Lothar Breuer

From Markov Jump Processes to Spatial Queues

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Julia Schneider

From Markov Jump Proceses To Spatial Queues:

From Markov Jump Processes to Spatial Queues L. Breuer,2012-12-06 From Markov Jump Processes to Spatial Queues aims to develop a unified theory of spatial queues that yields concrete results for the performance analysis of mobile communication networks A particular objective is to develop the most natural generalization of existing concepts e g the BMAP toward the needs of mobile communication networks To these belong the spatial distribution of batch arrivals and users in the system as well as time inhomogeneous e g periodic arrival intensities and user movements One of the major recent challenges for the stochastic modelling of communication systems is the emergence of wireless networks which are used by more and more subscribers today The main new feature of those which is not covered by classical queuing theory clearly is the importance of the user location within the area that is served by the base stations of the network In the framework of queuing theory this opens up the natural extension of classical queuing models towards queues with a structured space in which users are served The present book is intended to introduce this extension under the name of spatial queues The main point of view and the general approach will be that of Markov jump processes We start with a closer look into the theory Then we present new results for the theory of stochastic processes as well as for classical queuing theory Finally we introduce the new concepts of spatial Markovian arrival processes and spatial queues The main text is divided into three parts The first part provides a new presentation of the theory of Markov jump processes We derive a number of new results especially for time inhomogeneous processes which have been neglected too much in the current textbooks on stochastic processes For the first time the class of Markov additive jump processes is analysed in detail This extends and unifies all Markovian arrival processes that have been proposed up to now including arrivals for fluid queues and provides a foundation for the subsequent introduction of spatial Markovian arrival processes The second part contains new results for classical queues with BMAP input These include the first explicit formulae for the distribution of periodic queues The class of fluid Markovian arrival processes is introduced and we give statistical estimates for the parameters of a BMAP In the third part the concepts of spatial Markovian arrival processes abbreviated SMAPs and spatial queues are introduced After that periodic spatial Markovian queues are analysed as a model for the cells of a wireless communication network From Markov Jump Processes to Spatial Queues is intended to reach queuing theorists researchers in the field of communication systems as well as engineers with some background in probability theory Furthermore it is suitable as a textbook for advanced queuing theory on the graduate or post graduate level   **An Introduction to Queueing Theory** L. Breuer,Dieter Baum,2006-02-23 The present textbook contains the recordsof a two semester course on que ing theory including an introduction to matrix analytic methods This course comprises four hours oflectures and two hours of exercises per week andhas been taughtattheUniversity of Trier Germany for about ten years in quence The course is directed to last year undergraduate and rst year gr uate students of applied probability and computer science who have already completed an

introduction to probability theory Its purpose is to present terial that is close enough to concrete queueing models and their applications while providing a sound mathematical foundation for the analysis of these Thus the goal of the present book is two fold On the one hand students who are mainly interested in applications easily feel bored by elaborate mathematical questions in the theory of stochastic processes The presentation of the mathematical foundations in our courses is chosen to cover only the necessary results which are needed for a solid foundation of the methods of queueing analysis Further students oriented wards applications expect to have a justi cation for their mathematical efforts in terms of immediate use in queueing analysis This is the main reason why we have decided to introduce new mathematical concepts only when they will be used in the immediate sequel On the other hand students of applied probability do not want any heur tic derivations just for the sake of yielding fast results for the model at hand <u>Information Technologies and Mathematical Modelling. Queueing Theory and Applications</u> Alexander Dudin,Anatoly Nazarov,Alexander Moiseev,2018-08-27 This book constitutes the proceedings of the 17th International Conference on Information Technologies and Mathematical Modelling ITMM 2018 named after A F Terpugov and the 12th Workshop on Retrial Queues and Related Topics held in Tomsk Russia in September 2018 The 30 papers presented in this volume were carefully reviewed and selected from 84 submissions The conference covers various aspects of information technologies focusing on queueing theory stochastic processes Markov processes renewal theory network performance equation and network protocols **Continuous-Time Markov Decision Processes** Xianping Guo,Onésimo Hernández-Lerma,2009-09-18 Continuous time Markov decision processes MDPs also known as controlled Markov chains are used for modeling decision making problems that arise in operations research for instance inventory manufacturing and queueing systems computer science communications engineering control of populations such as fisheries and epidemics and management science among many other fields This volume provides a unified systematic self contained presentation of recent developments on the theory and applications of continuous time MDPs The MDPs in this volume include most of the cases that arise in applications because they allow unbounded transition and reward cost rates Much of the material appears for the first time in book form **Markov-Modulated Processes and Semiregenerative Phenomena** Loon Ching Tang,2009 The book presents a coherent treatment of Markov random walks and Markov additive processes together with their applications Part I provides the foundations of these stochastic processes underpinned by a solid theoretical framework based on Semiregenerative phenomena Part II presents some applications to queueing and storage systems **Tools and Algorithms for the Construction and Analysis of Systems** Jan Friso Groote,Kim Guldstrand Larsen,2021-04-20 This open access two volume set constitutes the proceedings of the 27th International Conference on Tools and Algorithms for the Construction and Analysis of Systems TACAS 2021 which was held during March 27 April 1 2021 as part of the European Joint Conferences on Theory and Practice of Software ETAPS 2021 The conference was planned to take place in Luxembourg and changed to an online format due to the COVID 19 pandemic The total of 41 full

