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Agent-based Modeling and Simulation

YOSELIN KENT

Discrete Event Simulation for Health Technology Assessment John Wiley & Sons

Computer modeling and simulation (M&S) allows engineers tostudy 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 memorycapacity increase, so DES-M&S tools become more powerful andmore widely used in solving real-life problems. Based on over 20 years of evolution within a classroomenvironment, as well as on decades-long experience in developingsimulation-based solutions for high-tech industries, Modelingand Simulation of Discrete-Event Systems is the only book onDES-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 theform of event graph, ACD, or state graph Diverse types of modeling templates and examples that can beused 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 usingpopular off-the-shelf simulators such as SIGMA®, ACE®,and Arena® Up-to-date research results as well as research issues anddirections in DES-M&S Modeling and Simulation of Discrete-Event Systems is anideal textbook for undergraduate and graduate students ofsimulation/industrial engineering and computer science, as well asfor simulation practitioners and researchers.

Simulation Modeling and Arena John Wiley & Sons

"This book provides a comprehensive overview of theory and practice in simulation systems focusing on major breakthroughs within the technological arena, with particular concentration on the accelerating principles, concepts and applications"--Provided by publisher.

Discrete Event Simulation of Bus Terminals McGraw-Hill Science, Engineering & Mathematics

The Discrete Event Simulation (DES) method has received widespread attention and acceptance by both researchers and practitioners in recent years. The range of application of DES spans across many different disciplines and research fields. In research, further development and advancements of the basic DES algorithm continue to be sought while various hybrid

methods derived by combining DES with other simulation techniques continue to be developed. This book presents state-of-the-art contributions on fundamental development of the DES method, novel integration of the method with other modeling techniques as well as applications towards simulating and analyzing the performances of various types of systems. This book will be of interest to undergraduate and graduate students, researchers as well as professionals who are actively engaged in DES related work.

A First Course John Wiley & Sons

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. Springer
Most current Unmanned Vehicle (UV) systems consist of teams of operators controlling a single UV. Technological advances will likely lead to the inversion of this ratio, and automation of low level tasking. These advances will also lead to a growth in UV use in large-scale applications such as urban search and rescue, which will require the use of both teams of operators and teams of UVs. This growth will in turn require research and development in the area of team supervisory control of multiple UVs. Human-in-the- loop experimentation is often used during this research but can be time consuming and expensive. The time and cost of experimentation can often be drastically reduced by using predictive models. However there is a lack of such models in the area of multiple-operator supervisory control of multiple-UVs. This problem is addressed in this thesis through the following method: First, current predictive models of human supervisory control of UVs are analyzed, and attributes of systems related to this modeling space are

identified. Second, a queuing-based multiple-operator multiple-vehicle discrete event simulation model (MO-MUVDES) is developed which captures these attributes, including the ability to predict performance in situations with low observable exogenous event arrivals. MO-MUVDES also incorporates traditional system variables such as level of vehicle autonomy, vehicle and operator team structure, and operator switching strategy. The accuracy and robustness of the MO-MUVDES model were measured by a two-stage validation process using data from a human-in-the-loop supervisory control experiment, and a Monte Carlo simulation. The first stage of the validation process used data from the experiment as input for the MOMUVDES model which was then used to generate predictions of operator performance. In the second stage of validation, a sensitivity analysis was performed on the MO-MUVDES model. This validation process achieved confidence in the model's ability to predict operator performance and a measurement of the robustness of the model under varying input conditions. Additionally, the process indicated that discrete event simulation is an effective technique for modeling team supervisory control of UVs in a situation where exogenous

event arrivals are not clearly observable. As a result, the MO-MUVDES model could be used to reduce development time for systems within its modeled space.

A Practical Introduction

Prentice Hall

This book offers readers a set of new approaches and tools a set of tools and techniques for facing challenges in parallelization with design of embedded systems. It provides an advanced parallel simulation infrastructure for efficient and effective system-level model validation and development so as to build better products in less time. Since parallel discrete event simulation (PDES) has the potential to exploit the underlying parallel computational capability in today's multi-core simulation hosts, the author begins by reviewing the parallelization of discrete event simulation, identifying problems and solutions. She then describes out-of-order parallel discrete event simulation (OoO PDES), a novel approach for efficient validation of system-level designs by aggressively exploiting the parallel capabilities of todays' multi-core PCs. This approach enables readers to design simulators that can fully exploit the parallel processing capability of the multi-core system to achieve fast speed simulation, without loss of simulation and timing accuracy. Based on this parallel simulation

infrastructure, the author further describes automatic approaches that help the designer quickly to narrow down the debugging targets in faulty ESL models with parallelism.

