

Preface

In practice, a large class of physical systems has variable structures subject to random changes. These may result from abrupt phenomena such as component and interconnection failures, parameters shifting, tracking, and the time required to measure some of the variables at different stages. Systems with this character may be modeled as hybrid ones; that is, to the continuous state variable, a discrete random variable called the mode, or regime, is appended. The mode describes the random jumps of the system parameters and the occurrence of discontinuities. Such a system model is useful particularly since it allows the decision maker to cope adequately with the discrete events that disrupt and/or change the normal operation of a system significantly, by using the knowledge of their occurrence and the statistical information on the rate at which these events take place. Markovian jump systems (MJS), with its powerful modeling capability in application areas such as the aerospace industry, industrial processes, biomedical industry, and socioeconomics, have proved to be of vital importance as a typical class of hybrid dynamical system. However, MJS have many limitations in applications, since the jump time in MJS is subject to exponential distribution or geometric distribution in continuous- and discrete-time domains, respectively. So, the results obtained for the MJS are intrinsically conservative due to constant transition rates. Compared with the MJS, semi-Markovian jump systems (S-MJS) are characterized by a fixed matrix of transition probabilities and a matrix of sojourn time probability density functions. Due to their relaxed conditions on the probability distributions, S-MJS have much broader applications than the conventional MJS. Thus, this area of research is significant because of both its theoretical and practical values.

This book aims to present up-to-date research developments and novel methodologies on S-MJS. The content of this book can be divided into three parts: Part I is focused on stability analysis and control of the considered S-MJS, Part II puts the emphasis on fault detection and filtering of S-MJS, while Part III summarizes the results of the book. These methodologies provide a framework for stability and performance analysis, robust controller design, robust filter design, and fault detection for the considered systems. The main contents of Part I include the following: Chapter 2 is concerned with stochastic stability of S-MJS with

mode-dependent delays; Chapter 3 studies the constrained regulation problem of singular S-MJS; Chapter 4 addresses the state estimation and sliding mode control problems of S-MJS with mismatched uncertainties; and Chap. 5 investigates the quantized dynamic output feedback control of nonlinear S-MJS. The main contents of Part II include the following: Chapter 6 is concerned with the neural network-based passive filter design for delayed neutral-type S-MJS; Chapter 7 studies event-triggered fault detection filtering problem for sojourn information-dependent S-MJS; Chapter 8 addresses the fault detection filtering for S-MJS via T-S fuzzy approach; Chapter 9 investigates the fault detection problem for underactuated manipulators modeled by MJS; and Chap. 10 summarizes the results of the book and discusses some future works.

This book is a research monograph whose intended audience is graduate and postgraduate students as well as researchers. Prerequisite to reading this book is elementary knowledge on mathematics, matrix theory, probability, optimization techniques, and control system theory.

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July 2016

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Control and Filtering for Semi-Markovian Jump Systems

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2017, XVIII, 199 p. 39 illus., 34 illus. in color., Hardcover

ISBN: 978-3-319-47198-3