

Mixed H_2/H_∞ -Control of Discrete-Time Markovian Jump Linear Systems

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Abstract : In this paper we consider the mixed H_2/H_∞ -control problem for the class of discrete-time linear systems with parameters subject to Markovian jumps (MLS). It is assumed that both the state variable and the jump variable are available to the controller. The transition probability matrix may not be exactly known, but belongs to an appropriate convex set. For this controlled discrete-time Markovian jump linear system, the problem of interest can be stated in the following way. Find a robust (with respect to the uncertainty on the transition Markov probability matrix) mean square stabilizing state and jump feedback controller that minimizes an upper bound for the H_2 -norm, under the restriction that the H_∞ -norm is less than a pre-specified value δ . The problem of the determination of the smallest H_∞ -norm is also addressed. We present an approximate version of these problems via LMI optimization.

Keywords : mixed H_2/H_∞ -control, Markovian jump systems, coupled algebraic Riccati equations, LMI optimization.

November 1996

This work was supported in part by CNPq (Brazilian National Research Council) and FAPESP (Research Council of the State of São Paulo).

Discretetime Markovian Jump Linear Systems

**Oswaldo Luiz do Valle Costa, Marcelo
D. Fragoso, Marcos G. Todorov**



Discretetime Markovian Jump Linear Systems:

Discrete-Time Markov Jump Linear Systems O.L.V. Costa, M.D. Fragoso, R.P. Marques, 2006-03-30 Safety critical and high integrity systems such as industrial plants and economic systems can be subject to abrupt changes for instance due to component or interconnection failure and sudden environment changes etc Combining probability and operator theory Discrete Time Markov Jump Linear Systems provides a unified and rigorous treatment of recent results for the control theory of discrete jump linear systems which are used in these areas of application The book is designed for experts in linear systems with Markov jump parameters but is also of interest for specialists in stochastic control since it presents stochastic control problems for which an explicit solution is possible making the book suitable for course use From the reviews This text is very well written it may prove valuable to those who work in the area are at home with its mathematics and are interested in stability of linear systems optimal control and filtering Journal of the American Statistical Association December 2005

Discrete-time Markovian Jump Linear Systems K. Szajowski, W. L. de Koning, 1992 **Discrete-time Markovian Jump Linear Quadratic Optimal Control** H. J. Chizeck, Alan S. Willsky, D. Castanon, 1985 This paper is concerned with the optimal control of discrete time linear systems that possess randomly jumping parameters described by finite state Markov processes For problems having quadratic costs and perfect observations the optimal control laws and expected costs to go can be precomputed from a set of coupled Riccati like matrix difference equations Necessary and sufficient conditions are derived for the existence of optimal constant control laws which stabilize the controlled system as the time horizon becomes infinite with finite optimal expected cost Originator supplied keywords are Markov chains Problem solving Steady state Author **Analysis and Design of Singular Markovian Jump Systems** Guoliang Wang, Qingling Zhang, Xinggang Yan, 2014-07-17 This monograph is an up to date presentation of the analysis and design of singular Markovian jump systems SMJSs in which the transition rate matrix of the underlying systems is generally uncertain partially unknown and designed The problems addressed include stability stabilization H control and filtering observer design and adaptive control applications of Markov process are investigated by using Lyapunov theory linear matrix inequalities LMIs S procedure and the stochastic Barbalat s Lemma among other techniques Features of the book include study of the stability problem for SMJSs with general transition rate matrices TRMs stabilization for SMJSs by TRM design noise control proportional derivative and partially mode dependent control in terms of LMIs with and without equation constraints mode dependent and mode independent H control solutions with development of a type of disordered controller observer based controllers of SMJSs in which both the designed observer and controller are either mode dependent or mode independent consideration of robust H filtering in terms of uncertain TRM or filter parameters leading to a method for totally mode independent filtering development of LMI based conditions for a class of adaptive state feedback controllers with almost certainly bounded estimated error and almost certainly asymptotically stable corresponding closed loop system states applications of Markov

process on singular systems with norm bounded uncertainties and time varying delays Analysis and Design of Singular Markovian Jump Systems contains valuable reference material for academic researchers wishing to explore the area The contents are also suitable for a one semester graduate course