A Discrete Event Simulation Model for Unstructured Supervisory Control of Unmanned Vehicles

John Wiley & Sons

In any production environment, discrete event simulation is a powerful tool for the analysis, planning, and operating of a manufacturing facility. Operations managers can use simulation to improve their production systems by eliminating bottlenecks, reducing cycle time and cost, and increasing capacity utilization. Offering a hands-on tutorial on how to model traditional applications to optimize production operations, Simulation of Industrial Systems: Discrete Event Simulation Using Excel/VBA— · Introduces the Design Environment for Event Driven Simulation (DEEDS), an original simulator, which facilitates the modeling of complex situations using four (self-contained) nodes: source, queue, facility, and delay. · Demonstrates how to use discrete event simulation as a powerful tool for the analysis, planning, design, and operation of diverse production systems · Shows how to model application areas such as facilities layout, material handling, inventory

control, scheduling, maintenance, quality control, and supply chain logistics · Integrates the design of experiments and optimization techniques for improving production systems With the comprehensive instruction provided within these pages, in combination with the flexibility of the DEEDS program environment, operations managers will be able to harness the power of discrete event simulation to streamline their production environments. The authors have created a website with a variety of teaching aids that professors will be able to access

Discrete Event Simulation Using Excel/VBA Discrete-event SimulationA First Course

Discrete event simulation and agent-based modeling are increasingly recognized as critical for diagnosing and solving process issues in complex systems. Introduction to Discrete Event Simulation and Agent-based Modeling covers the techniques needed for success in all phases of simulation projects. These include: • Definition – The reader will learn how to plan a project and communicate using a charter. • Input analysis – The reader will discover how to determine defensible sample sizes for all needed data collections. They will also learn how to fit distributions to that data. • Simulation – The reader will understand how

simulation controllers work, the Monte Carlo (MC) theory behind them, modern verification and validation, and ways to speed up simulation using variation reduction techniques and other methods. • Output analysis – The reader will be able to establish simultaneous intervals on key responses and apply selection and ranking, design of experiments (DOE), and black box optimization to develop defensible improvement recommendations. • Decision support – Methods to inspire creative alternatives are presented, including lean production. Also, over one hundred solved problems are provided and two full case studies, including one on voting machines that received international attention.

Introduction to Discrete Event Simulation and Agent-based Modeling demonstrates how simulation can facilitate improvements on the job and in local communities. It allows readers to competently apply technology considered key in many industries and branches of government. It is suitable for undergraduate and graduate students, as well as researchers and other professionals.

Modeling and Simulation of Discrete Event Systems

Springer

Discover How to Apply DES to Problems Encountered in HTA

Discrete event simulation (DES) has

traditionally been used in the engineering and operations research fields. The use of DES to inform decisions about health technologies is still in its infancy. Written by specialists at the forefront of this area, Discrete Event Simulation for Health Technology Assessment is the first book to make all the central concepts of DES relevant for health technology assessment (HTA). Accessible to beginners, the book requires no prerequisites and describes the concepts with as little jargon as possible. The book first covers the essential concepts and their implementation. It next provides a fully worked out example using both a widely available spreadsheet program (Microsoft Excel) and a popular specialized simulation package (Arena). It then presents approaches to analyze the simulations, including the treatment of uncertainty; tackles the development of the required equations; explains the techniques to verify that the models are as efficient as possible; and explores the indispensable topic of validation. The book also covers a variety of non-essential yet handy topics, such as the animation of a simulation and extensions of DES, and incorporates a real case study involving screening strategies for breast cancer surveillance. This book guides you in leveraging DES in your assessments of health

technologies. After reading the chapters in sequence, you will be able to construct a realistic model designed to help in the assessment of a new health technology.

Discrete Event Simulation Springer Science & Business Media

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.

