

Modeling And Control Of Discrete Event Dynamic Systems With Petri Nets And Other Tools Advanced Textbooks In Control And Signal Processing

Theory of Modeling and Simulation: Discrete Event & Iterative System Computational Foundations, Third Edition, continues the legacy of this authoritative and complete theoretical work. It is ideal for graduate and PhD students and working engineers interested in posing and solving problems using the tools of logico-mathematical modeling and computer simulation. Continuing its emphasis on the integration of discrete event and continuous modeling approaches, the work focuses light on DEVS and its potential to support the co-existence and interoperation of multiple formalisms in model components. New sections in this updated edition include discussions on important new extensions to theory, including chapter-length coverage of iterative system specification and DEVS and their fundamental importance, closure under coupling for iteratively specified systems, existence, uniqueness, non-deterministic conditions, and temporal progressiveness (legitimacy). Presents a 40% revised and expanded new edition of this classic book with many important post-2000 extensions to core theory Provides a streamlined introduction to Discrete Event System Specification (DEVS) formalism for modeling and simulation Packages all the "need-to-know" information on DEVS formalism in one place Expanded to include an online ancillary package, including numerous examples of theory and implementation in DEVS-based software, student solutions and instructors manual

More and more digital devices are being used for information processing and control purposes in a variety of systems applications, including industrial processes, power networks, biological systems and communication networks. This trend has been helped by the advent of microprocessors and the consequent availability of cheap distributed computing power. For those applications, where digital devices are used, it is reasonable to model the system in discrete-time. In addition there are other application areas, e.g. econometric systems, business systems, certain command and control systems, environmental systems, where the underlying models are in discrete-time and here discrete-time approaches to analysis and control are the most appropriate. In order to deal with these two situations, there has been a lot of interest in developing techniques which allow us to do analysis, design and control of discrete-time systems. This book provides a comprehensive treatment of discrete time dynamical systems. It covers the topics of modelling, optimization techniques and control design. The book is designed to serve as a text for teaching at the first year graduate level. The material included is organized into eight chapters.

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 Reviews research in the control of discrete-event systems, and its application to such areas as flexible manufacturing, communication, database management, traffic control, and concurrent and real-time software verification and design. The 19 papers present models of real-time system behavior, methods for decreasing computation and model complexity, unifying approaches to modeling, performance analysis, and other information. No index. Annotation c. by Book News, Inc., Portland, Or. Modeling Discrete-Event Systems with GPenSIM describes the design and applications of General Purpose Petri Net Simulator (GPenSIM), which is a software tool for modeling, simulation, and performance analysis of discrete-event systems. The brief explains the principles of modelling discrete-event systems, as well as the design and applications of GPenSIM. It is based on the author's lectures that were given on "modeling, simulation, and performance analysis of discrete event systems". The brief uses GPenSIM to enable the efficient modeling of complex and large-scale discrete-event systems. GPenSIM, which is based on MATLAB®, is designed to allow easy integration of Petri net models with a vast number of toolboxes that are available on the MATLAB®. The book offers an approach for developing models that can interact with the external environment; this will help readers to solve problems in industrial diverse fields. These problems include: airport capacity evaluation for aviation authorities; finding bottlenecks in supply chains; scheduling drilling operations in the oil and gas industry; and optimal scheduling of jobs in grid computing. This brief is of interest to researchers working on the modeling, simulation and performance evaluation of discrete-event systems, as it shows them the design and applications of an efficient modeling package. Since the book also explains the basic principles of modeling discrete-event systems in a step-by-step manner, it is also of interest to final-year undergraduate and postgraduate students.

Over the last decades Discrete Event Simulation has conquered many different application areas. This trend is, on the one hand, driven by an ever wider use of this technology in different fields of science and on the other hand by an incredibly creative use of available software programs through dedicated experts. This book contains articles from scientists and experts from 10 countries. They illuminate the width of

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application of this technology and the quality of problems solved using Discrete Event Simulation. Practical applications of simulation dominate in the present book. The book is aimed to researchers and students who deal in their work with Discrete Event Simulation and which want to inform them about current applications. By focusing on discrete event simulation, this book can also serve as an inspiration source for practitioners for solving specific problems during their work. Decision makers who deal with the question of the introduction of discrete event simulation for planning support and optimization this book provides a contribution to the orientation, what specific problems could be solved with the help of Discrete Event Simulation within the organization.

