simulation Modeling and Arena, Second Edition is an ideal textbook for upper-undergraduate and graduate courses in modeling and simulation within statistics, mathematics, industrial and civil engineering, construction management, business, computer science, and other departments where simulation is practiced. The book is also an excellent reference for professionals interested in mathematical modeling, simulation, and Arena.

Modeling and Simulation of Discrete Event Systems

Building Performance Simulation for Design and Operation

Modeling and Simulation in Python

A Data-driven Approach

Statistics, Testing, and Defense Acquisition

A View on Future Building System Modeling and Simulation

This user's reference is a companion to the separate book also titled "Guide to

Modelling and Simulation of Systems of Systems." The principal book explicates integrated development environments to support virtual building and testing of systems of systems, covering in some depth the MS4 Modelling EnvironmentTM. This user's reference provides a quick reference and exposition of the various concepts and functional features covered in that book. The topics in the user's reference are grouped in alignment with the workflow displayed on the MS4 Modeling EnvironmentTM launch page, under the headings Atomic Models, System Entity Structure, Pruning SES, and Miscellaneous. For each feature, the reference discusses why we use it, when we should use it, and how to use it. Further comments and links to related features are also included.

Modeling and Simulation of Computer Networks and Systems: Methodologies and Applications introduces you to a broad array of modeling and simulation issues related to computer networks and systems. It focuses on the theories, tools, applications and uses of modeling and simulation in order to effectively optimize networks. It describes methodologies for modeling and simulation of new generations of wireless and mobiles networks and cloud and grid computing systems. Drawing upon years of practical experience and using numerous examples and illustrative applications recognized experts in both academia and industry, discuss: Important and emerging topics in computer networks and systems including but not limited to; modeling, simulation,

analysis and security of wireless and mobiles networks especially as they relate to next generation wireless networks Methodologies, strategies and tools, and strategies needed to build computer networks and systems modeling and simulation from the bottom up Different network performance metrics including, mobility, congestion, quality of service, security and more... Modeling and Simulation of Computer Networks and Systems is a must have resource for network architects, engineers and researchers who want to gain insight into optimizing network performance through the use of modeling and simulation. Discusses important and emerging topics in computer networks and Systems including but not limited to; modeling, simulation, analysis and security of wireless and mobiles networks especially as they relate to next generation wireless networks Provides the necessary methodologies, strategies and tools needed to build computer networks and systems modeling and simulation from the bottom up Includes comprehensive review and evaluation of simulation tools and methodologies and different network performance metrics including mobility, congestion, quality of service, security and more

This textbook teaches the fundamentals of building energy modeling and analysis using open source example applications built with the US DOE’s OpenStudio modeling platform and EnergyPlus simulation engine. Designed by researchers at US National Laboratories to support a new generation of high performance buildings,

EnergyPlus and OpenStudio are revolutionizing how building energy modeling is taught in universities and applied by professional architects and engineers around the world. The authors, all researchers at National Renewable Energy Laboratory and members of the OpenStudio software development team, present modeling concepts using open source software that may be generally applied using a variety of software tools commonly used by design professionals. The book also discusses modeling process automation in the context of OpenStudio Measures—small self-contained scripts that can transform energy models and their data—to save time and effort. They illustrate key concepts through a sophisticated example problem that evolves in complexity throughout the book. The text also examines advanced topics including daylighting, parametric analysis, uncertainty analysis, design optimization, and model calibration. Building Energy Modeling with OpenStudio teaches students to become sophisticated modelers rather than simply proficient software users. It supports undergraduate and graduate building energy courses in Architecture, and in Mechanical, Civil, Architectural, and Sustainability Engineering.