Discrete Event Simulations Springer Science & Business Media

Researches and developers of simulation models

state that the Java program ming language presents a unique and significant opportunity for important changes in the way we develop simulation models today. The most important characteristics of the Java language that are advantageous for simulation are its multi-threading capabilities, its facilities for executing programs across the Web, and its graphics facilities. It is feasible to develop compatible and reusable simulation components that will facilitate the construction of newer and more complex models. This is possible with Java development environments. Another important trend that begun very recently is web-based simulation, i.e., and the execution of simulation models using Internet browser software. This book introduces the application of the Java programming language in discrete-event simulation. In addition, the fundamental concepts and prac tical simulation techniques for modeling different types of systems to study their general behavior and their performance are introduced. The approaches applied are the process interaction approach to discrete-event simulation and object-oriented modeling. Java is used as the implementation language and UML as the modeling language. The first offers several advantages compared to C++, the most important being:

thread handling, graphical user interfaces (QUI) and Web computing. The second language, UML (Unified Modeling Language) is the standard notation used today for modeling systems as a collection of classes, class relationships, objects, and object behavior.

Simulation Techniques for Discrete Event Systems CRC Press

To perform computer simulation successfully, two rather different sets of skills are required. One of these relates to programming: a simulation program should do what its author intends and do it efficiently. The other is concerned with the collection and analysis of data: statistical tools have to be used in order to obtain with a minimum of effort, accurate and reliable estimates for the desired performance measures. Dr Mitrani covers both of these aspects of the simulation method. The important topics of point and interval estimation, simulation efficiency and the analysis of simulation experiments are discussed in detail. This book, first published in 1982, will be useful to both undergraduate and postgraduate students taking courses on simulation in departments of computer science, operations research and statistics in universities and polytechnics. It will be of benefit also to practitioners in the field.

Concurrent and

Comparative Discrete Event Simulation Lee & Seshia
Introduction to Discrete Event Systems is a comprehensive introduction to the field of discrete event systems, offering a breadth of coverage that makes the material accessible to readers of varied backgrounds. The book emphasizes a unified modeling framework that transcends specific application areas, linking the following topics in a coherent manner: language and automata theory, supervisory control, Petri net theory, Markov chains and queuing theory, discrete-event simulation, and concurrent estimation techniques. This edition includes recent research results pertaining to the diagnosis of discrete event systems, decentralized supervisory control, and interval-based timed automata and hybrid automata models.
System Design, Modeling, and Simulation Using Ptolemy II Academic Press
In recent years, there has been a growing debate, particularly in the UK and Europe, over the merits of using discrete-event simulation (DES) and system dynamics (SD); there are now instances where both methodologies were employed on the same problem. This book details each method, comparing each in terms of both theory

and their application to various problem situations. It also provides a seamless treatment of various topics--theory, philosophy, detailed mechanics, practical implementation--providing a systematic treatment of the methodologies of DES and SD, which previously have been treated separately.
Voting Systems, Health Care, Military, and Manufacturing CRC Press
Simulation Modeling and Analysis with Arena is a highly readable textbook which treats the essentials of the Monte Carlo discrete-event simulation methodology, and does so in the context of a popular Arena simulation environment. It treats simulation modeling as an in-vitro laboratory that facilitates the understanding of complex systems and experimentation with what-if scenarios in order to estimate their performance metrics. The book contains chapters on the simulation modeling methodology and the underpinnings of discrete-event systems, as well as the relevant underlying probability, statistics, stochastic processes, input analysis, model validation and output analysis. All simulation-related concepts are illustrated in numerous Arena examples, encompassing production lines, manufacturing and inventory systems, transportation systems, and computer information systems in

networked settings. · Introduces the concept of discrete event Monte Carlo simulation, the most commonly used methodology for modeling and analysis of complex systems · Covers essential workings of the popular animated simulation language, ARENA, including set-up, design parameters, input data, and output analysis, along with a wide variety of sample model applications from production lines to transportation systems · Reviews elements of statistics, probability, and stochastic processes relevant to simulation modeling * Ample end-of-chapter problems and full Solutions Manual * Includes CD with sample ARENA modeling programs

Object-Oriented Discrete-Event Simulation with Java
CRC Press
"This is an excellent and well-written text on discrete event simulation with a focus on applications in Operations Research. There is substantial attention to programming, output analysis, pseudo-random number generation and modelling and these sections are quite thorough. Methods are provided for generating pseudo-random numbers (including combining such streams) and for generating random numbers from most standard statistical distributions." --ISI Short Book Reviews, 22:2, August 2002