Analysis and Design of Markov Jump Systems with Complex Transition Probabilities Lixian Zhang,Ting Yang,Peng Shi,Yanzheng Zhu,2016-01-19 The book addresses the control issues such as stability analysis control synthesis and filter design of Markov jump systems with the above three types of TPs and thus is mainly divided into three parts Part I studies the Markov jump systems with partially unknown TPs Different methodologies with different conservatism for the basic stability and stabilization problems are developed and compared Then the problems of state estimation the control of systems with time varying delays the case involved with both partially unknown TPs and uncertain TPs in a composite way are also tackled Part II deals with the Markov jump systems with piecewise homogeneous TPs Methodologies that can effectively handle control problems in the scenario are developed including the one coping with the asynchronous switching phenomenon between the currently activated system mode and the controller filter to be designed Part III focuses on the Markov jump systems with memory TPs The concept of mean square stability is proposed such that the stability problem can be solved via a finite number of conditions The systems involved with nonlinear dynamics described via the Takagi Sugeno fuzzy model are also investigated Numerical and practical examples are given to verify the effectiveness of the obtained theoretical results Finally some perspectives and future works are presented to conclude the book

Continuous-Time Markov Jump Linear Systems Oswaldo Luiz do Valle Costa,Marcelo D. Fragoso,Marcos G. Todorov,2012-12-18 It has been widely recognized nowadays the importance of introducing mathematical models that take into account possible sudden changes in the dynamical behavior of a high integrity systems or a safety critical system Such systems can be found in aircraft control nuclear power stations robotic manipulator systems integrated communication networks and large scale flexible structures for space stations and are inherently vulnerable to abrupt changes in their structures caused by component or interconnection failures In this regard a particularly interesting class of models is the so called Markov jump linear systems MJLS which have been used in numerous applications including robotics economics and wireless communication Combining probability and operator theory the present volume provides a unified and rigorous treatment of recent results in control theory of continuous time MJLS This unique approach is of great interest to experts working in the field of linear systems with Markovian jump parameters or in stochastic control The volume focuses on one of the few cases of stochastic control problems with an actual explicit solution and offers material well suited to coursework introducing students to an interesting and active research area The book is addressed to researchers working in control and signal processing engineering Prerequisites include a solid background in classical linear control theory basic familiarity with continuous time Markov chains and probability theory and some elementary knowledge of operator theory

Control and Filtering for Semi-Markovian Jump Systems Fanbiao Li,Peng Shi,Ligang Wu,2016-11-04 This book

presents up to date research developments and novel methodologies on semi Markovian jump systems S MJS It presents solutions to a series of problems with new approaches for the control and filtering of S MJS including stability analysis sliding mode control dynamic output feedback control robust filter design and fault detection A set of newly developed techniques such as piecewise analysis method positively invariant set approach event triggered method and cone complementary linearization approaches are presented Control and Filtering for Semi Markovian Jump Systems is a comprehensive reference for researcher and practitioners working in control engineering system sciences and applied mathematics and is also a useful source of information for senior undergraduates and graduates in these areas The readers will benefit from some new concepts new models and new methodologies with practical significance in control engineering and signal processing

Stability Analysis of Markovian Jump Systems Yu Kang, Yun-Bo Zhao, Ping Zhao, 2017-09-08 This book focuses on the stability analysis of Markovian jump systems MJSs with various settings and discusses its applications in several different areas It also presents general definitions of the necessary concepts and an overview of the recent developments in MJSs Further it addresses the general robust problem of Markovian jump linear systems MJLSs the asynchronous stability of a class of nonlinear systems the robust adaptive control scheme for a class of nonlinear uncertain MJSs the practical stability of MJSs and its applications as a modelling tool for networked control systems Markovian based control for wheeled mobile manipulators and the jump linear quadratic JLQ problem of a class of continuous time MJLSs It is a valuable resource for researchers and graduate students in the field of control theory and engineering

