

# Preface

Recently, networked control systems (NCSs) have gradually become an active area of research due to their advantages in many aspects such as low cost, reduced weight and power requirements, simple installation and maintenance, as well as high reliability. It is well known that the devices in networks are mutually connected via communication cables of limited capacity. Therefore, some new challenging issues have inevitably emerged, for example, network-induced time delay, data missing (also called packet dropout or missing measurement), and quantization effect, all of which should be taken into account in order to achieve the required performance of the NCSs. These issues are usually referred to as incomplete information.

In this book, we discuss the filtering and control problems for several classes of nonlinear stochastic systems with incomplete information. The causes of incomplete information considered here include missing measurements, sensor delays, quantization effects, sensor saturations, and signal sampling. The content of this book is conceptually divided mainly into three parts. In the first part, we focus on the  $H_\infty$  filtering and control problems for some very general classes of nonlinear stochastic discrete-time systems subject to missing measurements, quantization effects, and randomly varying sensor delays. Some sufficient conditions are derived for the existence of the desired filters and controllers in terms of the Hamilton–Jacobi–Isaacs (HJI) inequalities. The robust  $H_\infty$  filtering problems are considered in the second part for several special classes of nonlinear stochastic systems. In this part, some novel notions, including randomly occurring nonlinearities (RONs) and randomly occurring sensor saturations (ROSSs), are first put forward. Then, we develop a new filtering technique for the considered nonlinear stochastic systems with RONs, ROSSs, and packet dropouts. In the third part, the theory and technique developed in previous parts are applied to deal with some issues in both sensor networks and complex networks, and some sampled-data-based controllers and filters are designed.

The compendious frame and description of the book are given as follows. Chapter 1 introduces the recent advances on filtering and control with incomplete information and the outline of the book. Chapter 2 is concerned with the quantized  $H_\infty$  control problem for a class of nonlinear stochastic time-delay network-based systems with probabilistic data missing. The  $H_\infty$  filtering problems are investigated

for a general class of nonlinear discrete-time stochastic systems with missing measurements and randomly varying sensor delays in Chap. 3. In Chaps. 4 and 5, the robust  $H_\infty$  finite-horizon filtering problem is addressed for a special class of nonlinear discrete-time-varying stochastic systems where quantization effects, successive packet dropouts, RONS, and ROSSs are taken into account. Chapters 6, 7, and 8 investigate the distributed  $H_\infty$ -consensus filtering problem in sensor networks, while Chaps. 9 and 10 discuss the synchronization and state estimation problems for stochastic complex networks.

This book is a research monograph whose intended audience is graduate and postgraduate students as well as researchers.

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