Introduction to Discrete Event

Systems Springer Science & Business Media
Concurrent simulation is over twenty years old. During that pe riod it has been widely adopted for the simulation of faults in digital circuits, for which it provides a combination of extreme efficiency and generality . Yet, it is remarkable that no book published so far presents a correct and sufficiently detailed treatment of concurrent simulation. A first reason to welcome into print the effort of the authors is, therefore, that it provides a much needed account of an important topic in design automation. This book is, however, unique for sev eral other reasons. It is safe to state that no individual has contrib uted more than Ernst Ulrich to the development of digital logic simulation. For concurrent simulation, one may say that Ernst has contributed more than the rest of the world. We would find such a claim difficult to dispute. The unique experience of the authors con fers a special character to this book: It is authoritative, inspired, and focused on what is conceptually important. Another unique aspect of this book, perhaps the one that will be the most surprising for many readers, is that it is strongly projected towards the future. Concurrent simulation is presented as a general experimentation methodology and new

intriguing applications are analyzed. The discussion of multi-domain concurrent simulation-- recent work of Karen Panetta Lentz and Ernst Ulrich---is fascinat ing.

A Practical Approach

BoD – Books on Demand

Discrete Event Simulation is a process-oriented text/reference that utilizes an eleven-step model to represent the simulation process from problem formulation to implementation and documentation. The book presents the necessary level of detail required to fully develop a model that produces meaningful results and considers the tools necessary to interpret those results. Sufficient background information is provided so that the underlying concepts of simulation are understood. Major topics covered in Discrete Event Simulation include probability and distributional theory, statistical estimation and inference, the generation of random variates, verification and validation techniques, time management methods, experimental design, and programming language considerations. The book also examines distributed simulation and issues related to distributing the physical process over a network of tightly coupled processors. Topics covered in this area include deadlock, synchronization, rollback, event management, and communication

processes. Fully worked examples and numerous practical exercises have been drawn from the engineering disciplines and computer science, although they have been structured so that they will be useful as well to other disciplines such as economics, business administration, and management science. The presentation of techniques and methods in Discrete Event Simulation make it an ideal text/reference for all practitioners of discrete event simulation.

Discrete-event Simulation CRC Press

For junior- and senior-level simulation courses in engineering, business, or computer science. While most books on simulation focus on particular software tools, Discrete Event System Simulation examines the principles of modeling and analysis that translate to all such tools. This language-independent text explains the basic aspects of the technology, including the proper collection and analysis of data, the use of analytic techniques, verification and validation of models, and designing simulation experiments. It offers an up-to-date treatment of simulation of manufacturing and material handling systems, computer systems, and computer networks. Students and instructors will find a variety of resources at the associated website, www.bcnn.net/, including simulation

source code for download, additional exercises and solutions, web links and errata.
Stochastic Simulation Optimization for Discrete Event Systems Springer Science & Business Media
An insightful presentation of the key concepts, paradigms, and applications of modeling and simulation Modeling and simulation has become an integral part of research and development across many fields of study, having evolved from a tool to a discipline in less than two decades. Modeling and Simulation Fundamentals offers a comprehensive and authoritative treatment of the topic and includes definitions, paradigms, and applications to equip readers with the skills needed to work successfully as developers and users of modeling and simulation. Featuring contributions written by leading experts in the field, the book's fluid presentation builds from topic to topic and provides the foundation and theoretical underpinnings of modeling and simulation. First, an introduction to the topic is presented, including related terminology, examples of model development, and various domains of modeling and simulation. Subsequent chapters develop the necessary mathematical background needed to understand modeling

and simulation topics, model types, and the importance of visualization. In addition, Monte Carlo simulation, continuous simulation, and discrete event simulation are thoroughly discussed, all of which are significant to a complete understanding of modeling and simulation. The book also features chapters that outline sophisticated methodologies, verification and validation, and the importance of interoperability. A related FTP site features color representations of the book's numerous figures. Modeling and Simulation Fundamentals encompasses a comprehensive study of the discipline and is an excellent book for modeling and simulation courses at the upper-undergraduate and graduate levels. It is also a valuable reference for researchers and practitioners in the fields of computational statistics, engineering, and computer science who use statistical modeling techniques.

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