Filtering and Control of Stochastic Jump Hybrid Systems Xiuming Yao, Ligang Wu, Wei Xing Zheng, 2016-04-20 This book presents recent research work on stochastic jump hybrid systems Specifically the considered stochastic jump hybrid systems include Markovian jump Ito stochastic systems Markovian jump linear parameter varying LPV systems Markovian jump singular systems Markovian jump two dimensional 2 D systems and Markovian jump repeated scalar nonlinear systems Some sufficient conditions are first established respectively for the stability and performances of those kinds of stochastic jump hybrid systems in terms of solution of linear matrix inequalities LMIs Based on the derived analysis conditions the filtering and control problems are addressed The book presents up to date research developments and novel methodologies on stochastic jump hybrid systems The contents can be divided into two parts the first part is focused on robust filter design problem while the second part is put the emphasis on robust control problem These methodologies provide a framework for stability and performance analysis robust controller design and robust filter design for the considered systems Solutions to the design problems are presented in terms of LMIs The book is a timely reflection of the developing area of filtering and control theories for Markovian jump hybrid systems with various kinds of imperfect information It is a collection of a series of latest research results and therefore serves as a useful textbook for senior and or graduate students who are interested in knowing 1 the state of the art of linear filtering and control areas and 2 recent advances in stochastic jump hybrid systems The readers will also benefit

from some new concepts new models and new methodologies with practical significance in control engineering and signal processing

A Jump Linear Framework for Estimation and Robust Communication with Markovian Source and Channel Dynamics Alyson Kerry Fletcher,2005

Discrete and Continuous Dynamical Systems ,2005

Robust Control for Discrete-Time Markovian Jump Systems in the Finite-Time Domain Xiaoli Luan,Shuping He,Fei Liu,2023-02-13 This book provides robust analysis and synthesis tools for Markovian jump systems in the finite time domain with specified performances It explores how these tools can make the systems more applicable to fields such as economic systems ecological systems and solar thermal central receivers by limiting system trajectories in the desired bound in a given time interval Robust Control for Discrete Time Markovian Jump Systems in the Finite Time Domain focuses on multiple aspects of finite time stability and control including finite time H infinity control finite time sliding mode control finite time multi frequency control finite time model predictive control and high order moment finite time control for multi mode systems and also provides many methods and algorithms to solve problems related to Markovian jump systems with simulation examples that illustrate the design procedure and confirm the results of the methods proposed The thorough discussion of these topics makes the book a useful guide for researchers industrial engineers and graduate students alike enabling them systematically to establish the modeling analysis and synthesis for Markovian jump systems in the finite time domain

SIAM Journal on Control and Optimization Society for Industrial and Applied Mathematics,2009

Information Technology Applications in Industry Jun Zhang,Zhi Jian Wang,Shu Ren Zhu,Xiao Ming Meng,2012-12-27 Selected peer reviewed papers from the 2012 International Conference on Information Technology and Management Innovation ICITMI 2012 November 10 11 2012 Guangzhou China

Advances in the Control of Markov Jump Linear Systems with No Mode Observation Alessandro N. Vargas,Eduardo F. Costa,João B. R. do Val,2016-05-27 This brief broadens readers understanding of stochastic control by highlighting recent advances in the design of optimal control for Markov jump linear systems MJLS It also presents an algorithm that attempts to solve this open stochastic control problem and provides a real time application for controlling the speed of direct current motors illustrating the practical usefulness of MJLS Particularly it offers novel insights into the control of systems when the controller does not have access to the Markovian mode

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Time Delay Systems 2001 K. Gu,C. Abdullah,S-I Niculescu,2002-08-21 These Proceedings contain the papers presented at the 3rd IFAC International Workshop on Time Delay Systems Santa Fe New Mexico USA 8 10 December 2001 The first workshop in this series took place in Grenoble France 1998 and the second workshop was held in Ancona Italy 2000 This workshop s scope has expanded to include nonlinear systems This workshop also contains various new applications of delay systems including those of communication networks and computing The effects of delay are currently being felt in many research areas and this workshop was held in an attempt to bring together researchers from various technical fields in order to advance our understanding of delay

phenomena in dynamical systems **Dynamics of Continuous, Discrete & Impulsive Systems** ,2005 **Discrete Time Systems** Mario Alberto Jordán,2011-04-26 Discrete Time Systems comprehend an important and broad research field The consolidation of digital based computational means in the present pushes a technological tool into the field with a tremendous impact in areas like Control Signal Processing Communications System Modelling and related Applications This book attempts to give a scope in the wide area of Discrete Time Systems Their contents are grouped conveniently in sections according to significant areas namely Filtering Fixed and Adaptive Control Systems Stability Problems and Miscellaneous Applications We think that the contribution of the book enlarges the field of the Discrete Time Systems with signification in the present state of the art Despite the vertiginous advance in the field we also believe that the topics described here allow us also to look through some main tendencies in the next years in the research area **Compte Rendu Du Congrès, Congrès Canadien en Génie Électrique Et Informatique 1994** ,1994

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