This book aims to provide a unified treatment of input/output modelling and of control for discrete-time dynamical systems subject to random disturbances. The results presented are of wide applicability in control engineering, operations research, econometric modelling and many other areas. There are two distinct approaches to mathematical modelling of physical systems: a direct analysis of the physical mechanisms that comprise the process, or a 'black box' approach based on analysis of input/output data. The second approach is adopted here, although of course the properties of the models we study, which within the limits of linearity are very general, are also relevant to the behaviour of systems represented by such models, however they are arrived at. The type of system we are interested in is a discrete-time or sampled-data system where the relation between input and output is (at least approximately) linear and where additive random disturbances are also present, so that the behaviour of the system must be investigated by statistical methods. After a preliminary chapter summarizing elements of probability and linear system theory, we introduce in Chapter 2 some general linear stochastic models, both in input/output and state-space form. Chapter 3 concerns filtering theory: estimation of the state of a dynamical system from noisy observations. As well as being an important topic in its own right, filtering theory provides the link, via the so-called innovations representation, between input/output models (as identified by data analysis) and state-space models, as required for much contemporary control theory.

Discrete Control Systems establishes a basis for the analysis and design of discretized/quantized control systems for continuous physical systems. Beginning with the necessary mathematical foundations and system-model descriptions, the text moves on to derive a robust stability condition. To keep a practical perspective on the uncertain physical systems considered, most of the methods treated are carried out in the frequency domain. As part of the design procedure, modified Nyquist–Hall and Nichols diagrams are presented and discretized proportional–integral–derivative control schemes are reconsidered. Schemes for model-reference feedback and discrete-type observers are proposed. Although single-loop feedback systems form the core of the text, some consideration is given to multiple loops and nonlinearities. The robust control performance and stability of interval systems (with multiple uncertainties) are outlined. Finally, the monograph describes the relationship between feedback-control and discrete event systems. The nonlinear phenomena associated with practically important event-driven systems are elucidated. The dynamics and stability of finite-state and discrete-event systems are defined. Academic researchers interested in the uses of discrete modelling and control of continuous systems will find Discrete Control Systems instructive. The inclusion of end-of-chapter problems also makes the book suitable for use in self study either by professional control engineers or graduate students supplementing a more formal regimen of learning.

Fueled by advances in computer technology, model-based approaches to the control of industrial processes are now widespread. While there is an enormous literature on modeling, the difficult first step of selecting an appropriate model structure has received almost no attention. This book fills the gap, providing practical insight into model selection for chemical processes and emphasizing structures suitable for control system design.

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Modeling and Control of Discrete-event Dynamic Systems with Petri Nets and Other Tools Springer Science & Business Media

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 field of discrete event systems has emerged to provide a formal treatment of many of the man-made systems such as manufacturing systems, communication networks, automated traffic systems, database management systems, and computer systems that are event-driven, highly complex, and not amenable to the classical treatments based on differential or difference equations. Discrete event systems is a growing field that utilizes many interesting mathematical models and techniques. In this book we focus on a high level treatment of discrete event systems, where the order of events, rather than their occurrence times, is the principal concern. Such treatment is needed to guarantee that the system under study meets desired logical goals. In this framework, discrete event systems are modeled by formal languages or, equivalently, by state machines. The field of logical discrete event systems is an interdisciplinary field-it includes ideas from computer science, control theory, and operations research. Our goal is to bring together in one book the relevant techniques from these fields. This is the first book of this kind, and our hope is that it will be useful to professionals in the area of discrete event systems since most of the material presented has appeared previously only in journals. The book is also designed for a graduate level course on logical discrete event systems. It contains all the necessary background material in formal language theory and lattice theory. The only prerequisite is some degree of "mathematical maturity".

This book shows how supervisory control theory (SCT) supports the formulation of various control problems of standard types, like the synthesis of controlled dynamic invariants by state feedback, and the resolution of such problems in terms of naturally definable control-theoretic concepts and properties, like reachability, controllability and observability. It exploits a simple, abstract model of controlled discrete-event systems (DES) that has proved to be tractable, appealing to control specialists, and expressive of a range of control-theoretic ideas. It allows readers to choose between automaton-based and dually language-based forms of SCT, depending on whether their preference is for an internal-structural or external-behavioral description of the problem. The monograph begins with two chapters on algebraic and linguistic preliminaries and the fundamental concepts and results of SCT are introduced. To handle complexity caused by system scale, architectural

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approaches—the horizontal modularity of decentralized and distributed supervision and the vertical modularity of hierarchical supervision—are introduced. Supervisory control under partial observation and state-based supervisory control are also addressed; in the latter, a vector DES model that exploits internal regularity of algebraic structure is proposed. Finally SCT is generalized to deal with timed DES by incorporating temporal features in addition to logical ones. Researchers and graduate students working with the control of discrete-event systems or who are interested in the development of supervisory control methods will find this book an invaluable aid in their studies. The text will also be of assistance to researchers in manufacturing, logistics, communications and transportation, areas which provide plentiful examples of the class of systems being discussed.