Computer modeling and simulation (M&S) allows engineers to study and analyze complex systems. Discrete-event system (DES)-M&S is used in modern management, industrial engineering, computer science, and the military. As computer speeds and memory capacity increase, so DES-M&S tools become more powerful and more widely

used in solving real-life problems. Based on over 20 years of evolution within a classroom environment, as well as on decades-long experience in developing simulation-based solutions for high-tech industries, Modeling and Simulation of Discrete-Event Systems is the only book on DES-M&S in which all the major DES modeling formalisms – activity-based, process-oriented, state-based, and event-based – are covered in a unified manner: A well-defined procedure for building a formal model in the form of event graph, ACD, or state graph Diverse types of modeling templates and examples that can be used as building blocks for a complex, real-life model A systematic, easy-to-follow procedure combined with sample C# codes for developing simulators in various modeling formalisms Simple tutorials as well as sample model files for using popular off-the-shelf simulators such as SIGMA®, ACE®, and Arena® Up-to-date research results as well as research issues and directions in DES-M&S Modeling and Simulation of Discrete-Event Systems is an ideal textbook for undergraduate and graduate students of simulation/industrial engineering and computer science, as well as for simulation practitioners and researchers.

Energy Simulation in Building Design

Building Information Modeling

Modeling and Simulation of Aerospace Vehicle Dynamics

AnyLogic 7 in Three Days

EWork and EBusiness in Architecture, Engineering and Construction
A Quick Course in Simulation Modeling
Collecting the work of the foremost scientists in the field, Discrete-Event Modeling and Simulation: Theory and Applications presents the state of the art in modeling discrete-event systems using the discrete-event system specification (DEVS) approach. It introduces the latest advances, recent extensions of formal techniques, and real-world examples of various applications. The book covers many topics that pertain to several layers of the modeling and simulation architecture. It discusses DEVS model development support and the interaction of DEVS with other methodologies. It describes different forms of simulation supported by DEVS, the use of real-time DEVS simulation, the relationship between DEVS and graph transformation, the influence of DEVS variants on simulation performance, and interoperability and composability with emphasis on DEVS standardization. The text also examines extensions to DEVS, new formalisms, and abstractions of DEVS models as well as

the theory and analysis behind real-world system identification and control. To support the generation and search of optimal models of a system, a framework is developed based on the system entity structure and its transformation to DEVS simulation models. In addition, the book explores numerous interesting examples that illustrate the use of DEVS to build successful applications, including optical network-on-chip, construction/building design, process control, workflow systems, and environmental models. A one-stop resource on advances in DEVS theory, applications, and methodology, this volume offers a sampling of the best research in the area, a broad picture of the DEVS landscape, and trend-setting applications enabled by the DEVS approach. It provides the basis for future research discoveries and encourages the development of new applications.

The first practical textbook on AnyLogic 7 from AnyLogic developers. AnyLogic is the unique simulation software that supports three simulation modeling methods: system dynamics,

discrete event, and agent based modeling and allows you to create multi-method models. The book is structured around four examples: a model of a consumer market, an epidemic model, a job shop model and an airport model. We also give some theory on different modeling methods. You can consider this book as your first guide in studying AnyLogic 7.

Modeling and simulation technology is the use of models to develop data as a basis for making managerial or technical decisions. It can be a valuable tool for program managers, but it is one that is vastly under-used. This article provides a business-case framework (a methodology to evaluate investment opportunities) for program managers within the Department of Defense to use when determining how to apply modeling and simulation in project management. The authors reviewed selected M & S efforts within civilian industry and DoD. They visited several key manufacturing and service industries, which were also wrestling with the same subject -- the assessment of M & S investment. They surveyed a large number of DoD program managers with programs in

various stages of the acquisition process. The survey requested general information from the program managers regarding how they made decisions on M & S investments. Additionally, in an effort to maintain balance, they also surveyed several government contractors. They also conducted a literary search to capture the body of knowledge in non-government organizations related to justifying M & S investments. Most program managers justified their M & S investment based on one or more of the following: reducing design cycle time; augmenting or replacing physical tests; helping resolve limitations of funds, assets, or schedules; or providing insight into issues that were impossible or impracticable to examine in other ways.

A Statistical Approach to Modelling in the Social Sciences with the Simulation Method

Simulation Model Building