

Preface

Nonlinearity and stochasticity are ubiquitous features existing in almost all practical systems that contribute significantly to the complexity of system modeling. Since the occurrence of the nonlinearity and stochasticity inevitably degrades the system performance and even leads to instability, the analysis and synthesis problems for nonlinear stochastic systems have long been the mainstream of research topics and much efforts have been made to deal with the nonlinear stochastic systems. Over the past decade, with the rapid developments of the networked control systems (NCSs), the design of controller/filter for nonlinear stochastic systems with network-induced phenomena has become a hot research focus that has attracted an increasing interest.

This book is concerned with the recursive filtering and sliding mode design problems for several classes of discrete-time nonlinear stochastic systems with network-induced phenomena. The content of this book can be conceptually divided into two parts. In the first part, we focus mainly on the recursive filter design problems for some classes of time-varying nonlinear stochastic systems subject to random parameter matrices, multiple fading measurements, correlated noises, stochastic nonlinearities, missing measurements, quantization effects, probabilistic sensor delays, gain constraints, as well as sensor saturations. Some new filtering algorithms are developed in terms of the solutions to Riccati-like difference equations or difference linear matrix inequalities (DLMI), which are suitable for recursive computations in online applications. Some theories and methodologies obtained are applied to design the filters for the target tracking systems, which show the promising applications of the proposed approaches. In the second part, the sliding mode control (SMC) and sliding mode observer (SMO) design problems are considered for several classes of nonlinear stochastic systems with randomly occurring uncertainties (ROUs), randomly occurring nonlinearities (RONs), time-varying delays, infinite distributed delays and Markovian jumping parameters. In this part, the new concept of ROUs is put forward and some new sliding surfaces are constructed for the addressed systems. Some sufficient conditions are established for the sliding mode design that can be solved easily by using the semidefinite programming method.

The compendious framework and description of this book are given as follows. Chapter 1 introduces the recent advances on recursive filtering and sliding mode design for discrete nonlinear stochastic systems. Chapter 2 is concerned with the recursive filtering for time-varying nonlinear systems with stochastic nonlinearities, multiple missing measurements, and quantized effects. The recursive filtering problems are investigated in Chap. 3 for time-varying nonlinear systems where the correlated noises, random parameter matrices, multiple fading measurements, probabilistic sensor delays, and gain constraints are taken into account. In Chap. 4, the probability-guaranteed H_∞ finite-horizon filtering problem is studied for a class of time-varying nonlinear systems with randomly uncertain parameters and sensor saturations. The H_∞ SMO design problem is dealt with in Chap. 5 for a class of nonlinear time-delay systems. Chapter 6 investigates the robust SMC problem for uncertain stochastic systems with time-delays, RONS, and stochastic nonlinearities, while Chap. 7 discusses the problem of robust SMC with mixed time-delays, ROUs, RONS, and Markovian jump parameters. Chapter 8 draws conclusions on this book and points out some possible research directions related to the work done in this book.

This book is a research monograph whose intended audience is graduate and postgraduate students as well as researchers, serving as both a summary of the recent research results and a source of further research directions.

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Nonlinear Stochastic Systems with Network-Induced
Phenomena

Recursive Filtering and Sliding-Mode Design

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2015, XV, 223 p. 79 illus., 77 illus. in color., Hardcover

ISBN: 978-3-319-08710-8