Stochastic Systems

- *Stochastic system*: a triple $\Sigma = (S, A, P)$
  - S = finite set of states
  - A = finite set of actions
  - $P_a(s' \mid s)$ = probability of going to s' if we execute a in s
  - $\sum_{s' \in S} P_a(s' \mid s) = 1$
- Several different possible action representations
  - e.g., Bayes networks, probabilistic operators
  - Situation calculus with stochastic (nature) effects
  - Explicit enumeration of each $P_a(s' \mid s)$

Discretetime Stochastic Systems

Vasile Dragan,Toader Morozan,Adrian-Mihail Stoica

Discretetime Stochastic Systems:

Discrete-time Stochastic Systems Torsten Söderström,2012-12-06 This comprehensive introduction to the estimation and control of dynamic stochastic systems provides complete derivations of key results The second edition includes improved and updated material and a new presentation of polynomial control and new derivation of linear quadratic Gaussian control

Optimization of Stochastic Systems Masanao Aoki,2016-06-03 Optimization of Stochastic Systems *Optimal Control of Discrete Time Stochastic Systems* C. Striebel,2012-02-29 **Control and System Theory of Discrete-Time Stochastic Systems** Jan H. van Schuppen,2021 This book helps students researchers and practicing engineers to understand the theoretical framework of control and system theory for discrete time stochastic systems so that they can then apply its principles to their own stochastic control systems and to the solution of control filtering and realization problems for such systems Applications of the theory in the book include the control of ships shock absorbers traffic and communications networks and power systems with fluctuating power flows The focus of the book is a stochastic control system defined for a spectrum of probability distributions including Bernoulli finite Poisson beta gamma and Gaussian distributions The concepts of observability and controllability of a stochastic control system are defined and characterized Each output process considered is with respect to conditions represented by a stochastic system called a stochastic realization The existence of a control law is related to stochastic controllability while the existence of a filter system is related to stochastic observability Stochastic control with partial observations is based on the existence of a stochastic realization of the filtration of the observed process *Discrete-Time Stochastic Sliding Mode Control Using Functional Observation* Satnesh Singh,S. Janardhanan,2019-11-25 This book extrapolates many of the concepts that are well defined for discrete time deterministic sliding mode control for use with discrete time stochastic systems It details sliding function designs for various categories of linear time invariant systems and its application for control The resulting sliding mode control addresses robustness issues and the functional observer approach reduces the observer order substantially Sliding mode control SMC is designed for discrete time stochastic systems extended so that states lie within a specified band and able to deal with incomplete information Functional observer based SMC is designed for various clauses of stochastic systems discrete time discrete time with delay state time delayed and those with parametric uncertainty Stability considerations arising because of parametric uncertainty are taken into account and where necessary the effects of unmatched uncertainties mitigated A simulation example is used to explain the use of the functional observer approach to SMC design Discrete Time Stochastic Sliding Mode Control Using Functional Observation will interest all researchers working in sliding mode control and will be of particular assistance to graduate students in understanding the changes in design philosophy that arise when changing from continuous to discrete time systems It helps to pave the way for further progress in applications of discrete time SMC

Performance Analysis and Synthesis for Discrete-Time Stochastic Systems with Network-Enhanced Complexities Derui

Ding,Zidong Wang,Guoliang Wei,2018-10-11 The book addresses the system performance with a focus on the network enhanced complexities and developing the engineering oriented design framework of controllers and filters with potential applications in system sciences control engineering and signal processing areas Therefore it provides a unified treatment on the analysis and synthesis for discrete time stochastic systems with guarantee of certain performances against network enhanced complexities with applications in sensor networks and mobile robotics Such a result will be of great importance in the development of novel control and filtering theories including industrial impact Key Features Provides original methodologies and emerging concepts to deal with latest issues in the control and filtering with an emphasis on a variety of network enhanced complexities Gives results of stochastic control and filtering distributed control and filtering and security control of complex networked systems Captures the essence of performance analysis and synthesis for stochastic control and filtering Concepts and performance indexes proposed reflect the requirements of engineering practice Methodologies developed in this book include backward recursive Riccati difference equation approach and the discrete time version of input to state stability in probability **Optimal Control of Discrete Time Stochastic Systems** Charlotte Striebel,1975 *H [hoch Unendlich] type control for discrete-time stochastic systems* Abdelmoulah el Bouhtouri,Diederich Hinrichsen,Anthony J. Pritchard,1998 **$ H^ \infty $ Type Control for Discrete-time Stochastic Systems** A. El Bouhtouri,D. Hinrichsen,Anthony J. Pritchard,1998 Identification of Time Varying Delays in Linear Discrete Time Stochastic Systems Farrokh Abrishamkar,1984 **Design of Inputs for Identification of Discrete Time Stochastic Systems** Michael Athans,Alejandro Antonio Lopez-Toledo,1974 **Optimal Control of Discrete-time Stochastic Systems** David D. Sworder,University of Southern California. Department of Electrical Engineering,University of Southern California. School of Engineering. Electronic Sciences Laboratory,United States. Joint Services Electronics Program,1965 Optimization of stochastic systems Masanao Aoki,1967 *Formal Verification and Control of Discrete-time Stochastic Systems* Morteza M. Lahijanian,2013 Abstract This thesis establishes theoretical and computational frameworks for formal verification and control synthesis for discrete time stochastic systems Given a temporal logic specification the system is analyzed to determine the probability that the specification is achieved and an input law is automatically generated to maximize this probability The approach consists of three main steps constructing an abstraction of the stochastic system as a finite Markov model mapping the given specification onto this abstraction and finding a control policy to maximize the probability of satisfying the specification The framework uses Probabilistic Computation Tree Logic PCTL as the specification language The verification and synthesis algorithms are inspired by the field of probabilistic model checking In abstraction a method for the computation of the exact transition probability bounds between the regions of interest in the domain of the stochastic system is first developed These bounds are then used to construct an Interval valued Markov Chain IMC or a Bounded parameter Markov Decision Process BMDP abstraction for the system Then a representative transition probability