papers presented in the proceedings was carefully reviewed and selected from 141 submissions The volume also contains 7 tool papers 6 Tool Demo papers 9 SV Comp Competition Papers The papers are organized in topical sections as follows Part I Game Theory SMT Verification Probabilities Timed Systems Neural Networks Analysis of Network Communication Part II Verification Techniques not SMT Case Studies Proof Generation Validation Tool Papers Tool Demo Papers SV Comp Tool Competition Papers **Quantitative Evaluation of Systems** Alessandro Abate,Andrea Marin,2021-08-19 This book constitutes the proceedings of the 18th International Conference on Quantitative Evaluation Systems QEST 2021 held in Paris France in August 2021 The 21 full papers and 2 short papers presented together with 2 keynote papers were carefully reviewed and selected from 47 submissions The papers are organized in the following topics probabilistic model checking quantitative models and metamodels analysis and validation queueing systems learning and verification simulation performance evaluation abstractions and aggregations and stochastic models **Environmental Risk Assessment and Management from a Landscape Perspective** Lawrence A. Kapustka,Wayne G. Landis,2010-07-15 An important guide to assessing and managing the environment from a landscape perspective Ecological relationships are nested within the landscape Identifying the relevant spatial and temporal scales is critical for an effective understanding of ecological functions that human societies depend upon Moreover human encroachment into natural areas or changes in climate can alter spatial relationships which in turn can negatively affect vital plant and wildlife patterns and weaken economic structures needed to sustain human societies This book is the first to combine multiple disciplines into one cohesive strategy to study these crucial connections and looks toward building a social paradigm that embraces the dynamics of ecological systems This book Integrates landscape ecology environmental risk assessment valuation of ecological goods and services and environmental management decision processes into one single source Includes chapters on quantitative measures Bayesian modeling economic analysis and sustainable landscapes Covers marine forest agricultural and pharmaceutical risk assessment Has a chapter on predicting climate change risk to ecosystems Has a companion ftp site with color graphics animations and risk assessment tools With material that is accessible across all knowledge levels Environmental Risk Assessment and Management from a Landscape Perspective moves beyond looking solely at chemical contaminants to diagnose environmental threats and aims to accomplish practical risk assessment in a manner that supports long term sustainable management **Introduction to Stochastic Networks** Richard Serfozo,2012-12-06 In a stochastic network such as those in computer telecommunications and manufacturing discrete units move among a network of stations where they are processed or served Randomness may occur in the servicing and routing of units and there may be queueing for services This book describes several basic stochastic network processes beginning with Jackson networks and ending with spatial queueing systems in which units such as cellular phones move in a space or region where they are served The focus is on network processes that have tractable closed form expressions for the equilibrium probability distribution of the numbers of

units at the stations These distributions yield network performance parameters such as expectations of throughputs delays costs and travel times The book is intended for graduate students and researchers in engineering science and mathematics interested in the basics of stochastic networks that have been developed over the last twenty years Assuming a graduate course in stochastic processes without measure theory the emphasis is on multi dimensional Markov processes There is also some self contained material on point processes involving real analysis The book also contains rather complete introductions to reversible Markov processes Palm probabilities for stationary systems Little laws for queueing systems and space time Poisson processes This material is used in describing reversible networks waiting times at stations travel times and space time flows in networks Richard Serfozo received the Ph D degree in Industrial Engineering and Management Sciences at Northwestern University in 1969 and is currently Professor of Industrial and Systems Engineering at Georgia Institute of Technology Prior to that he held positions in the Boeing Company Syracuse University and Bell Laboratories He has held