Stochastic discrete-event systems (SDES) capture the randomness in choices due to activity delays and the probabilities of decisions. This book delivers a comprehensive overview on modeling with a quantitative evaluation of SDES. It presents an abstract model class for SDES as a pivotal unifying result and details important model classes. The book also includes nontrivial examples to explain real-world applications of SDES.

This volume brings about the contemporary results in the field of discrete-time systems. It covers papers written on the topics of robust control, nonlinear systems and recent applications. Although the technical views are different, they all geared towards focusing on the up-to-date knowledge gain by the researchers and providing effective developments along the systems and control arena. Each topic has a detailed discussions and suggestions for future perusal by interested investigators.

Research of discrete event systems is strongly motivated by applications in flexible manufacturing, in traffic control and in concurrent and real-time software verification and design, just to mention a few important areas. Discrete event system theory is a promising and dynamically developing area of both control theory and computer science. Discrete event systems are systems with non-numerically-valued states, inputs, and outputs. The approaches to the modelling and control of these systems can be roughly divided into two groups. The first group is concerned with the automatic design of controllers from formal specifications of logical requirements. This research owes much to the pioneering work of P.J. Ramadge and W.M. Wonham at the beginning of the eighties. The second group deals with the analysis and optimization of system throughput, waiting time, and other performance measures for discrete event systems. The present book contains selected papers presented at the Joint Workshop on Discrete Event Systems (WODES'92) held in Prague, Czechoslovakia, on August 26-28, 1992 and organized by the Institute of Information Theory and Automation of the Czechoslovak Academy of Sciences, Prague, Czechoslovakia, by the Automatic Control Laboratory of the Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, and by the Department of Computing Science of the University of Groningen, Groningen, the Netherlands.

Modeling, Control And Optimization Of Complex Systems is a collection of contributions from leading international researchers in the fields of dynamic systems, control theory, and modeling. These papers were presented at the Symposium on Modeling and Optimization of Complex Systems in honor of Larry Yu-Chi Ho in June 2001. They include

exciting research topics such as: -modeling of complex systems, -power control in ad hoc wireless networks, -adaptive control using multiple models, -constrained control, -linear quadratic control, -discrete events, -Markov decision processes and reinforcement learning, -optimal control for discrete event and hybrid systems, -optimal representation and visualization of multivariate data and functions in low-dimensional spaces.

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.

Supervisory Control of Discrete Event Systems Using Petri Nets presents a novel approach to its subject. The concepts of supervisory control and discrete event systems are explained, and the background material on general Petri net theory necessary for using the book's control techniques is provided. A large number of examples is used to illustrate the concepts and techniques presented in the text, and there are plenty of references for those interested in additional study or more information on a particular topic. Supervisory Control of Discrete Event Systems Using Petri Nets is intended for graduate students, advanced undergraduates, and practicing engineers who are interested in the control problems of manufacturing, communication and computer networks, chemical process plants, and other high-level control applications. The text is written from an engineering perspective, but it is also appropriate for students of computer science, applied mathematics, or economics. The book contains enough background material to stand alone as an introduction to supervisory control with Petri nets, but it may also be used as a supplemental text in a course on discrete event systems or intelligent autonomous control.

Discrete-event dynamic systems (DEDs) permeate our world. They are of great importance in modern manufacturing processes, transportation and various forms of computer and communications networking. This book begins with the mathematical basics required for the study of DEDs and moves on to present various tools used in their modeling and control. Industrial examples illustrate the concepts and methods discussed, making this book an invaluable aid for students embarking on further courses in control, manufacturing engineering or computer studies.

"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

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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

CD-ROM contains: MATLAB m-files -- Discussions and examples of MATLAB commands relevant to each chapter -- Test data for 3 case studies.

Control of Discrete-event Systems provides a survey of the most important topics in the discrete-event systems theory with particular focus on finite-state automata, Petri nets and max-plus algebra. Coverage ranges from introductory material on the basic notions and definitions of discrete-event systems to more recent results. Special attention is given to results on supervisory control, state estimation and fault diagnosis of both centralized and distributed/decentralized systems developed in the framework of the Distributed Supervisory Control of Large Plants (DISC) project. Later parts of the text are devoted to the study of congested systems through fluidization, an over approximation allowing a much more efficient study of observation and control problems of timed Petri nets. Finally, the max-plus algebraic approach to the analysis and control of choice-free systems is also considered. Control of Discrete-event Systems provides an introduction to discrete-event systems for readers that are not familiar with this class of systems, but also provides an introduction to research problems and open issues of current interest to readers already familiar with them. Most of the material in this book has been presented during a Ph.D. school held in Cagliari, Italy, in June 2011.

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