

Robust Stabilization of Markovian Jump Linear Singular Systems with Wiener Process

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Abstract: This paper deals with the robust stability and the robust stabilizability problems for the class of uncertain Markovian jump continuous-time singular systems with Wiener process. Our attention is focused on developing sufficient conditions on robust stability and the design of a state feedback controller such that the robust stochastic stability is assured, even if the singular system incorporates both Wiener process disturbance and norm-bounded uncertainties. The obtained sufficient conditions are based on linear matrix inequality technique. Numerical examples are given to show the usefulness of the proposed results.

Keywords: Jumping parameters, Singular system, Linear matrix inequality, Stochastic stability, Stabilization, Wiener process, norm-bounded uncertainties.

1. Introduction

During the past decades, singular systems has received considerable interest, because this class is more suitable than the conventional ones in modelling practical systems in different areas such as power systems, chemical systems, economics systems, robotics, etc., (see for instance, [6], [7]). When the system incorporates also abrupt changes in its structure, the Markovian jump lin-

ear system is very appropriate to describe its dynamics. For more details regarding this class of systems, we refer the reader to [8], [3] and the references therein. Many contributions related to problems like stability, stabilizability and their robustness, H_∞ control, output-feedback, filtering, have been reported in the literature, see for instance ([2], [4], [5]). For the class of stochastic systems with Markovian jumping parameters, a lot of works was done. In [2] sufficient conditions guaranteeing the exponential stabilizability for the uncertain system with Brownian motion perturbation are provided. The robust H_∞ control problem for uncertain continuous-time linear time delay systems with Markovian jumping parameters was studied in [11]. Recently, the robust stability and robust stabilizability of jumps linear systems with delays are developed in [4]. For the class of uncertain singular system, stability conditions for singular system with parameter uncertainties have been derived by applying Lyapunov stability theory in [5]. To the best of our knowledge, only few works have been done on the resulting class of systems that we call the class of linear singular systems with Markovian jumps. However, the uncertain Markovian jump linear singular system with Wiener process disturbance has

Discretetime Markovian Jump Linear Systems

Lixian Zhang



Discrete-time Markovian Jump Linear Systems:

Discrete-Time Markov Jump Linear Systems O.L.V. Costa, M.D. Fragoso, R.P. Marques, 2005-02-02 This will be the most up to date book in the area the closest competition was published in 1990 This book takes a new slant and is in discrete rather than continuous time

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 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

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

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

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 **Discrete and Continuous Dynamical Systems** ,2005 *SIAM Journal on Control and Optimization* Society for Industrial and Applied Mathematics,2009 *Mode-dependent $H[\infty]$ Filtering for Discrete-time Markovian Jump Linear Systems with Partly Unknown Transition Probabilities* Lixian Zhang,El-Kébir Boukas,Groupe d'études et de recherche en analyse des décisions (Montréal, Québec),2007 **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 **Journal of Dynamic Systems, Measurement, and Control** ,2007

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 **Mode-dependent $H[\infty]$ Filtering for Discrete-time Markovian Jump Linear Systems with Partly Unknown Transition Probabilities** Lixian Zhang,2007

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 **Proceedings of the 26th IEEE Conference on Decision and Control** ,1987

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