Preface

In the last decades, the rapid developments in the communication, control and computer technologies have had a vital impact on the control system structure. In the traditional control systems, the connections between the sensors, controllers and actuators are usually realized by the port to port wiring. Such a structure has certain drawbacks such as difficult wiring and maintenance, and the low flexibility. The drawbacks have become more severe due to the increasing size and complexity of modern plants. A networked control system (NCS) is a control system in which the control loops are closed through a communication network. It is gaining popularity recently because the utilization of a multipurpose shared network to connect spatially distributed elements results in flexible architectures and it generally reduces installation and maintenance costs. The NCSs have been successfully applied in many practical systems such as the car automation, intelligent building, transportation networks, haptics collaboration over the Internet and unmanned aerial vehicles.

Note that an NCS works over a network through "non-ideal channels". This is the main difference between the traditional control systems and NCSs. In NCSs, phenomena such as communication delays, data dropouts, packet disorder, quantization errors and congestions may occur due to the usage of communication channels. These imperfections would significantly degrade the system performance and may even destabilize the control systems.

The wireless communication becomes more popular recently for its better mobility in locations, more flexibility in system design, lower cost in implementation and greater ease in installation, compared with the wired one. While sharing many common features and issues with the wired one as described above, the wireless one has special issues worth mentioning. In wireless networked control systems (WNCSs), a sensor usually has a limited power from its battery, and replacing the battery during the operation of WSNs is very difficult. In addition, sensor nodes are usually deployed in a wild region and they are easily affected by the disturbances from the environment, which may cause malfunction of the sensor nodes, e.g., the gain variations of the computational unit. However, the networked systems should be robust or non-fragile to these disturbances.

Due to the great challenges for the analysis and design of NCSs, especially for wireless one, the filtering and control of such systems is an emerging research domain of significant importance in both theory and applications. This book addresses these challenging issues. It presents new formulations, methods and solutions for filtering and control of wireless networked networks. It gives a timely, comprehensive and self-contained coverage of the recent advances in a single volume for easy access by the researchers in this domain. Special attention is paid to the wireless one with the energy constraint and filter/controller gain variation problems, and both centralized and distributed solutions are presented.

The book is organized as follows: Chap. 1 presents a comprehensive survey of NCSs, which shows major research approaches to the critical issues and insights of these problems. Chapter 2 gives the fundamentals of the system analysis, which are often used in subsequent chapters. The first part with Chaps. 3–6 deals with the centralized filtering of wireless networked systems, in which different approaches are presented to achieve the energy-efficient goal. The second part with Chaps. 7–10 discusses the distributed filtering of wireless networked systems, where the energy constraint and filter gain variation problems are addressed. The last part with Chaps. 11–14 presents the distributed control of wireless networked systems, where the energy constraint and controller gain variations are the main concerns.

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