is used to construct an approximating Markov chain MC for the stochastic system The exact bound of the approximation error and an explicit expression for its growth over time are derived To achieve a desired error value an adaptive refinement algorithm that takes advantage of the linear dynamics of the system is employed To verify the properties of the continuous domain stochastic system against a finite time PCTL specification IMC and BMDP verification algorithms are designed These algorithms have low computational complexity and are inspired by the MC model checking algorithms The low computational complexity is achieved by over approximating the probabilities of satisfaction To increase the precision of the method two adaptive refinement procedures are proposed Furthermore a method of generating the control strategy that maximizes the probability of satisfaction of a PCTL specification for Markov Decision Processes MDPs is developed Through a similar method a formal synthesis framework is constructed for continuous domain stochastic systems by utilizing their BMDP abstractions These methodologies are then applied in robotics applications as a means of automatically deploying a mobile robot subject to noisy sensors and actuators from PCTL specifications This technique is demonstrated through simulation and experimental case studies of deployment of a robot in an indoor environment The contributions of the thesis include verification and synthesis frameworks for discrete time stochastic linear systems abstraction schemes for stochastic systems to MCs IMCs and BMDPs model checking algorithms with low computational complexity for IMCs and BMDPs against finite time PCTL formulas synthesis algorithms for Markov Decision Processes MDPs from PCTL formulas and a computational framework for automatic deployment of a mobile robot from PCTL specifications The approaches were validated by simulations and experiments The algorithms and techniques in this thesis help to make discrete time stochastic systems a more useful and effective class of models for analysis and control of real world systems Estimation and Control for Discrete-time Stochastic Systems with Semi-Markovian Or Markovian Parameter Jumps Leon John Campo,1989

Sub-optimal Control of Linear Discrete-time Stochastic Systems Using Memory Elements James Richard Huddle,1966 **Suboptimal Control as Applied to a Class of Discrete-time, Stochastic Systems** Jimmy Lee Bybee,1967 **Mathematical Methods in Robust Control of Discrete-Time Linear Stochastic Systems** Vasile Dragan,Toader Morozan,Adrian-Mihail Stoica,2009-11-10 In this monograph the authors develop a theory for the robust control of discrete time stochastic systems subjected to both independent random perturbations and to Markov chains Such systems are widely used to provide mathematical models for real processes in fields such as aerospace engineering communications manufacturing finance and economy The theory is a continuation of the authors work presented in their previous book entitled Mathematical Methods in Robust Control of Linear Stochastic Systems published by Springer in 2006 Key features Provides a common unifying framework for discrete time stochastic systems corrupted with both independent random perturbations and with Markovian jumps which are usually treated separately in the control literature Covers preliminary material on probability theory independent random variables conditional expectation and Markov chains

Proposes new numerical algorithms to solve coupled matrix algebraic Riccati equations Leads the reader in a natural way to the original results through a systematic presentation Presents new theoretical results with detailed numerical examples The monograph is geared to researchers and graduate students in advanced control engineering applied mathematics mathematical systems theory and finance It is also accessible to undergraduate students with a fundamental knowledge in the theory of stochastic systems **Optimal Feedback for Discrete-time Linear Stochastic Systems** Eliezer Colina Morles,1983 H− Index for Discrete-time Stochastic Systems with Markovian Jump and Multiplicative Noise ,2018

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