Mathematical Reviews ,2006 **Grundlagen der Warteschlangentheorie** Dieter Baum,2013-08-23 Dieses Buch pr sentiert die Grundlagen der stochastischen Modellierung Ma theorie Wahrscheinlichkeitstheorie Theorie stochastischer Prozesse und Markov Theorie in ihrer nat rlichen Aufbaufolge Damit und erg nzt durch einen Anhang zu wichtigen Begriffsbildungen der allgemeinen Topologie werden die wesentlichen Aussagen der Warteschlangentheorie auf ein solides mathematisches Fundament gestellt Kapitel 5 behandelt klassische Markov und Semi Markov Modelle die Phasenmethode Markov additive Ankunftsprozesse das BMAP G 1 System und Matrix geometrische Verteilungen Kapitel 6 ist r umlichen Ankunftsprozessen vom Typ BMAP gewidmet Modellierung zeitlich variierender und fl chenhaft verteilter Bedienanforderungen mittels zuf lliger Punktfelder Gegenstand des letzten Kapitels sind Reversibilit ts und Balance Eigenschaften klassischer Warteschlangennetze Studierende der Mathematik Informatik und Elektrotechnik f hrt das Buch in die breit gestreute wissenschaftliche Literatur zum Thema ein Stochastic Networks and Queues Philippe Robert,2013-04-17 Queues and stochastic networks are analyzed in this book with purely probabilistic methods The purpose of these lectures is to show that general results from Markov processes martingales or ergodic theory can be used directly to study the corresponding stochastic processes Recent developments have shown that instead of having ad hoc methods a better understanding of fundamental results on stochastic processes is crucial to study the complex behavior of stochastic networks In this book various aspects of these stochastic models are investigated in depth in an elementary way Existence of equilibrium characterization of stationary regimes transient behaviors rare events hitting times and critical regimes etc A simple presentation of stationary point processes and Palm measures is given Scaling methods and functional limit theorems are a major theme of this book In particular a complete chapter is devoted to fluid limits of Markov processes *Markov Processes for Stochastic Modeling* Oliver Ibe,2008-09-02 Markov processes are used to model systems with limited memory They are used in many areas including communications systems transportation networks image segmentation and analysis

biological systems and DNA sequence analysis random atomic motion and diffusion in physics social mobility population studies epidemiology animal and insect migration queueing systems resource management dams financial engineering actuarial science and decision systems This book which is written for upper level undergraduate and graduate students and researchers presents a unified presentation of Markov processes In addition to traditional topics such as Markovian queueing system the book discusses such topics as continuous time random walk correlated random walk Brownian motion diffusion processes hidden Markov models Markov random fields Markov point processes and Markov chain Monte Carlo Continuous time random walk is currently used in econophysics to model the financial market which has traditionally been modelled as a Brownian motion Correlated random walk is popularly used in ecological studies to model animal and insect movement Hidden Markov models are used in speech analysis and DNA sequence analysis while Markov random fields and Markov point processes are used in image analysis Thus the book is designed to have a very broad appeal Provides the practical current applications of Markov processes Coverage of HMM Point processes and Monte Carlo Includes enough theory to help students gain throrough understanding of the subject Principles can be immediately applied in many specific research projects saving researchers time End of chapter exercises provide reinforcement practice and increased understanding to the student   **Subject Guide to Books in Print** ,1991   **Systems Modeling: Methodologies and Tools** Antonio Puliafito,Kishor S. Trivedi,2018-10-16 This book covers ideas methods algorithms and tools for the in depth study of the performance and reliability of dependable fault tolerant systems The chapters identify the current challenges that designers and practitioners must confront to ensure the reliability availability and performance of systems with special focus on their dynamic behaviors and dependencies Topics include network calculus workload and scheduling simulation sensitivity analysis and applications queuing networks analysis clouds federations and big data and tools This collection of recent research exposes system researchers performance analysts and practitioners to a spectrum of issues so that they can address these challenges in their work   *The British National Bibliography* Arthur James Wells,2003   Point Process Calculus in Time and Space Pierre Brémaud,2020-12-05 This book provides an introduction to the theory and applications of point processes both in time and in space Presenting the two components of point process calculus the martingale calculus and the Palm calculus it aims to develop the computational skills needed for the study of stochastic models involving point processes providing enough of the general theory for the reader to reach a technical level sufficient for most applications Classical and not so classical models are examined in detail including Poisson Cox renewal cluster and branching Kerstan Hawkes point processes The applications covered in this text queueing information theory stochastic geometry and signal analysis have been chosen not only for their intrinsic interest but also because they illustrate the theory Written in a rigorous but not overly abstract style the book will be accessible to earnest beginners with a basic training in probability but will also interest upper graduate students and experienced researchers   *Probability Theory Subject Indexes from Mathematical Reviews*

American Mathematical Society,1987   **Scientific and Technical Aerospace Reports** ,1992   *Applied Probability*
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